AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Cell Biology
Course Code : BSB101, Credits : 03, Session : 2017-2018(Odd Sem.), Class : B.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To acquaint the students to understand the basic concept of cell biology and cell as a unit of living system, its various organelles, their structure, function and metabolic processes. Further, to help students to understand the concept of cellular evolution. Enable students to strengthen the cellular structure of cell organelle and their function.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB101.1. To study cell as a basic unit of life. Cell Theory. Understanding cellular organisation of Plant and animal cells. Their tissue, organ and organisational structure.

BSB101.2. To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, ribosomes, cytoskeletal, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.

BSB101.3. Students will learn about Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome and eu and hetero-chromatin.

BSB101.4. To develop deeper knowledge about Cell cycle, interphase, mitosis and meiosis.

BSB101.5. Knowledge of cell locomotion, cell senescence and apoptosis.

BSB101.6. Understanding of mechanism of cell differentiation and difference between normal and cancer cell.

C. **Programme Outcomes:**

PO1. Knowledge: Biotechnology deals with developing knowledge of biological

sciences and effective implementation of engineering technologies that manipulate

living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO 2: Achieve the scientific acumen and ability to identify research- based problems and develop suitable approach by designing protocols and

their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Cell as a basic unit of living systems: The cell theory, precellular evolution; broad classification of cell types: archaebacteria, PPLOs, bacteria, eukaryotic microbes, plant and animal cells; cell, tissue, organ and organisms, different levels of organization.

Module II: Ultrastructure of the cell membrane and cell organelles**:** Ultrastructure of cell membrane and function, Structure of cell organelles; golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes; cytoskeletal structures (actin, microtubules.), mitochondria, chloroplast, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus).

Module III: Chromosomes**:** Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome organisations; eu-and heterochromatin.

Module IV: Cell division and cell cycle**:** Cell cycle, interphase, mitosis and meiosis.

Module V: Cell interaction: Cell locomotion (amoeboid, flagellar and ciliar); cell

senescence and death (apoptosis).

Module VI: Cell differentiation: Mechanism of cell differentiation (e.g., RBC); difference between normal and cancer cells.

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.
- Cell and Molecular Biology –Sheelar & Bianchi, John Wiley
- Essential Cell Biology: An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company
- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J. Danell, W.H. Preeman and Company.
- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell Biology, Singh & Tomar
- The world of the cell Becker, Klinshmith & Harden, Pearson

H. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**
1	Cell Theory	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
2	Precellular Evolution	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
3	Broad Classification of Cell Types	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam

4	Eukaryotic Microbes	Lecture	BSB101.1	Mid Term, Quiz & End Sem

				Exam
5	Plant and animal cells, tissues and organs	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
6	Different levels of organization	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
7	Ultrastructure of cell membrane and function	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
8	Structure of cell organelles	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
9	Golgi bodies, Endoplasmic Reticulum (Smooth and Rough), Ribosomes	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
10	Cytokeletal Structures (Actin and Microtubules)	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
11	Mitochondria, Chloroplast	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
12	Lysosomes and Peroxisomes	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
13	Nucleus Structure	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
14	Nuclear Membrane, Nucleoplasm, Nucleolus	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
15	Structural organisation of chromosomes	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam

16	Chromatids	Lecture	BSB101.3	Mid Term, Quiz & End Sem

				Exam
17	Centromere and Telomere	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
18	Streptomycin and Tetracycline	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
19	Chromatin and Nucleosome Organization	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
20	Eu and Hetero-Chromatin	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
21	Cell Cycle	Lecture	BSB101.4	Quiz & End Sem Exam
22	Interphase	Lecture	BSB101.4	Quiz & End Sem Exam
23	Mitosis	Lecture	BSB101.4	Quiz & End Sem Exam
24	Meiosis	Lecture	BSB101.4	Quiz & End Sem Exam
25	Cell Locomotion	Lecture	BSB101.5	Quiz & End Sem Exam
26	Amoeboid, Flagellar and Cilliar	Lecture	BSB101.5	Quiz & End Sem Exam
27	Cell Senescence	Lecture	BSB101.5	Quiz & End Sem Exam
28	Cell Death	Lecture	BSB101.5	Quiz & End Sem Exam
29	Apoptosis	Lecture	BSB101.5	Quiz & End Sem Exam

30	Cell Division	Lecture	BSB101.5	Quiz & End Sem Exam
31	Mechanisms of Cell	Lecture	BSB101.6	Quiz &

	Differentiation			End Sem Exam
32	RBCs	Lecture	BSB101.6	Quiz & End Sem Exam
33	Cancer	Lecture	BSB101.6	Quiz & End Sem Exam
34	Carcinogens	Lecture	BSB101.6	Quiz & End Sem Exam
35	p53 Gene and its role in cancer development	Lecture	BSB101.6	Quiz & End Sem Exam
36	Difference between normal and cancer cell	Lecture	BSB101.6	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB101.1	To study cell as a basic unit of life. Cell Theory. Understanding cellular organization of Plant and animal cells. Their tissue, organ and organizational structure.	3	2	2	2	2	2	2	2	2	2	3	2	3

BSB101.2	To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, ribosomes, cytoskeletal, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.	3	2	2	2	2	2	2	2	3	2	3	3	2
BSB101.3	Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome and eu and hetero-chromatin.	3	2	2	3	2	2	2	2	3	2	3	3	2
BSB101.4	To develop deeper knowledge about Cell cycle, interphase, mitosis and meiosis.	3	3	2	3	2	2	2	1	3	2	3	2	2
BSB101.5	Knowledge of cell locomotion, cell senescence and apoptosis.	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB101.6	Understanding of mechanism of cell differentiation and difference between normal and cancer cell.	3	3	2	2	2	2	2	2	2	2	3	2	2

Sample Question Paper

Amity Institute of Biotechnology MID-SEMESTER 2017-18						
Class: BSB101 (Biotech) I Semester						
Subject Name: BSB 101 Cell Biology		Time: 2 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzin g	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to
CO1: To understand cell as a basic unit of life. Cell Theory. Understanding cellular organization of Plant and animal cells, their tissue, organ and organizational structure.
CO2: To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, ribosome's, cytoskeleton, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the Cell Theory.	3
CO1	Q.2a	What are different cytoskeletal structures?	3
	Q.2b	How is mode of functioning of Peroxysomes and lysosomes are different from each other?	3
CO1	Q.3	How Nucleosome organization affects eu and heterochromatin region of DNA?	6
CO2	Q.4	Explain the different stages of cellular reductional division i.e. Meiosis.	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **CELL BIOLOGY/BSB 101** is **level 3** for the academic year 2017-18.

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2017-18

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant

and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

	PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
	BSB 202	3	2	2	3	-	-	-	1	2	1			3	2	-	
														-	-	-	
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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOANALYTICAL TECHNIQUES
Course Code : BSB 202, Crédits : 03, Session :2017-18 (Even Sem.), Class : B.Sc. 1st Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in Bioanalytical techniques The student will be exposed to principles, instrumentation & application of various instruments & techniques used in biological research.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 202.1. Develop deep theoretical understanding of analytical instruments and their practical use in the laboratory, it includes the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc.
BSB 202.2. Understand principle instrumentation of chromatographic techniques and their types.
BSB 202.3. Principle and applications of electrophoresis i.e., PAGE (Native and SDS), Immunoelectrophoresis etc.
BSB 202.4. Understand about radioisotope and tracer techniques in life sciences.

C. **Programme Outcomes:**

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.
PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting

commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Instruments, basic principles and usage
pH meter, absorption and emission spectroscopy, Principle and law of absorption, fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), polarography, centrifugation, atomic absorption, NMR, X-ray crystallography, Circular Dichorism.

Module II: Chromatography techniques
Paper chromatography, thin layer chromatography, affinity chromatography, column chromatography, HPLC, gas chromatography, gel filtration and ion exchange chromatography,

Module III: Electrophoresis
Agarose gel electrophoresis, SDS polyacrylamide electrophoresis, immunoelectrophoresis, Isoelectric focussing.

Module IV: Radioisotope tracer techniques and autoradiography

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
- Bioinstrumentation, Webster
- Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
- Crystal Structure Analysis, J.P. Glusker and K.N. Trueblood, Oxford University Press
- Modern Spectroscopy, J.M. Hollas, John Wiley and Son Ltd.
- NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry, H. Gunther, John Wiley and Sons Ltd.
- Principles of Physical Biochemistry, K.E. Van Holde, Prentice Hall.
- Principles and Practice of Bioanalysis, Richard F. Venn
- Microscopic Techniques in Biotechnology, Michael Hoppert
- Principles of Fermentation Technology, P.F. Stanbury, A. Whitaker, S.J. Hall

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction of instrumentation	Lecture	BSB 202.1.	Mid Term-1, Quiz & End Sem Exam
2	pH meter,	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Absorption and emission spectroscopy,	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Absorption and emission spectroscopy,	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Principle and law of absorption,	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Principal and applications fluorimetry,	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Principal and applications Colorimetry	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Principal and applications spectrophotometry (visible, UV, infra-red),	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Principal and applications Polorography	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Principal and applications Centrifugation	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Principal and applications NMR	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Principal and applications X-ray Crystellography	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Principal and applications Circular Dichorism.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Principal and applications of Paper Chramatography	Lecture	BSB 202.2.	Mid Term-1, Quiz & End Sem Exam
15	Principal and applications thin layer chromatography	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Principal and applications Column Chromatography	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Principal and applications Column Chromatography	Lecture		Quiz & End Sem Exam
18	Principal and applications Affinity chromatography	Lecture		Quiz & End Sem Exam
19	Principal and applications gel filtration Chromatography	Lecture		Quiz & End Sem Exam

20	Principal and applications ion exchange Chromatography	Lecture		Quiz & End Sem Exam
21	Principal and applications	Lecture		Quiz & End Sem

	Gas Chromatography			Exam
22	Principal and applications of HPLC	Lecture		Quiz & End Sem Exam
23	Agarose gel electrophoresis,	Lecture	BSB 202.3.	Quiz & End Sem Exam
24	Agarose gel electrophoresis,	Lecture		Quiz & End Sem Exam
25	Native polyacrylamide electrophoresis (PAGE)	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Native polyacrylamide electrophoresis (PAGE)	Lecture		Quiz & End Sem Exam
27	SDS polyacrylamide electrophoresis (SDS-PAGE)	Lecture		Quiz & End Sem Exam
28	SDS polyacrylamide electrophoresis (SDS-PAGE)	Lecture		Quiz & End Sem Exam
29	Immunoelectrophoresis	Lecture		Quiz & End Sem Exam
30	Imunoelectrophoresis	Lecture		Quiz & End Sem Exam
31	Isoelectric focussing.	Lecture	BSB 202.4.	Quiz & End Sem Exam
32	Radioisotopes in life sciences	Lecture		Quiz & End Sem Exam
33	Radioisotope tracer techniques	Lecture		Quiz & End Sem Exam
34	Radioisotope tracer techniques	Lecture		Quiz & End Sem Exam
35	Autoradiography	Lecture		Quiz & End Sem Exam
36	Autoradiography	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3

BSB 202.1.	Develop deep theoretical understanding of analytical instruments and their practical use	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**

	in the laboratory, it includes the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc.															
BSB 202.2.	Understand basic instrumentation of chromatographic techniques and their types.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**
BSB 202.3	Principle and applications of electrophoresis i.e., PAGE (Native and SDS), Immunoelectrophoresis etc.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**
BSB 202.4	Understand about radioisotope and tracer techniques in life sciences.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**2**	**2**	**1**			**3**	**1**	**-**

<u>Sample Question Paper</u>

Amity Institute Biotechnology 2017-18						
Class: B.Sc. (H) Biotechnology II Semester						
Subject Name: BIOANALYTICAL TECHNIQUES		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.2, 10	Q. 7, 8, 9,	

Student will be able to:			
CO Map	Question No.	Question	Marks

CO1	Q.1	Write the standard definition of pH? How does pH meter measures the pH?	6
CO2	Q.2	Differentiate between Ascending and Descending paper chromatography.	6
	Q.3	Write short note on of counter-current imunoelectrophoresis.	6
CO4	Q.4	Define radioisotopes tracer technique and its applications in biological research.	6
CO4	Q.5	Write a short note on autoradiography and its applications in biological research.	6
CO3	Q.6	Define retention factor (Rf) value, write its significance.	6
	Q.7	Discuss polyacrylamide gel electrophoresis, Why low molecular weight proteins are separated on high el percentage in PAGE? How PAGE offers advantage over Agarose gel electrophoresis?	10
CO1	Q.8	Explain the principle and instrumentation of UV/Vis spectrophotometer. Draw its block diagramme and enlist its applications.	10
CO3	Q.9	Explain the working principle and methodology of Thin Layer Chromatography (TLC). Enlist its applications.	10
CO3	Q.10	. A Design the affinity column to separate the eukaryotic mRNA from mixture of different types of RNAs (rRNA, t-RNA, mRNA, and other snRNA)? Write the detailed description.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioanalytical techniques***/Course code ***BSB 202*** is level **3** for the academic year ***2017-18***.


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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2017-18

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant

and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

	PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
II SEM	BSB 202	3	2	2	3	-	-	-	1	2	1			3	2	-	
														-	-	-	
														-	-	-	
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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOANALYTICAL TECHNIQUES
Course Code : BSB 202, Crédits : 03, Session :2017-18 (Even Sem.), Class : B.Sc. 1st Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in Bioanalytical techniques The student will be exposed to principles, instrumentation & application of various instruments & techniques used in biological research.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 202.1. Develop deep theoretical understanding of analytical instruments and their practical use in the laboratory, it includes the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc.
BSB 202.2. Understand principle instrumentation of chromatographic techniques and their types.
BSB 202.3. Principle and applications of electrophoresis i.e., PAGE (Native and SDS), Immunoelectrophoresis etc.
BSB 202.4. Understand about radioisotope and tracer techniques in life sciences.

C. **Programme Outcomes:**

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.
PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting

commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Instruments, basic principles and usage

pH meter, absorption and emission spectroscopy, Principle and law of absorption, fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), polarography, centrifugation, atomic absorption, NMR, X-ray crystallography, Circular Dichorism.

Module II: Chromatography techniques

Paper chromatography, thin layer chromatography, affinity chromatography, column chromatography, HPLC, gas chromatography, gel filtration and ion exchange chromatography,

Module III: Electrophoresis

Agarose gel electrophoresis, SDS polyacrylamide electrophoresis, immunoelectrophoresis, Isoelectric focussing.

Module IV: Radioisotope tracer techniques and autoradiography

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
- Bioinstrumentation, Webster
- Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
- Crystal Structure Analysis, J.P. Glusker and K.N. Trueblood, Oxford University Press
- Modern Spectroscopy, J.M. Hollas, John Wiley and Son Ltd.
- NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry, H. Gunther, John Wiley and Sons Ltd.
- Principles of Physical Biochemistry, K.E. Van Holde, Prentice Hall.
- Principles and Practice of Bioanalysis, Richard F. Venn
- Microscopic Techniques in Biotechnology, Michael Hoppert
- Principles of Fermentation Technology, P.F. Stanbury, A. Whitaker, S.J. Hall

I. **Lecture Plan**

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Introduction of instrumentation	Lecture	BSB 202.1.	Mid Term-1, Quiz & End Sem Exam
2	pH meter,	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Absorption and emission spectroscopy,	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Absorption and emission spectroscopy,	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Principle and law of absorption,	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Principal and applications fluorimetry,	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Principal and applications Colorimetry	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Principal and applications spectrophotometry (visible, UV, infra-red),	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Principal and applications Polorography	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Principal and applications Centrifugation	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Principal and applications NMR	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Principal and applications X-ray Crystellography	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Principal and applications Circular Dichorism.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Principal and applications of Paper Chramatography	Lecture	BSB 202.2.	Mid Term-1, Quiz & End Sem Exam
15	Principal and applications thin layer chromatography	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Principal and applications Column Chromatography	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Principal and applications Column Chromatography	Lecture		Quiz & End Sem Exam
18	Principal and applications Affinity chromatography	Lecture		Quiz & End Sem Exam
19	Principal and applications gel filtration Chromatography	Lecture		Quiz & End Sem Exam

20	Principal and applications ion exchange Chromatography	Lecture		Quiz & End Sem Exam
21	Principal and applications	Lecture		Quiz & End Sem

	Gas Chromatography			Exam
22	Principal and applications of HPLC	Lecture		Quiz & End Sem Exam
23	Agarose gel electrophoresis,	Lecture	BSB 202.3.	Quiz & End Sem Exam
24	Agarose gel electrophoresis,	Lecture		Quiz & End Sem Exam
25	Native polyacrylamide electrophoresis (PAGE)	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Native polyacrylamide electrophoresis (PAGE)	Lecture		Quiz & End Sem Exam
27	SDS polyacrylamide electrophoresis (SDS-PAGE)	Lecture		Quiz & End Sem Exam
28	SDS polyacrylamide electrophoresis (SDS-PAGE)	Lecture		Quiz & End Sem Exam
29	Immunoelectrophoresis	Lecture		Quiz & End Sem Exam
30	Imunoelectrophoresis	Lecture		Quiz & End Sem Exam
31	Isoelectric focussing.	Lecture	BSB 202.4.	Quiz & End Sem Exam
32	Radioisotopes in life sciences	Lecture		Quiz & End Sem Exam
33	Radioisotope tracer techniques	Lecture		Quiz & End Sem Exam
34	Radioisotope tracer techniques	Lecture		Quiz & End Sem Exam
35	Autoradiography	Lecture		Quiz & End Sem Exam
36	Autoradiography	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3

BSB 202.1.	Develop deep theoretical understanding of analytical instruments and their practical use	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**

	in the laboratory, it includes the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc.															
BSB 202.2.	Understand basic instrumentation of chromatographic techniques and their types.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**
BSB 202.3	Principle and applications of electrophoresis i.e., PAGE (Native and SDS), Immunoelectrophoresis etc.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**
BSB 202.4	Understand about radioisotope and tracer techniques in life sciences.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**2**	**2**	**1**			**3**	**1**	**-**

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2017-18</td></tr>
<tr><td colspan="7">Class: B.Sc. (H) Biotechnology
II Semester</td></tr>
<tr><td colspan="2">Subject Name:
BIOANALYTICAL TECHNIQUES</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.2, 10</td><td>Q. 7, 8, 9,</td><td></td></tr>
</table>

Student will be able to:			
CO Map	Question No.	Question	Marks

CO1	Q.1	Write the standard definition of pH? How does pH meter measures the pH?	6
CO2	Q.2	Differentiate between Ascending and Descending paper chromatography.	6
	Q.3	Write short note on of counter-current imunoelectrophoresis.	6
CO4	Q.4	Define radioisotopes tracer technique and its applications in biological research.	6
CO4	Q.5	Write a short note on autoradiography and its applications in biological research.	6
CO3	Q.6	Define retention factor (Rf) value, write its significance.	6
	Q.7	Discuss polyacrylamide gel electrophoresis, Why low molecular weight proteins are separated on high el percentage in PAGE? How PAGE offers advantage over Agarose gel electrophoresis?	10
CO1	Q.8	Explain the principle and instrumentation of UV/Vis spectrophotometer. Draw its block diagramme and enlist its applications.	10
CO3	Q.9	Explain the working principle and methodology of Thin Layer Chromatography (TLC). Enlist its applications.	10
CO3	Q.10	. A Design the affinity column to separate the eukaryotic mRNA from mixture of different types of RNAs (rRNA, t-RNA, mRNA, and other snRNA)? Write the detailed description.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioanalytical techniques***/Course code ***BSB 202*** is level **3** for the academic year ***2017-18***.


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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Genetics
Course Code : BSB301, Credits : 03, Session : 2017-18 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : Dr. Manish Kumar

A. Introduction: To acquaint the students to understand the basic concept of genetics incorporating the concepts of classical, molecular genetics. Students will learn about Mendelian Laws, Extension of Mendels Law, Multiple allele and isoallele, etc. Mutation, Mutagen, Chromosomal Aberrations, Human Genetic Disorders.Knowledge of methods of sex determination, Chromosomal non-disjunction, Chromosomal theory of inheritance, Sex linked, Sex limited and Sex limited Inheritance, Extra-chromosomal inheritance. Understanding of Population Genetics, Hardy-Weinberg Equilibrium, Gene and Genotype Frequencies.

B. Course Outcomes: At the end of the course, students will be able to:

BSB301.1. Students will develop an understanding of History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance.

BSB301.2. Understanding the pre-Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation.

BSB301.3. To study the classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage.

BSB301.4. Students will develop a basic understanding of Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders.

BSB301.5. Knowledge of Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influencedand Sex limited inheritance.

BSB301.6. Students will learn about extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA.

BSB301.7. Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies.

C. Programme Outcomes:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution,

morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course

also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

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PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Program Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Brief history, scope and significance of Genetics. Mendelian law of inheritance. Lethality and interaction of gene. Multiple allele and isoallele. Penetrance and Expressivity. Linkage and crossing over. Mapping of genes. interference and coincidence.

Module II: Basic microbial genetics, Conjugation, transformation, transduction and their use in genetic mapping.

Module III: Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over and complementation test, Benzers work on rII locus in T4 Bacteriophage.

Module IV: Mutation; spontaneous and induced, Mutagen;chemical and physical. Chromosomal aberrations; structural and numerical. Economic importance of mutation. Genetic disorders in human; Kleinefelter, Turner, Cri-du-Chat and Down syndrome.

Module V: Sex determination in plant and animal. Non disjunction as a proof of chromosomal theory of inheritance. Sex linked, sex influenced and sex limited inheritance.

Module VI: Extra chromosomal inheritance; cytoplasmic inheritance, Mitochondrial and Chloroplast genetic system.

Module VII: Population genetics; Hardy-Weinberg equilibrium law, Gene and genotype frequencies.

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

Principles of Genetics, E. J. Gardner, John Wiley & Sons Inc.

Genetics, P.K. Gupta, Rastogi Publication.

Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, Pearson Education.

Genetics, M.W. Strickberger, Prentice Hall College Division.

Genetics, P.J. Russell, Benjamin/Cummings.

Genetics, R. Goodenough, International Thomson Publishing.

Introduction to Genetic Analysis, A.J. F. Griffiths, W.H. Freeman and Company.

Principles of Genetics, D.P. Snustad& M.J. Simmons, John Wiley and Sons Inc.

Molecular Biology of the Gene (Fifth Edition), J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison Wiesley Publishing.

H. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**
1	Brief history, scope and significance of Genetics	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
2	Mendelian law of inheritance	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
3	Lethality and interaction of gene. Multiple allele and isoallele.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam

4	Penetrance and Expressivity. Linkage and crossing over.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam

5	Mapping of genes. Interference and coincidence.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
6	Basic microbial genetics	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
7	Conjugation	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
8	Transformation	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
9	Transduction	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
10	Genetic Mapping	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
11	Classical and modern concept of gene	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
12	Pseudoallelism, position effect	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
13	Intragenic crossing over	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
14	Mapping of genes	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
15	Interference and coincidence	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
16	Mutation; spontaneous and induced	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
17	Mutagen; chemical and physical	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
18	Chromosomal aberrations	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
19	Structural and numerical Aberration	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam

20	Economic importance of mutation	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam

21	Genetic disorders in human	Lecture	BSB301.4	Quiz & End Sem Exam
22	Sex determination in plant	Lecture	BSB301.5	Quiz & End Sem Exam
23	Sex determination in animal	Lecture	BSB301.5	Quiz & End Sem Exam
24	Non disjunction	Lecture	BSB301.5	Quiz & End Sem Exam
25	Non disjunction as a proof of chromosomal theory of inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
26	Sex linked inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
27	Sex influenced and sex limited inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
28	Extra chromosomal inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
29	Cytoplasmic inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
30	Mitochondrial DNA	Lecture	BSB301.6	Quiz & End Sem Exam
31	Chloroplast genetic system	Lecture	BSB301.6	Quiz & End Sem Exam
32	Significance of Extra chromosomal inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
33	Significance of cytoplasmic inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
34	Population genetics	Lecture	BSB301.7	Quiz & End Sem Exam
35	Hardy-Weinberg equilibrium law	Lecture	BSB301.7	Quiz & End Sem Exam
36	Gene and genotype frequencies	Lecture	BSB301.7	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB301.1	History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB301.2	Pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB301.3	Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage	3	2	2	2	2	2	2	2	3	3	3	2	2
BSB301.4	Mutation- Types, Mutagen- Types, and Chromosomal aberrations- structural & numerical and human genetic disorders	3	3	2	3	2	2	2	2	2	2	3	2	2

BSB301.5	Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal	3	2	3	2	2	3	2	2	2	2	3	2	2

	Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance													
BSB301.6	Extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA	3	3	2	3	2	2	2	2	2	2	3	2	2
BSB301.7	Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies	3	2	2	3	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

Amity Institute of Biotechnology MID-SEMESTER 2017-18						
Class: B.Sc. (Biotech) III Semester						
Subject Name: BSB 301 GENETICS		Time: 2 Hrs		Max. Marks: 30		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		
Student will be able to CO1: History and scope of Genetics CO2: Understanding the pre Mendelian genetic concepts						

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the scope and significance of genetics.	3
CO1	Q.2a	What are different steps involved in genetic mapping ?	3
	Q.2b	How is mechanism of conjugation is different from transformation ?	3

CO1	Q.3	How classical concept of gene is different from modern concept of gene ?	6

CO2	Q.4	Explain the significance of extra-chromosomal inheritance and cytoplasmic inheritance.	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **GENETICS/BSB 301** is **level 3** for the academic year 2017-18.

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Established vide Government of Madhya Pradesh Act No. 27 of 2010

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2017-18

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
	BSB 402	3	2	3	3	1	-	-	-	1	1			3	2	1
IV SEM																

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR CELL BIOLOGY
Course Code : BSB 402, Crédits : 03, Session :2017-18 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques in Molecular Cell Biology, further to extend understanding of the molecular mechanisms via which genetic information's are stored, expressed and transmitted among generations.

B. Course Outcomes: At the end of the course, students will be able to:

BSB 402.1. Develop deep understanding of DNA/ RNA structure, and mechanism of DNA replication.
BSB 402.2. Understand Genetic Codes and Transposable elements
BSB 402.3. Understand mechanism of transcription and translation in prokaryotes and eukaryotes.
BSB 402.4. Enhance fine molecular understanding of operon gene regulation ion in prokaryotes.
BSB402.5. Understand the mechanism of Oncogenes and Tumor suppressor genes.

C. Programme Outcomes:

On completion of the course, students are able to understand about:
PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures,

isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and

recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

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PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction to Moleculer Biology,
Structure and composition of DNA, RNA structure and its types, Basic techniques in molecular biology (Agarose gel electrophoresis, PCR etc.) and its applications.
Molecular basis of life:DNA replication in prokaryotes and eukaryotes; DNA recombination molecular mechanisms.

Module II: Insertion elements, transposons and retrotransposons
Mobile genetic elements and its types in both prokaryotes and eukaryotes and their applications.
Application of genetic engineering, Organisation of genetic material: Split genes; overlapping genes; pseudogenes; cryptic genes
Genetic Code: Properties of genetic code, codon assignment, chain termination codons, wobble hypothesis.

Module III: Structure of prokaryotic and eukaryotic genes
Transcription mechanism in prokaryotes and eukaryotes. Translation: Translation mechanisms in prokaryotes and eukaryotes.

Module IV: Gene Expression in prokaryotes

Operon concept, Positive and Negative control of operon (Lac, Tryptophan and Arabinose operon)

Module V: Eukaryotic geneExpression
Overview of gene expression, polyadenylation, cap formation, RNA degradation.

Module VI: Oncogenes and Tumor Suppressor genes
Oncogenes, tumorsuppressor genes in humans, role of genes in cancer development.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

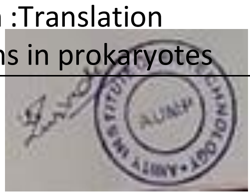
- Gene VIII, Benjamin Lewin 2005, Oxford University Press
- Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing.

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education
- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Cell Biology, H. Lodish, A.Berk, S. Zipursky, P Matsundaira, D.Baltimore and J.E. Barnell,W. H Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing
- .Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley and Sons Inc.

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspon ding CO**	**Mode of Assessing CO**
1	Structure and composition of DNA, RNA structure and its types	Lecture	BSB 402.1.	Mid Term-1, Quiz & End Sem Exam
2	Structure and composition of DNA, RNA structure and	Lecture		Mid Term-1, Quiz & End Sem Exam

	its types			
3	Structure and composition of DNA, RNA structure and its types	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Structure and composition of DNA, RNA structure and its types	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Basic techniques in molecular biology: PCR etc.) and its applications.	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Basic techniques in molecular biology (Agarose gel electrophoresis, and its applications.	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Mobile genetic elements and its types in prokaryotes	Lecture	BSB 402.2.	Mid Term-1, Quiz & End Sem Exam
8	Mobile genetic elements and its types in prokaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Mobile genetic elements and its types in eukaryotes	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Organisation of genetic material: Split genes; overlapping genes; pseudogenes; cryptic genes	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Application of genetic engineering,	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Genetic Code: Properties of genetic code, codon assignment, chain termination codons,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	, wobble hypothesis.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Structure of prokaryotic and eukaryotic genes	Lecture	BSB 402.3.	Mid Term-1, Quiz & End Sem Exam
15	Transcription mechanism in prokaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Transcription mechanism in eukaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Translation :Translation mechanisms in prokaryotes	Lecture		Quiz & End Sem Exam



18	Translation :Translation mechanisms in prokaryotes	Lecture		Quiz & End Sem Exam
19	Translation :Translation mechanisms in eukaryotes.	Lecture		Quiz & End Sem Exam
20	Operon concept, Positive and Negative control of operon	Lecture	BSB 402.4.	Quiz & End Sem Exam
21	Operon concept, Positive and Negative control of operon Lac Operon	Lecture		Quiz & End Sem Exam
22	Operon concept, Positive and Negative control of operon Lac Operon	Lecture		Quiz & End Sem Exam
23	Operon concept, Positive and Negative control of operon Trp operon	Lecture		Quiz & End Sem Exam
24	Operon concept, Positive and Negative control of operon Trp operon	Lecture		Quiz & End Sem Exam
25	Operon concept, Positive and Negative control of operon Ara Operon	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Overview of Eukaryotic gene expression,	Lecture	BSB 402.5.	Quiz & End Sem Exam
27	Mechanism of polyadenylation,	Lecture		Quiz & End Sem Exam
28	Mechanism of cap formation.	Lecture		Quiz & End Sem Exam
29	Mechanism of RNA degradation.	Lecture		Quiz & End Sem Exam
30	Oncogene in humans,	Lecture	BSB 402.6.	Quiz & End Sem Exam
31	Oncogenes in humans,	Lecture		Quiz & End Sem Exam
32	Tumorsuppressor genes in humans.	Lecture		Quiz & End Sem Exam
33		Lecture		Quiz & End Sem Exam
34	Tumorsuppressor genes in humans.	Lecture		Quiz & End Sem Exam
35	Role of genes in cancer	Lecture		Quiz & End Sem Exam
36	Role of genes in cancer	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
BSB 402.1.	Develop deep understanding of DNA/ RNA structure, and mechanism of DNA replication.	**3**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.2.	Understand Genetic Codes and Transposable elements	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.3	Understand mechanism of transcription and translation in prokaryotes and eukaryotes.	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.4	Enhance fine molecular understanding of operon gene regulation ion in prokaryotes	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.5.	Understand the mechanism of Oncogenes and Tumor suppressor genes.	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**1**

Sample Question Paper

Amity Institute Biotechnology 2017-18
Class: B.Sc.(H)Biotechnology IV Semester

Subject Name: MOLECULAR CELL BIOLOGY	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,6,2	Q.4,3	Q.7,6	Q.5,8	Q. 9, 10	

Student will be able to:

CO Map	Question No.	Question	Marks
CO1	Q.1	What is melting temperature (Tm). How Tm varies with increasing GC content and pH?	6
CO1	Q.2	Write a note on the bacterial insertion elements (IS).	6
	Q.3	Write the functions of the following. (i) Carboxyl terminal domain (CTD) (ii) Primosome (iii) Sigma (σ) Factor	6
CO2	Q.4	Define degeneracy of genetic codes and its significance.	6
CO1	Q.5	Write the function of the following proteins (i) Helicase (ii) Gyrase (iii) Primase	6
CO3	Q.6	Write short note on 5'Cap in eukaryotic mRNA.	6
	Q.7	Design the experiment to proof that DNA replication is (i) Semiconservative (ii) Bidirectional.	10

CO4	Q.8	Explain the structure and function of *Lac* operon in *E.coli*. Discuss the mechanism of *Lac* operon expression regulation under following conditions (I) When lactose sugar present in growth medium (ii) When lactose sugar absent in growth medium.	10

CO5	Q.9	Define Oncogenes, discuss the different classes andproperties of oncogenes. How Proto-oncogenes converted into oncogenes?	10
CO3	Q.10	What is the basic mechanism of PCR? and explain the following variants of PCR and their advantages (i) RT- PCR (ii) Touch Down PCR (iii) Hot start PCR.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Molecular cell Biology***/Course code ***BSB 402*** is level **3** for the academic year ***2017-18***.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2017-18

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

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PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual

property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business

leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
	BSB 502	3	2	3	3	-	1	2	1	1	-			3	2	1
														-	-	-
														-	-	-
V														-	-	-

SEM														-	-	-

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ANIMAL BIOTECHNOLOGY
Course Code : BSB 502, Crédits : 03, Session :2017-18 (Odd Sem.), Class : B.Sc. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques in animal biotechnology like in vitro fertilization, animal cell and tissue culture, hormone vaccine and important enzyme production through animal biotechnology.

B. Course Outcomes: At the end of the course, students will be able to:

BSB 502.1. Understand theory of animal cell culture, culture media, methods to develop cell lines. and their maintenance for commercial applications.
BSB 502.2. Understand scale up production of monoclonal antibodies and hybridoma technology.
BSB 502.3. Understand the structure and function of variety of hormones and growth factors.
BSB 502.4. Understand the technology and concepts of invitro fertilization and embryo transfer, and development of superior live stocks.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of

Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

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PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective

interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I:

Introduction of animal cell culture substrate, culture media, preservation and maintenance of cell lines

Module II:

Production of monoclonal antibodies. Bioreactors for large scale culture of cells

Module III:

Growth factors promoting proliferation of animal cells (EGF, FGF, PDGF, IL-1, IL-2, NGF,erythropoietin).

Module IV:

Transgenic animals. In vitro fertilization and embryo transfer.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss. References:
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford.
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag.
- Cell Culture LabFax, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press.
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Animal Cell Culture: Overview	Lecture	BSB 502.1.	Mid Term-1, Quiz & End Sem Exam
2	Animal Cell culture substrates for attatchment	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Broad outline of Animal Cell culture Media	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Animal Cell Culture Media: Natural media	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Animal Cell Culture Media: Artificial media	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Advantages and limitations of natural and artificial media.	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Methods of Initiation of Cell culture	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Methods of Initiation of Cell culture	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Preversation and maintenance of cell culture.	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Monoclonal antibodies:	Lecture	BSB 502.2.	Mid Term-1, Quiz & End Sem Exam
11	Methods of somatic cell fusion	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Hybridoma technology for MAbs production	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Hybridoma technology for	Lecture		Mid Term-1, Quiz

	MAbs production			& End Sem Exam
14	Bioreactors	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Bioreactors	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Applications of bioreactoras and MAbs	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Growth factors: epidermal growth factor (EGF), receptor, structure and functions.	Lecture	BSB 502.3.	Quiz & End Sem Exam
18	Growth Factors:Fibroblast growth factor (FGF), receptor, structure and functions FGF.	Lecture		Quiz & End Sem Exam
19	Growth Factors: Platelates derived growth factor (PDGF), receptor, structure and functions PDGF.	Lecture		Quiz & End Sem Exam
20	Growth Factors:Neural growth factor (NGF), receptor, structure and functions NGF.	Lecture		Quiz & End Sem Exam
21	Growth Factors:Interleukins IL1 and IL2 structure and functions.	Lecture		Quiz & End Sem Exam
22	Growth Factors: erythropoiten (EP) structure and functions.	Lecture		Quiz & End Sem Exam
23	Applications of growth factors.	Lecture		Quiz & End Sem Exam
24	Transgenic Animals: overview	Lecture	BSB 502.4.	Quiz & End Sem Exam
25	Vectors for transgene transfer	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Methods of transgenic animal production	Lecture		Quiz & End Sem Exam
27	Application of transgenic animals	Lecture		Quiz & End Sem Exam
28	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
29	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
30	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
31	Embryo transfer technique	Lecture		Quiz & End Sem

				Exam
32	Embryo transfer technique	Lecture		Quiz & End Sem Exam
33	Embryo transfer technique	Lecture		Quiz & End Sem Exam
34	Embryo transfer technique	Lecture		Quiz & End Sem Exam
35	Application of embryo transfer technique	Lecture		Quiz & End Sem Exam
36	Application of embryo transfer technique	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
BSB 502.1.	Understand theory of animal cell culture, culture media, methods to develop cell lines. and their maintenance for commercial applications.	3	2	3	3	-	1	-	1	1	-			**3**	**2**	**1**
BSB 502.2.	Understand scale up production of monoclonal antibodies and hybridoma technology.	3	2	3	3	-	1	-	1	1	-			**3**	**2**	**1**
BSB 502.3	Understand the structure and function of variety of hormones and growth factors.	3	2	3	3	-	2	-	-	1	-			**3**	**2**	**1**

BSB 502.4	Understand the technology and concepts of *invitro* fertilization and embryo transfer, and development of superior live stocks.	3	2	3	3	-	2	3	-	1	-			**3**	**2**	**1**

Sample Question Paper

<table>
<tr><td colspan="7" align="center">Amity Institute Biotechnology
2017-18</td></tr>
<tr><td colspan="7" align="center">Class: B.Sc.(H) Biotechnology
V Semester</td></tr>
<tr><td colspan="2">Subject Name:
ANIMAL BIOTECHNOLOGY</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4,6</td><td>Q.2,5,3</td><td>Q.7,8</td><td>Q.9</td><td>Q. 10</td><td></td></tr>
<tr><td colspan="7">Student will be able to:</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Write a short note on primary cell culture including its advantages and limitations.	6
CO1	Q.2	Write a short note on reporter genes used during cloning in animal cells.	6
	Q.3	Briefly discuss moist heat sterilization method including its advantages and limitations.	6
CO2	Q.4	Write a short note on Stirred tanked bioreactor.	6

CO2	Q.5	Explain the selection method of hybridoma cells for vaccine production.	6

CO1	Q.6	Define bioethics? Enlist the initiatives of CSIRO's animal ethics committee.	6
	Q.7	Explain various methods of cell separation from animal tissue, clearly indicating their merits and demerits. How is cell culture maintained in the laboratory?	10
CO3	Q.8	Explain the following- (a) Method of selection of myeloma cells form bone marrow. (b) Recombinant erythropoietin (EPO) and its commercial applications.	10
CO4	Q.9	Discuss the principal and steps involved in Intra-cytoplasmic Sperm Injection (ICSI) with suitable diagramme during IVF for genetically superior livestock development. Enlist the risks associated with IVF.	10
CO4	Q.10	Discuss the following in detail (a) Various selection criteria for grading best embryos for embryo transfer technology (ETT). (b) Natural animal cell culture media.	20

Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Animal Biotechnology***/Course code ***BSB 502*** is level **3** for the academic year ***2017-18***.

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B. Sc.) Academic Year – 2017-18

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific

domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context

of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
	BSB 601	3	1	2	2	-	1	-	3	-	-	-		3	2	-
VII SEM																

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL BIOTECHNOLOGY
Course Code : BSB 601, Crédits : 03, Session :2017-18 (Even Sem.), Class : B.Sc. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with different processes and use of microbial technology that can be employed for a cleaner environment. The course also aims to make the students aware of legislation and rules prevalent to control the degradation of our environment.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 601.1. Understand the delicate interrelationship of different components of environment.
BSB 601.2. Understand conventional fuels, their impact and concept of clean fuel technology.
BSB 601.3. Learn approaches and concepts behind bioremediation xenobiotic compounds, mechanism of microbial leaching and mining.
BSB 601.4. Learn the concept of municipal solid and liquid wastes management. environmental impact assessment (EIA) and assessment of environmental quality.
BSB 601.5. Learn the concept of biopesticides and biofertilizers and Bioassessment of assessment of environmental quality.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food,

Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on

distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas

of cell and molecular biology, microbiology, genetics, biochemistry and metabolic

regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. **Syllabus**

Module I

Environmental components, Environmental pollution and its types, Non-renewable and renewable energy resources.

Module II

Conventional fuels and their major impacts: Global warming and greenhouse effect, Global Ozone Problem, Acid rain, Eutrophication, Biomagnification, Concept of clean fuel technology: Biomass energy and biofuels

Module III

Biodegradation of Xenobiotic compounds i.e. oil, pesticide and PAHs and bioremediation of major pollutants

Biomineralisation: Use of microbial technology for mining

Module IV

Treatment of municipal solid and liquid wastes

Environmental impact assessment and Environmental audit

odule V

Bioassessment of Environmental Quality,

Biofertilizers and Biopesticides

G. **Examination Scheme:**

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

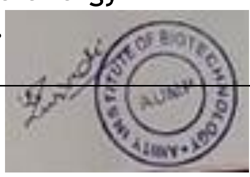
H. **Suggested Text/Reference Books:**

- Environmental Science, S.C. Santra
- Environmental Biotechnology, Pradipta Kumar Mohapatra
- Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
- Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill
- Agricultural Biotechnology, S.S. Purohit
- Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer
- Introduction to Environmental Biotechnology, Milton Wainwright
- Principles of Environmental Engineering, Gilbert Masters
- Principles of fermentation Technology, Salisbury, Whitaker and Hall

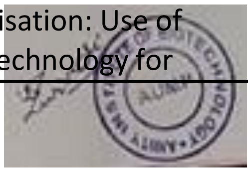
- Industrial Microbiology – Cassida
- Agricultural Biotechnology – S.S. Purohit
- Wastewater Engineering – Metcalf & Eddy.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Introduction of Environmental components.	Lecture	BSB 601.1.	Mid Term-1, Quiz & End Sem Exam
2	Environmental components. (Biotic)	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Environmental components. (Abiotic)	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Introduction to Environmental pollution.	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Environmental pollution and its types.	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Environmental pollution:Air	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Environmental pollution:Water	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Environmental pollution:Water	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Environmental pollution:Soil	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Environmental pollution:Impact	Lecture	BSB 601.2.	Mid Term-1, Quiz & End Sem Exam
11	Non-renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Non-renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam



15	Conventional fuels and their major impacts.	Lecture	BSB 601.2.	Mid Term-1, Quiz & End Sem Exam
16	Global Warming and GHGs	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Global Ozone Problem,	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Acid rain,	Lecture		Mid Term-1, Quiz & End Sem Exam
19	Eutrophication, Biomagnification,	Lecture		Mid Term-1, Quiz & End Sem Exam
20	Concept of clean fuel technology: Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
21	Concept of clean fuel technology: Biomass energy and biofuels	Lecture		Mid Term-1, & End Sem Exam
22	Concept of clean fuel technology: Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
23	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
24	Xenobiotic compounds	Lecture	BSB 601.3.	Quiz & End Sem Exam
25	Biodegradation of Xenobiotic compounds	Lecture		Quiz & End Sem Exam
26	Biodegradation of Xenobiotic compounds	Lecture		Quiz & End Sem Exam
27	Bioremediation of major pollutants	Lecture		Quiz & End Sem Exam
28	Bioremediation of major pollutants	Lecture		Quiz & End Sem Exam
29	Biomineralisation: Use of microbial technology for mining.	Lecture		Quiz & End Sem Exam
30	Biomineralisation: Use of microbial technology for mining.	Lecture		Quiz & End Sem Exam
31	Biomineralisation: Use of microbial technology for mining.	Lecture		Quiz & End Sem Exam
32	Biomineralisation: Use of microbial technology for	Lecture		Quiz & End Sem Exam



	mining.			
33	Treatment of municipal solid and liquid wastes	Lecture	BSB 601.4.	Quiz & End Sem Exam
34	Treatment of municipal solid and liquid wastes	Lecture		Quiz & End Sem Exam
35	Treatment of municipal solid and liquid wastes	Lecture		Quiz & End Sem Exam
36	Environmental impact assessment and Environmental audit	Lecture		Quiz & End Sem Exam
37	Environmental impact assessment and Environmental audit	Lecture		Quiz & End Sem Exam
38	Environmental impact assessment and Environmental audit	Lecture		Quiz & End Sem Exam
39	Bioassessment of Environmental Quality	Lecture	BSB 601.5.	Quiz & End Sem Exam
40	Bioassessment of Environmental Quality.	Lecture		Quiz & End Sem Exam
41	Bioassessment of Environmental Quality.	Lecture		Quiz & End Sem Exam
42	Biofertilizers and Biopesticides	Lecture		Quiz & End Sem Exam
43	Biofertilizers and Biopesticides	Lecture		Quiz & End Sem Exam
44	Biofertilizers and Biopesticides	Lecture		Quiz & End Sem Exam
45	Revision	Lecture		Quiz & End Sem Exam
46	Revision	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

BSB 601.1.	Understand the delicate interrelationship of different components of environment.	3	1	-	-	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.2.	Understand conventional fuels, their impact and concept of clean fuel technology.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.3.	Learn approaches and concepts behind bioremediation xenobiotic compounds, mechanism of microbial leaching and mining.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.4.	Learn the concept of municipal solid and liquid wastes management. environmental impact assessment (EIA) and assessment of environmental quality.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.5.	Learn the concept of Biopesticides and biofertilizers and assessment of environmental quality.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2017-18</td></tr>
<tr><td colspan="7">Class: B.Sc.(H) Biotechnology
VI Semester</td></tr>
<tr><td colspan="2">Subject Name: ENVIRONMENTAL BIOTECHNOLOGY</td><td colspan="2">Time: 3 Hrs</td><td colspan="3">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,2,6</td><td>Q.3,4</td><td>Q.5,7,10</td><td>Q.6,8</td><td>Q. 9,</td><td></td></tr>
<tr><td colspan="7">Student will be able to:</td></tr>
</table>

CO Map	Question No.	Questi on	Marks
CO1	Q.1	What is biological oxygen demand (BOD)? How it differs from Dissolved oxygen (DO) of water bodies?	6
CO1	Q.2	Define ecosystem and its major components.	6
	Q.3	Write a short note on concept of clean fuel technology.	6
CO2	Q.4	Write a brief note on Noise pollution. Point out WHO recommended day and night noise level.	6
CO5	Q.5	Write brief note on neem based bio-pesticides and its role in agricultural sustainability.	6
CO4	Q.6	Briefly explain Environment Impact assessment (EIA). Why it is important?	6
CO 1	Q.7	What is trophic level in ecosystem? Explain different levels in context of energy flow in ecosystem. Point out the 10% energy flow rule.	10

CO3	Q.8	Explain the impact of oil spills on water ecosystem and its bioremediation strategies.	10

CO3	Q.9	Define the term biomining. Discuss the following methods of metal extraction (i) Heap bioleaching (ii) Dump bioleaching.	10
CO4	Q.10	Discuss the following: (a) Explain the impact of nutrient enrichment of water bodies on water ecosystem. (b) Explain the process of biodiesel production, how it is helpful in reducing need of conventional fuels?	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental Biotechnology***/Course code ***BSB 601*** is level **3** for the academic year ***2017-18***.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
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ROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2017-18

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
VI SEM	**BSB 620**	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**1**	**2**	**-**	**-**	**2**	**3**	**1**

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL AND INDUSTRIAL BIOTECHNOLOGY LAB
Course Code : BSB 620, Crédits : 01, Session :2017-18 (Even Sem.), Class : B.Sc. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with impact of conventional fules/ pollutions on environment and plants by assessing through lab experiments i.e, Comparative and statistical analysis of the pigment contents, Sugar content, NR activity and alcohol production

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 620.1. Understand and perform Symptomological studies and comparative and statistical analysis of the pigment content due to air pollution.
BSB 620.2. Understand and perform comparative and statistical analysis of the sugar content as an impact of air pollution and NR activity
BSB 620.3. Understand and perform production & downstream processing of alcoholic fermentation.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of

Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

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PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1 practical based	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination (Practical Exam)	EE	70%

Total			**100%**

F. Syllabus

Module I

Symptomological studies of the impacts of conventional fuel

Comparative and statistical analysis of the pigment content due to air pollution..

Module II

Comparative and statistical analysis of the sugar content as an impact of air pollution

NR activity estimation and its statistical analysis under pollution stress conditions.

Module III

Production & downstream processing of alcoholic fermentation.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Lab Manual for B.Sc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Lab Introduction	Practical	BSB 620.1.	Mid Term-, Quiz & End Sem Exam
2	Symptomological studies of the impacts of conventional fuel Symptomological studies of the impacts of conventional fuel	Practical		Mid Term-1, Quiz & End Sem Exam
3	Symptomological studies of the impacts of conventional fuel	Practical		Mid Term-1, Quiz & End Sem Exam

4	Symptomological studies of the impacts of conventional fuel	Practical		Mid Term-1, Quiz & End Sem Exam

5	Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution. Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution.	Practical		Mid Term-1, Quiz & End Sem Exam
6	Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution.	Practical	BSB 620.2.	Mid Term-1, Quiz & End Sem Exam
7	Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution.	Practical		Mid Term-1, Quiz & End Sem Exam
8	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
9	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
10	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
11	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
12	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam
13	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam
14	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam

15	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam

16	Production & downstream processing of alcoholic fermentation.	Practical	BSB 620.3.	Mid Term-1, Quiz & End Sem Exam
17	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
18	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
19	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
20	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
21	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, & End Sem Exam
22	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
23	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
24	Production & downstream processing of alcoholic fermentation.	Practical	B	Quiz & End Sem Exam
		Practical		

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

BSB 620.1.	Understand and perform Symptomological studies and comparative and statistical analysis of the pigment content due to air pollution.	3	3	3	2	3	-	-	**1**	1	2	-	-	2	3	-
BSB 620.2.	Understand and perform comparative and statistical analysis of the sugar content as an impact of air pollution and NR activity	3	3	3	2	3	-	-	1	1	2	-	-	2	3	-
BSB 620.3.	Understand and perform production & downstream processing of alcoholic fermentation.	3	3	3	2	3	-	-	-	1	2	-	-	2	3	1

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental and Industrial Biotechnology Lab***/Course code ***BSB 620*** is level **3** for the academic year ***2017-18***.


AMITY INSTITUTE OF BIOTECHNOLOGY •

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Microbiology
Course Code : BTB303, Credits : 04, Session : 2017-18(Odd Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** This fundamental paper discusses the importance of microorganisms. The course throws light on types of microorganisms in and around humans. At the end of the course, the student has understanding on the metabolism and mechanism of microbial life. Students will gain knowledge about the different cell organelles of microorganisms and their detailed functions. Students will also study the growth and control of microbes as well as different bacteriological techniques involved in microbiology. Students will learn about the biomolecules by studying their structures and types.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB303.1. Students will learn about the historical perspective of microbial world, spontaneous generation, role of microbes, pure culture, microbial nutrition, culture media, and sterilization.

BTB303.2. Students will gain knowledge of prokaryotic cell, structural and functional anatomy of cell and organelles. Growth and growth curve, culture types – batch and continuous, culture collection and maintenance of cultures.

BTB303.3. Students will gain knowledge about the Systematics and taxonomy of bacteria, ribotyping, nomenclature and Bergey’s manual.

BTB303.4. Students will know about the Metabolic Diversity among microorganisms, microbial photosynthesis, photosynthetic pigments, Chemolithotrophy, hydrogen- iron- nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions.

BTB303.5. Students will develop deeper understanding of Archae, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles. Viruses –

Bacterial and Animal, their structure, reproduction. Viroids and Prions. Algae and Fungi – their reproduction and classification.

BTB303.6. Students will learn about the Host-parasite relationship, micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections, types of toxins (Exo, endo, entro) and their mechanism of action. Microbial pathogenesis and sexually transmitted disease.

BTB303.7. Students will have knowledge of Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics.

C. Programme Outcomes:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural,societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioral attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization.

Module II: Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, Fed batch culture, continuous culture, culture collection and maintenance of cultures.

Module III: Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV: Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-ironnitrite- oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophilesViruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI: Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenicfungi.

Module VII: Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE

Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott
The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.
The Microbial World, Roger Y. Stanier, Prentice Hall
Microbiology, Tortora, Funke and Chase, Benzamin& Cummings
Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
Industrial Microbiology, Casida, New Age International
Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC.Brown Publisher.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Discovery of the microbial world	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
2	Controversy over spontaneous generation	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
3	Role of microorganisms in transformation of organic matter and in the causation of diseases	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
4	Development of pure culture methods	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
5	Methods in Microbiology	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
6	Principles of microbial nutrition, Culture media	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
7	Theory and practice of sterilization	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam

8	Prokaryotic structure and function	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
9	Functional anatomy of bacteria: cell envelope, cell	Lecture	BTB303.2	Mid Term,

	wall, cytoplasmic membrane, capsule			Quiz & End Sem Exam
10	Functional anatomy of bacteria: surface appendages, cytoplasm and cytoplasmic Inclusions	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
11	Growth - The definition of growth, mathematical expression of growth, growth curve	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
12	Measurement of growth, Synchronous growth	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
13	Fed batch culture, continuous culture	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
14	Culture collection and maintenance of cultures	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
15	Systematics and taxonomy	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
16	New approaches to bacterial taxonomy	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
17	Classification including ribotyping	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
18	Ribosomal RNA sequencing	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
19	Characteristics of primary domains	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
20	Taxonomy, nomenclature	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
21	Bergey's manual	Lecture	BTB303.3	Quiz & End Sem Exam
22	Metabolic Diversity among microorganisms	Lecture	BTB303.4	Quiz & End Sem Exam
23	Photosynthesis in microorganisms	Lecture	BTB303.4	Quiz & End Sem Exam
24	Role of bacteriochlorophylls, carotenoids and phycobilins	Lecture	BTB303.4	Quiz & End Sem Exam

25	Chemolithotrophy, hydrogen-iron-nitrite-oxidizing bacteria	Lecture	BTB303.4	Quiz & End Sem Exam
26	Nitrate and Sulphate reduction, methanogenesis and acetogenesis	Lecture	BTB303.4	Quiz & End Sem Exam

27	Fermentations, nitrogen fixation	Lecture	BTB303.4	Quiz & End Sem Exam
28	Plant microbe interactions (mycorrhizae)	Lecture	BTB303.4	Quiz & End Sem Exam
29	Archae as earliest life forms	Lecture	BTB303.5	Quiz & End Sem Exam
30	Thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BTB303.5	Quiz & End Sem Exam
31	Viruses: Bacterial, animal	Lecture	BTB303.5	Quiz & End Sem Exam
32	Structure of viruses	Lecture	BTB303.5	Quiz & End Sem Exam
33	Reproduction and life cycle of RNA and DNA viruses	Lecture	BTB303.5	Quiz & End Sem Exam
34	Viroids and prions.	Lecture	BTB303.5	Quiz & End Sem Exam
35	Algae and Fungi: Classification and Reproduction	Lecture	BTB303.5	Quiz & End Sem Exam
36	Host-parasite relationship	Lecture	BTB303.6	Quiz & End Sem Exam
37	Normal micro flora of skin, oral cavity, gastrointestinal tract	Lecture	BTB303.6	Quiz & End Sem Exam
38	Respiratory infections; entry of pathogens into the host	Lecture	BTB303.6	Quiz & End Sem Exam
39	Types of toxins (Exo, endo, entro) and their mode of actions	Lecture	BTB303.6	Quiz & End Sem Exam
40	Microbial pathogenesis - Disease reservoirs	Lecture	BTB303.6	Quiz & End Sem Exam
41	Epidemiological terminologies; Infectious disease transmission	Lecture	BTB303.6	Quiz & End Sem Exam
42	Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi	Lecture	BTB303.6	Quiz & End Sem Exam
43	Chemotherapy/antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam
44	Antimicrobial agents, sulfa drugs	Lecture	BTB303.7	Quiz & End Sem Exam
45	Antibiotics - Penicillin and Cephalosporins	Lecture	BTB303.7	Quiz & End Sem Exam

46	Broad spectrum antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam

47	Antifungal antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam
48	Mode of action of antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BTB303.1	historical perspective of microbial world, spontaneous generation, role of microbes, pure culture, microbial nutrition, culture media, and sterilization	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.2	prokaryotic cell, structural and functional anatomy of cell and organelles. Growth and growth curve, culture types – batch and continuous, culture collection and maintenance of cultures	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

BTB303.3	Systematics and taxonomy of bacteria, ribotyping, nomenclature and Bergey’s manual	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

BTB303.4	Metabolic Diversity among microorganisms, microbial photosynthesis, photosynthetic pigments, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.5	Archaea, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles. Viruses – Bacterial and Animal, their structure, reproduction. Viroids and Prions. Algae and Fungi – their reproduction and classification	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

BTB303.6	Host-parasite relationship, micro flora of skin, oral cavity, gastrointestinal tract,	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

	Respiratory infections, types of toxins (Exo, endo, entro) and their mechanism of action. Microbial pathogenesis and Sexually transmitted disease															
BTB303.7	Chemotherapy/ antibiotics - Antimicrobial agents, sulfa drugs, penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2017-18						
Class: B.Tech. Biotechnology III Semester						
Subject Name: BTB 303 MICROBIOLOGY		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

Student will be able to
CO1: Enumerate bacterial count their isolation and development of pure culture.
CO2: Apply generation time calculation for different microbial
entities.

CO Map	Question No.	Question	Marks

CO1	Q.1	Explain in brief about microbial evolution.	3
CO1	Q.2a	What do you understand by isolation of culture?	3
	Q.2b	How are prokaryotic microbes different from eukaryotic microbes?	3
CO1	Q.3	Give an account of DNA sequencing.	6
CO2	Q.4	Explain the significance of bacterial toxins.	3
CO2	Q.5a	What are the factors favoring enteric bacteria?	3
	Q.5b	Discuss the different factors affecting the growth of bacteria.	3
CO2	Q 6	Differentiate between monoauxic and diauxic bacterial growth curve.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **MICROBIOLOGY/BTB 303** is **level 3** for the academic year 2017-18.

Amity Institute of Biotechnology
Course Handout
Course : Microbiology Lab
Course Code : BTB322, Credits : 01, Session : 2017-18(Odd Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Manish Kumar

A. Introduction: To understand the basics of microbiology and different culture techniques. Preparation of culture media – liquid, slant and solid. Growth curve and different types of staining – grams, endospore and capsule staining. Isolation and identification of rhizobium from root nodules

B. Course Outcomes: At the end of the course, students will be able to:

BTB322.1. Students will learn about preparation of solid and liquid media.

BTB322.2. Students will do isolation and maintenance of organisms by plating, streaking and serial dilution.

BTB322.3. Students will know about the preparation of slant cultures.

BTB322.4. Students will learn about growth curve measurement of bacterial population by turbidometry.

BTB322.5. Students will know about measurement of bacterial population by dilution method.

BTB322.6. Students will gain knowledge of effect of temperature, pH, carbon and nitrogen sources on growth of bacteria.

BTB322.7. Students will do microscopic examination of bacteria by gram staining.

BTB322.8. Students will learn about Endospore staining.

BTB322.9. Students will be acquainted with Capsule Staining.

BTB322.10. Students will experimentally perform isolation and identification of Rhizobium from root nodules.

C. Programme Outcomes:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of

complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural,societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of

technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Internal Examination	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%

Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	External Examination	EE	70%

Total			**100%**

E. Syllabus

Module I: Preparation of solid and liquid media.

Module II: Isolation and maintenance of organisms by plating, streaking and serial dilution.

Module III: Preparation of slant cultures.

Module IV: Growth curve measurement of bacterial population by turbidometry.

Module V: Measurement of bacterial population by dilution method.

Module VI: Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria.

Module VII: Microscopic examination of bacteria by gram staining.

Module VIII: Endospore staining.

Module IX: Capsule Staining.

Module X: Isolation and identification of Rhizobium from root nodules.

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian

Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott

The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

The Microbial World, Roger Y. Stanier, Prentice Hall

Microbiology, Tortora, Funke and Chase, Benzamin& Cummings

Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.

Industrial Microbiology, Casida, New Age International

Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of

Microbiology, R.M. Atlas, WMC.Brown Publisher.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Preparation of solid and liquid media	Practical	BTB322.1	Internal & External Exam
2	Learning about autoclave, laminar air flow	Practical	BTB322.1	Internal & External Exam
3	Isolation and maintenance of organisms by plating and streaking	Practical	BTB322.1	Internal & External Exam
4	Isolation and maintenance of organisms by serial dilution	Practical	BTB322.1	Internal & External Exam
5	Measurement of bacterial population by dilution	Practical	BTB322.1	Internal & External Exam
6	Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria	Practical	BTB322.1	Internal & External Exam
7	Microscopic examination of bacteria by gram staining	Practical	BTB322.1	Internal & External Exam
8	Endospore staining	Practical	BTB322.2	Internal & External Exam
9	Capsule staining	Practical	BTB322.2	Internal & External Exam
10	Collection of Root Nodules	Practical	BTB322.2	Internal & External Exam
11	Isolation of Rhizobium from root nodules	Practical	BTB322.2	Internal & External Exam
12	Identification of Rhizobium from root nodules	Practical	BTB322.2	Internal & External Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BTB 322.1	Preparation of solid and liquid media	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.2	Isolation and maintenance of organisms by plating, streaking and serial dilution	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.3	Preparation of slant cultures	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.4	Growth curve measurement of bacterial population by turbidometry	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.5	Measurement of bacterial population by dilution method	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.6	Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.7	Microscopic examination of bacteria by gram staining	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.8	Endospore staining	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.9	Capsule Staining	3	2	2	2	3	2	2	2	2	2	3	2	2
BTB 322.10	Isolation and identification of Rhizobium from root nodules	3	2	2	2	2	2	2	2	2	2	3	2	2

Sample Question Paper

Amity Institute of Biotechnology MID-SEMESTER 2017-18
Class: B.Tech (Biotech) III Semester

Subject Name: BTB 322 Microbiology Lab	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to
CO1: List the broad perceptive of cloud architecture and model.
CO2: Apply different cloud programming models as per need.

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss the development of pure cultures.	3
CO1	Q.2a	Differentiate between bacteria and fungi.	3
	Q.2b	Write a short note on bacterial DNA marker.	3
CO1	Q.3	Differentiate between genotype and ribotype.	6
CO2	Q.4	Explain about the capsule staining and	3

Attainments		Rubric
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **MICROBIOLOGY LAB/BTB 322** is **level 2** for the academic year 2017-18.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2017-18

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent

responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX																		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12		PSO 1	PSO 2	PSO 3	PSO 4
V SEM	BTB 502	3	2	2	3	2	1	2	2	1	2	1	-		3	2	1	-

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ANIMAL BIOTECHNOLOGY
Course Code : BTB 502, Crédits : 03, Session :2017-18 (Odd Sem.), Class : B.Tech. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques in animal biotechnology like in vitro fertilization, animal cell and tissue culture, hormone vaccine and important enzyme production through animal biotechnology.

B. Course Outcomes: At the end of the course, students will be able to:

BTB 502.1. Understand Concepts of animal biotechnology and its commercial applicability methods of sterilization techniques and understanding of organ culture.
BTB 502.2. Learn methods of animal cell culture and maintenance and immobilization cell culture techniques.
BTB 502.3. Understand the technology and concepts of invitro fertilization and embryo transfer, and development of superior live stocks.
BTB 502.4. Become familiar with concept of somatic hybridization and hybridoma technology for vaccine production
BTB 502.5. Understand Animal genetic engineering -vectors, gene transfer methods
BTB 502.6. Understand transgenic technology in animal biotechnology for producing commercially important products.
BTB 502.7. Understand ethical issues in animal biotechnology

C. Programme Outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics,

science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Historical perspectives, sterilization methods, organ culture - culture techniques, plasma clot, raft methods, agar gel, grid method, organ engineering.

Module II

Cell culture substrates, cultural media, natural and artificial media, initiation and maintenance of cell cultures, cell culture products, cryopreservation techniques, immobilized cultures

Module III

In vitro fertilization and embryo transfer

Module IV

Somatic cell hybridization, hybridoma technology

Module V

Animal genetic engineering -vectors, gene transfer methods - microinjection, virus mediated and other methods of gene transfer

Module VI

Transgenic animals with new traits, transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutic etc.

odule VII

Bioethical issues related to animal biotechnology,

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss. References:
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford.
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag.
- Cell Culture LabFax, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press.
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Historical perspectives, sterilization methods,	Lecture	BTB 502.1.	Mid Term-1, Quiz & End Sem Exam
2	organ culture - culture techniques, plasma clot, raft methods,	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Agar gel, grid method of Organ culture	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Organ engineering.	Lecture		Mid Term-1, Quiz & End Sem Exam

5	Animal Cell culture substrates for attatchment	Lecture	BTB 502.2.	Mid Term-1, Quiz & End Sem Exam
6	Broad outline of Animal Cell culture Media	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Animal Cell Culture Media: Natural media	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Animal Cell Culture Media: Artificial media	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Advantages and limitations of natural and artificial media.	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Methods of Initiation of Cell culture	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Preversation and maintenance of cell culture.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	cryopreservation techniques,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	immobilized cultures	Lecture		Mid Term-1, Quiz & End Sem Exam
14	In-vitro fertilization technique	Lecture	BTB 502.3.	Mid Term-1, Quiz & End Sem Exam
15	In-vitro fertilization technique	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Embryo transfer	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Embryo transfer .	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Somatic cell hybridization	Lecture	BTB 502.4.	Quiz & End Sem

				Exam
19	Somatic cell hybridization	Lecture		Quiz & End Sem Exam
20	Hybridoma technology for MAbs production	Lecture		Quiz & End Sem Exam
21	Hybridoma technology for MAbs production	Lecture		Quiz & End Sem Exam
22	Applications of bioreactoras and MAbs	Lecture		Quiz & End Sem Exam
23	Animal genetic engineering -vectors, gene transfer methods : Direct	Lecture	BTB 502.5.	Quiz & End Sem Exam
24	Animal genetic engineering -vectors, gene transfer methods: Indirect	Lecture		Quiz & End Sem Exam
25	Vectors for transgene transfer	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Transgenic animals	Lecture	BTB 502.6.	Quiz & End Sem Exam
27	Methods of transgenic animal production	Lecture		Quiz & End Sem Exam
28	Methods of transgenic animal production	Lecture		Quiz & End Sem Exam
29	Transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutic etc.	Lecture		Quiz & End Sem Exam
30	Transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutic etc.	Lecture		Quiz & End Sem Exam
31	Transgenic animals with new traits	Lecture		Quiz & End Sem Exam
32	Transgenic animals with new traits	Lecture		Quiz & End Sem Exam
33	Bioethical issues related to animal biotechnology,	Lecture	BTB 502.7.	Quiz & End Sem Exam
34	Bioethical issues related to animal biotechnology,	Lecture		Quiz & End Sem Exam
35	Bioethical issues related to animal biotechnology,	Lecture		Quiz & End Sem Exam

36	Test	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFI OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
BTB 502.1.	Understand Concepts of animal biotechnology and its commercial applicability methods of sterilization techniques and understanding of organ culture. .	3	2	1	2	1	1	-	-	1	-	-	1	3	1	1
BTB 502.2.	Learn methods of animal cell culture and maintenance and immobilization cell culture techniques	3	2	1	2	1	1	-	-	**1**	-	-	1	3	2	1
BTB 502.3.	Understand the technology and concepts of invitro fertilization and embryo transfer, and development of superior live stocks.	3	2	1	2	1	1	1	-	1	-	-	1	3	2	1

BTB 502.4.	Become familiar with concept of somatic hybridization and hybrodoma technology for vaccine production	3	1	1	-	1	1	-	-	1	-	-	1	3	2	-

BTB 502.5.	Understand Animal genetic engineering -vectors, gene transfer methods	3	-	1	-	1	1	-	-	1	-	-	1	3	2	-
BTB 502.6.	Understand transgenic technology in animal biotechnology for producing commercially important products.	3	-	1	2	1	1	2	-	1	-	-	1	3	2	1
BTB 502.7.	Understand ethical issues in animal biotechnology	3	-	1	-	1	1	3	-	1	-	-	1	3	2	-

Sample Question Paper

Amity Institute Biotechnology 2017-18						
Class: B. Tech. Biotechnology V Semester						
Subject Name: ANIMAL BIOTECHNOLOGY		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4,6	Q.2,5,3	Q.7,8	Q.9	Q. 10	
Student will be able to:						
CO Map	Question No.	Question				Marks

CO2	Q.1	Write a short note on primary cell culture including its advantages and limitations.	6
	Q.2	Write a short note on reporter genes used	6

CO5		during cloning in animal cells.	
CO1	Q.3	Briefly discuss moist heat sterilization method including its advantages and limitations.	6
CO2	Q.4	Write a short note on Stirred tanked bioreactor.	6
CO5	Q.5	Explain the selection method of hybridoma cells for vaccine production.	6
CO7	Q.6	Define bioethics? Enlist the initiatives of CSIRO's animal ethics committee.	6
	Q.7	Explain various methods of cell separation from animal tissue, clearly indicating their merits and demerits. How is cell culture maintained in the laboratory?	10
CO1	Q.8	Explain the following- (a) Method of selection of myeloma cells form bone marrow. (b) Recombinant erythropoietin (EPO) and its commercial applications.	10
CO3	Q.9	Discuss the principal and steps involved in Intra-cytoplasmic Sperm Injection (ICSI) with suitable diagramme during IVF for genetically superior livestock development. Enlist the risks associated with IVF.	10
CO2	Q.10	Discuss the following in detail (a) Various selection criteria for grading best embryos for embryo transfer technology (ETT). (b) Natural animal cell culture media.	20

Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Animal Biotechnology***/Course code ***BTB 502*** is level **3** for the academic year ***2017-18***.


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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2017-18

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent

responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12		PSO1	PSO2	PSO3	PSO4
	BTB 521	3	3	1	2	-	1	2	-	1	1		1		3	2	-	-
V SEM																		

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ANIMAL BIOTECHNOLOGY LAB
Course Code : BTB 521, Crédits : 03, Session :2017-18 (Odd Sem.), Class : B.Tech. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with different techniques in animal biotechnology like , Media preparation, cell culture, subculturing and cytotoxicity assay.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB 521.1. Prepare and sterilize animal cell culture media under aseptic conditions.
BTB 521.2. Inoculate specific cells or tissues for callusing in media
BTB 521.3. Maintain cell culture by subculturing.
BTB 521.4. Perform cytotoxicity test

Programme Outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering

activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

C. **Programme Specific Outcomes:**

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer

programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

D. **Assessment Plan:**

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. **Syllabus**

1. Preparation, standardization and sterilization of culture media
2. Inoculation of specific tissues for callusing
3. Inoculation and maintenance of cell lines
4. Study of toxicity on cell lines

F. **Examination Scheme:**

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

IA			**EE**			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. **Suggested Text/Reference Books:**

- Lab Manual

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss. References:
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford.
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Basic calculations and preparation of solutions and buffers	Practical	BTB 521.1.	Mid Term-1, Quiz & End Sem Exam
2	Basic calculations and preparation of solutions and buffers	Practical		Mid Term-1, Quiz & End Sem Exam
3	Preparation of cell Culture Media (Natural)	Practical		Mid Term-1, Quiz & End Sem Exam
4	Study of composition and Preparation of cell Culture Media (Artificial)	Practical		Mid Term-1, Quiz & End Sem Exam
5	Method of sterilization of culture media.	Practical	BTB 521.2.	Mid Term-1, Quiz & End Sem Exam
6	Separation of cells from tissue/ and inoculation in culture vessel	Practical		Mid Term-1, Quiz & End Sem Exam
7	Separation of cells from tissue/ and inoculation in culture vessel	Practical		Mid Term-1, Quiz & End Sem Exam
8	Cell separation and Inoculation of specific tissues for callusing	Practical		Mid Term-1, Quiz & End Sem Exam
9	Observation of callus development and data recording	Practical		Mid Term-1, Quiz & End Sem Exam
10	preparations of buffers and stains to Study of toxicity on cell lines MTT assay.	Practical		Mid Term-1, Quiz & End Sem Exam
11	Study of cytotoxicity using MTT assay.	Practical		Mid Term-1, Quiz & End Sem Exam
12	Spot identification /slides	Practical		Mid Term-1, Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			PSO	PSO	PSO	PSO

													1	2	3	4
BTB 521.1.	Prepare and sterilize animal cell culture media under aseptic conditions.	3	3	1	-	-	-	-	-	1	-		**3**	**1**	**-**	**-**
BTB 521.2.	Inoculate specific cells or tissues for callusing in media	3	3	1	-	-	1	2	-	1	-		**3**	**1**	**-**	**-**
BTB 521.3.	Maintain cell culture by subculturing.	3	3	1	1	-	1	1	-	1	-		**3**	**1**	**-**	**-**
BTB 521.4.	Perform cytotoxicity test	3	3	1	2	-	1	-	-	1	-		**3**	**1**	**-**	**-**

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Animal Biotechnology***/Course code ***BTB 521*** is level **3** for the academic year ***2017-18***.


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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2017-18

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge

to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
VII SEM	BTB 701	3	2	2	1	1	1	1	-	1	2	1	-	3	2	-	1

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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOPROCESS TECHNOLOGY
Course Code : BTB 701, Crédits : 03, Session :2017-18 (Odd Sem.), Class : B.Tech. 4th Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques in bioprocess technology. The objective of the course is to apply the principles of biochemical engineering in large scale cultivation of microorganism for production of important products. The present course will make them competent academically to envisage the different problems.

B. Course Outcomes: At the end of the course, students will be able to:

BTB 701.1. Understand Concepts of bioprocess technology the advantages of biochemical processes and its conventions.
BTB 701.2. Develop skill of process technology for ethanol, amino acids and biomass production.
BTB 701.3. Gain understanding of production of secondary metabolites and antibiotics.
BTB 701.4. Get knowledge of industrial production of commercially important enzymes.

C. Programme Outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and

environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and

research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial

biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Advantage of bioprocess over chemical process. Basic principle in bioprocess technology. Media formulation, Cell culture techniques; Inoculum development and aseptic transfers. Different types of pumps, valves, and line materials, piping conventions etc. used in Biochemical Process

Module II

Process technology for the production of primary metabolites, eg. Biomass, ethanol, acetone-butanol, citric acid, amino acids, polysaccharides and plastics.

Ethanol: production by batch, continuous and cell recycle adopted by various technologies practiced in Indian distilleries using molasses and grains. Computation of fermentation efficiency, distillation efficiency and overall efficiency of ethanol production, recovery, uses, glucose effect etc. Power alcohol – definition, uses, merits and demerits of various technologies for its production.

Amino Acid: Genetic Control of metabolic pathway.

Lysine: Indirect and direct fermentation – mechanism of ph of metabolic block in accumulation of L-

lysine by inhibition and repression mechanism.

Biomass: Bakers and distillers yeast production using various raw materials, “bios” factors for growth, Crabtree effect, harvesting, different forms and uses.

What are mushroom, different forms of common mushroom production from agro based raw materials and uses. Biofertilizers, biocompost and biopesticides

Module III

Production of secondary metabolites – penicillin, cephalosporins, streptomycin, tetracycline etc. Metabolites from plant and animal cell culture

Penicillin: Classification, various penicillin as precursor and 'R' – side chain, penicillinase, 6-APA, penicillin production, harvest and recovery, uses of various forms etc.

Streptomycin: chemical structure, production, harvest and recovery, use by-product of streptomycin fermentation etc.

Tetracycline: chemical structure, production, harvest and recovery, use by-product of tetracycline fermentation etc.

Module IV

Microbial production of industrial enzymes – glucose isomerase, penicillin acylase, cellulase, amylase, lipase, protease etc.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Biochemical Engineering- Kinetics, Mass Transport, Reactors and Gene Expression, W F Weith, John Wiley and Sons Inc
- Biochemical Engineering, S Aiba, A E Humphery and N F Millis, University of Tokyo Press
- Bioprocess Engineering Basic Concepts, M.L. Shuler and F. Kargi, Prentice Hall
- Bioprocess Engineering, B.K. Lydersen, K.L. Nelson, B.K. Lyderson and N. D'Elia, John Wiley and Sons Inc.
- Bioprocess Engineering Principles, P Doran, Academic Press
- Biotechnology. A Textbook of Industrial Microbiology, W. Crueger and a. Crueger, Sinauer Associates.
- Principles of Fermentation Technology, P.F. Stanbury and A. Whitaker, Pergamon Press
- Process Engineering in Biotechnolgy, A T Jackson , Prentice Hall

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Advantage of bioprocess over chemical process. Basic principle in bioprocess technology.	Lecture	BTB 701.1.	Mid Term-1, Quiz & End Sem Exam
2	Techniques; Inoculum development and aseptic transfers.	Lecture		Mid Term-1, Quiz & End Sem Exam

3	Different types of pumps, valves, and line materials, piping conventions etc.	Lecture		Mid Term-1, Quiz & End Sem Exam

4	Different types of pumps, valves, and line materials, piping conventions etc.	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Ethanol: production by batch, continuous and cell recycle adopted by various technologies	Lecture	BTB 701.2.	Mid Term-1, Quiz & End Sem Exam
6	Ethanol: production by batch, continuous and cell recycle adopted by various technologies	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Power alcohol – definition, uses, merits and demerits of various technologies for its production.	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Power alcohol – definition, uses, merits and demerits of various technologies for its production.	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Amino Acid: Genetic Control of metabolic pathway.	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Lysine: Indirect and direct fermentation – mechanism of ph of metabolic block in accumulation of L- lysine by inhibition and repression mechanism.	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Lysine: Indirect and direct fermentation – mechanism of ph of metabolic block in accumulation of L- lysine by inhibition and repression mechanism.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Biomass: Bakers and distillers yeast production using various raw materials,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Biomass: Bakers and distillers yeast production using various raw materials,	Lecture		Mid Term-1, Quiz & End Sem Exam
14	What are mushroom, different forms of Mushrooms	Lecture		Mid Term-1, Quiz & End Sem Exam

15	common mushroom production from agro based raw materials and uses	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Biofertilizers, biocompost	Lecture		Mid Term-1, Quiz

				& End Sem Exam
17	Biopesticides	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Production of secondary metabolites – penicillin,	Lecture	BTB 701.3.	Quiz & End Sem Exam
19	Production of secondary metabolites – cephalosporins,	Lecture		Quiz & End Sem Exam
20	Production of secondary metabolites – streptomycin	Lecture		Quiz & End Sem Exam
21	Production of secondary metabolites – tetracyclin	Lecture		Quiz & End Sem Exam
22	Metabolites from plant and animal cell culture	Lecture		Quiz & End Sem Exam
23	Penicillin: Classification, various penicillin as precursor and „R? – side chain,	Lecture		Quiz & End Sem Exam
24	penicillinase, 6-APA, penicillin production,	Lecture		Quiz & End Sem Exam
25	Harvest and recovery, uses of various forms etc	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Streptomycin: chemical structure, production, harvest and recovery, use by-product of streptomycin fermentation etc.	Lecture		Quiz & End Sem Exam
27	Production, harvest and recovery, use by-product of tetracycline fermentation etc.	Lecture		Quiz & End Sem Exam
28	Tetracycline: chemical structure, production, harvest and recovery, use by-product of tetracycline fermentation etc.	Lecture		Quiz & End Sem Exam
29	Tetracycline: chemical structure, production, harvest and recovery, use	Lecture		Quiz & End Sem Exam
30	Tetracycline: chemical structure, production, harvest and recovery, use	Lecture		Quiz & End Sem Exam
31	Microbial production of industrial enzymes –	Lecture	BTB 701.4.	Quiz & End Sem Exam

32	Microbial production of industrial enzymes – glucose isomerase,	Lecture		Quiz & End Sem Exam
33	Microbial production of industrial enzymes –			Quiz & End Sem Exam

	Penicillin acylase,			
34	Microbial production of industrial enzymes – cellulase, amylase, lipase, protease etc.	Lecture		Quiz & End Sem Exam
35	Microbial production of industrial enzymes – cellulase, amylase, lipase, protease etc.	Lecture		Quiz & End Sem Exam
36	Microbial production of industrial enzymes – cellulase, amylase, lipase, protease etc.	Lecture		Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
BTB 701.1.	Understand Concepts of bioprocess technology the advantages of biochemical processes and its conventions.	3	2	-	2	-	1	-	-	1	-	-	3	2	-	-
BTB 701.2.	Develop skill of process technology for ethanol, amino acids and biomass production.	3	2	1	1	-	1	-	-	1	-	-	3	2	-	-

BTB 701.3.	Gain understanding of production of secondary metabolites and antibiotics.	3	2	1	1	-	1	-	-	-	-	-	3	2	-	-

BTB 701.4.	Get knowledge of industrial production of commercially important enzymes.	3	2	1	1	-	1	-	-	1	-	-	3	2	-	1

Sample Question Paper

Amity Institute Biotechnology 2017-18						
Class: B.Tech.Biotechnology VII Semester						
Subject Name: BIOPROCESS TECHNOLOGY		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,2	Q.3,4	Q.,5,6	Q.9,7	Q. 8,10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	Write a short note on crabtree effect.	6
CO2	Q.2	*Discuss* basic principles and applications of bioprocess technology.	6
	Q.3	Differentiate between primary metabolites and secondary metabolites with suitable example	6
CO2	Q.4	Define the term Auxotrophs. Name the bacterial auxotrophs used in L-lysin production.	6
CO3	Q.5	What is penicillin? Explain the mode of action and target site of Penicillin.	6
	Q.6	Write a short note on ion exchange chromatography for product recovery	6

CO4	Q.7	Discuss the process of Industrial production of the following enzymes. (a) Glucose Isomerase. (b) Amylase.	10

CO2	Q.8	Discuss the Different forms Mushrooms production methods using various substrates.	10
CO3	Q.9	Discuss the process of media formulation. Why it is very for fermentation process	10
CO4	Q.10	Discuss the following in details (a) Indirect method of large scale production of L-Lysine amino acid (b) Discuss the industrial production of tetracycline antibiotic using solid state fermentation.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioprocess Technology***/Course code ***BTB 701*** is level **3** for the academic year ***2017-18***.


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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2017-18

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge

to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “

PROGRAMME ARTICULATION MATRIX

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3	PSO 4
VII SEM	BTB 708	1	2	3	3	2	1	3	1	-	1	1	1	-	3	2	-	1
																-	-	-
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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL BIOTECHNOLOGY
Course Code : BTB 708, Crédits : 03, Session :2017-18 (Odd Sem.), Class : B.Tech. 4th Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques in environmental biotechnology. Environment constitutes one of the most important ingredients because of the global problems. Thus, it is imperative to understand the Bioremeditation of different components of environment. The present course will make them competent academically to envisage the different problems.

B. Course Outcomes: At the end of the course, students will be able to:

BTB 708.1. Understand Concepts of Ecology and ecosystem.
BTB 708.2. Understand environmental components and their delicate interrelationship and pollutions.
BTB 708.3. Learn concepts of waste water treatment using biotechnological interventions.
BTB 708.4. Understand the concept and theory of solid waste disposal methods.
BTB 708.5. Understand microbial role in bioremediation of various xenobiotic.
BTB 708.6. Build up understanding the mechanism of microbial leaching and mining of metals from
BTB 708.7. Understand Wasteland management uses and biorestoration
BTB 708.8. Understand environmental genetics especially release of genetically engineered microbes in environment.
BTB 708.9. Understand Hazardous wastes their source , management and safety.

C. Programme Outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with

appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology,

structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology,

biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction

Ecology and ecosystem.

Module II: Environmental pollution

Water, soil and air, noise and thermal pollution, their sources and effects.

Module III: Waste water (sewage and industrial effluents) treatments

Anaerobic and aerobic treatment, conventional and advanced treatment technology, methanogenesis, methanogenic, acetogenic, and fermentative bacteria- technical process and conditions, emerging biotechnological processes in waste - water treatment.

Module IV: Solid waste management

Landfills, composting, earthworm treatment, recycling and processing of organic residues.

Module V: Biodegradation

Biodegradation of xenobiotic compounds, organisms involved in degradation of chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants and microbial treatment of oil pollution

Module VI: Microbial leaching and mining

Microbial leaching and mining: Extraction of metals from ores; Recovery of metals from solutions; Microbes in petroleum extraction; Microbial desulfurization of coal.

Module VII: Wasteland

Wasteland: Uses and management, bioremediation and biorestoration of contaminated lands.

Module VIII:Environmental genetics

Environmental genetics: degradative plasmids, release of genetically engineered microbes in environment.

Module IX: Hazardous wastes

Hazardous wastes: source management and safety.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Environmental Biotechnology by PK Mohapatra
- Comprehensive Biotechnology (Vol. 1-4): M.Y.Young (Eds.), Pergamon Press, Oxford.
- Environmental Microbiology: W.D. Grant & P.E. Long, Blakie, Glassgow and London.
- Microbial Gene Technology: H. Polasa (ED.) South Asian Publishers, New Delhi.
- BiotreatmentSystems, Vol.22, D. L. Wise (Ed.), CRCPress, INC.
- Standard Methods for the Examination of Water and Waste Water (14th Education), 1985. American Public health Association.

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing CO**

1	Broad outline of Ecology	Lecture	BTB 708.1.	Mid Term-1, Quiz & End Sem Exam
2	Components of Ecology	Lecture		Mid Term-1, Quiz

				& End Sem Exam
3	Components of Ecosystem	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Types of Ecosystem	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Water pollution and its sources and effects	Lecture	BTB 708.2.	Mid Term-1, Quiz & End Sem Exam
6	Soil pollution and its sources and effects	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Air pollution and its sources and effects	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Noise and Thermal Pollution and their sources and effects.	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Waste-water and sewage water treatment- An overview	Lecture	BTB 708.3.	Mid Term-1, Quiz & End Sem Exam
10	Methods of sewage water treatment	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Role of Methanogenic, Acetogenic and fermentative bacteria in waste water treatment.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Emerging biotechnological approaches in waste - water treatment.	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Solid wastes, origin sources and types	Lecture	BTB 708.4.	Mid Term-1, Quiz & End Sem Exam
14	Solid waste management: Composting, earthworm treatment.	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Solid waste management: Landfills and their impact	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Solid waste management :Recycling and processing of organic residues.	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Xenobiotic compounds: An overview	Lecture	BTB 708.5.	Quiz & End Sem Exam
18	Biodegradation of xenobiotic compounds:	Lecture		Quiz & End Sem Exam
19	Biodegradation of xenobiotic compounds:	Lecture		Quiz & End Sem Exam
20	Microbial Biosurfactants	Lecture		Quiz & End Sem Exam
21	Microbial bio degradation of Oil :	Lecture		Quiz & End Sem Exam

22	Microbial treatment of oil pollution	Lecture		Quiz & End Sem Exam
23	Microbial leaching and mining:	Lecture	BTB 708.6.	Quiz & End Sem Exam

	Extraction of metals from ores.			
24	Microbial leaching and mining: Mechanism and methods	Lecture		Quiz & End Sem Exam
25	Microbial leaching and mining: Mechanism and methods	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Microbes in petroleum extraction;	Lecture		Quiz & End Sem Exam
27	Microbes in petroleum extraction;	Lecture		Quiz & End Sem Exam
28	Microbes in petroleum extraction;	Lecture		Quiz & End Sem Exam
29	Microbial desulfurization of coal.	Lecture		Quiz & End Sem Exam
30	Wasteland: Uses and management,	Lecture	BTB 708.7.	Quiz & End Sem Exam
31	Bioremediation and biorestoration of contaminated lands.	Lecture		Quiz & End Sem Exam
32	Bioremediation and biorestoration of contaminated lands.	Lecture		Quiz & End Sem Exam
33	Environmental genetics: Degradative Plasmids	Lecture	BTB 708.8.	Quiz & End Sem Exam
34	Environmental genetics: GE microbes and environment	Lecture		Quiz & End Sem Exam
35	Hazardous wastes: characteristics and types	Lecture	BTB 708.9.	Quiz & End Sem Exam
36	Hazardous wastes: characteristics and types	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4

BTB 708.1.	Understand Concepts of Ecology and ecosystem.	3	2	2	3	1	-	-	3	-	-	-	3	2	-	1

BTB 708.2.	Understand environmental components and their delicate interrelationship and pollutions.	3	2	2	3	1	-	-	3	-	-	-	3	2	-	1
BTB 708.3.	Learn concepts of waste water treatment using biotechnological interventions.	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.4.	Understand the concept and theory of solid waste disposal methods	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.5.	Understand microbial role in bioremediation of various xenobiotic.	3	2	2	3	1	1	-	3	-	-	-	3	2	-	1
BTB 708.6.	Build up understanding the mechanism of microbial leaching and mining of metals from ores.	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.7.	Understand Wasteland management uses and biorestoration	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.8.	Understand environmental genetics especially release of genetically engineered microbes in environment	3	2	**2**	3	1	2	-	3	-	-	-	3	2	-	1

BTB 708.9.	Understand Hazardous wastes their source ,	3	2	2	1	1	2	-	3	-	-	-	3	2	-	1

	management and safety.															

Sample Question Paper

Amity Institute Biotechnology 2017-18						
Class: B.Tech Biotechnology VII Semester						
Subject Name: ENVIRONMENTAL BIOTECHNOLOGY		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,6	Q.2,4	Q.3,5,7	Q.9,	Q. 8,10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	What is Ecosystem? Briefly point out its vital components.	6
CO2	Q.2	Write a short note on acid rain and its impact on old monuments.	6
	Q.3	Write a short note on vermicomposting. How it is useful in agricultural sustainability?	6
CO4	Q.4	Explain the following terms with suitable example (i) Rhizofilteration (ii) Phytoextraction	6
CO3	Q.5	Write a short note on genetically engineered microbes in bioremediations and their limitations.	6
CO6	Q.6	Give brief description of characteristic features of hazardous wastes.	6
	Q.7	Write explanatory note on main stages of sewage water treatment. How biotehnological interventions offers better solution over conventional approach?	10

CO7	Q.8	microbial enhanced oil recovery (MEOR), briefly explain the microbial products and their e in enhanced petroleum oil extraction. Enlist the key factors affecting MEOR.	10

CO9	Q.9	in-situ bioremediation. Explain the following in context of in-situ bioremediation of land tic Bioagumentation (ii) Biostimulation (iii) Biosparging	10
CO4	Q.10	Explain the following in details a) What is microbial desulfurization of coal? Discuss the methods of coal desulphurization and its beneficial effect on air pollution. b) Discuss the role of microbial enzymes in pesticides and PAHs degradation.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental Biotechnology***/Course code ***BTB 708*** is level **3** for the academic year ***2017-18***.


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MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2017-18

Programme Outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the

knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
VII SEM	BTB 720	3	2	3	3	1	-	-	1	1	-		3	3	-	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOPROCESS TECHNOLOGY LAB
Course Code : BTB 720, Crédits : 01, Session :2017-18 (Odd Sem.), Class : B.Tech. 4th Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in bioprocess technology. The objective of the course is to provide laboratory exposure and hands on experiments to produce large scale cultivation of microorganism, production of important commercial pharmaceutical products through fermentation like., ethanol, enzymes etc.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB 720.1. Isolate and cultivate of industrially important microorganisms for microbial processes.
BTB 720.2. Perform and standardization of fermentation procedure for ethanol production.
BTB 720.3. Produce single cell protein product as well as enzymes.
BTB 720.4. Perform immobilization of enzymes or cells and Sauer Krant fermentation processes.

C. **Programme Outcomes:**

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and

synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class test (practical based)	CT	15%
	Mid term-Viva-Voce	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Isolation of industrially important micro organisms for microbial processes.

Module II: Determination of Thermal Death Point and Thermal death time of micro organisms for design of a sterilizer

Module III: Determination of growth curve of a supplied micro organism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.

Module IV: Comparative studies of ethanol production using different substrates.

Module V : Production of single cell protein

Module VI: Production and estimation of alkaline protease

Module VII: Sauer Krant fermentation

Module VIII: Use of alginate for cell immobilization

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**

Weightage (%)	5	15	10	70

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Bioprocess Engineering Principles, P Doran, Academic Press
- Biotechnology. A Textbook of Industrial Microbiology, W. Crueger and a. Crueger, Sinauer Associates.
- Principles of Fermentation Technology, P.F. Stanbury and A. Whitaker, Pergamon Press
- Process Engineering in Biotechnolgy, A T Jackson , Prentice Hall

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Isolation of industrially important microorganisms for microbial processes.	Practical	BTB 720.1.	Class test Mid Term Viva/ End Sem Exam
2	Determination of Thermal Death Point and Thermal death time of micro organisms for design of a sterilizer	Practical		Class test Mid Term Viva/ End Sem Exam
3	Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.	Practical		Class test Mid Term Viva/ End Sem Exam
4	Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.	Practical		Class test Mid Term Viva/ End Sem Exam

5	Comparative studies of ethanol production using different substrates.	Practical	BTB 720.2.	Class test Mid Term Viva/ End Sem Exam

6	Comparative studies of ethanol production using different substrates.	Practical		Class test Mid Term Viva/ End Sem Exam
7	Comparative studies of ethanol production using different substrates.	Practical		Class test Mid Term Viva/ End Sem Exam
8	Production of single cell protein	Practical	BTB 720.3.	Class test Mid Term Viva/ End Sem Exam
9	Production and estimation of alkaline protease	Practical		Class test Mid Term Viva/ End Sem Exam
10	Sauer Krant fermentation	Practical	BTB 720.4.	Class test Mid Term Viva/ End Sem Exam
11	Use of alginate for cell immobilization	Practical		Class test Mid Term Viva/ End Sem Exam
12	Use of alginate for cell immobilization	Practical		Class test Mid Term Viva/ End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
BTB 720.1.	Isolate and cultivate of industrially important microorganisms for microbial processes.	3	2	3	3	1	-	-	1	1	-		3	3	-	1

BTB 720.2.	Perform and standardization of fermentation procedure for ethanol production.	3	2	3	3	1	-	-	-	-	-		3	3	-	1

BTB 720.3.	Produce single cell protein product as well as enzymes.	3	2	2	3	1	-	-	-	-	-		3	3	-	1
BTB 720.4.	Perform immobilization of enzymes or cells and Sauer Krant fermentation processes.	3	2	3	2	1	-	-	-	-	-		3	3	-	1

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioprocess Lab***/Course code ***BTB 720*** is level **3** for the academic year ***2017-18***.


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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2017-18

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
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[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
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[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

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1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY-I
Course Code : BTB-302 Credits: 03, Session :2021-22 (Odd Sem.), Class : B. Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

B. Course Outcomes: At the end of the course, students will be able to:

BTB302.1. Learn about chemical interactions in biological system.

BTB302.2. Develop the understanding between structure and function of carbohydrates & lipids.

BTB302.3. Learn the concept of metabolism and energy involved in metabolic pathways.

BTB302.4. Understand the metabolic pathways and regulations of carbohydrates metabolism.

BTB302.5. Learn about the digestion, transport, anabolism and catabolism of lipids in the body.

C. Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriateconsideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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norms of engineering practices.
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diverse teams, and in multidisciplinary settings.

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D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction aims and scope

Chemical foundations of Biology -Properties of water, acids, bases and buffers, covalent bonds, Non-covalent interactions in biological systems.

Module II

Introduction to biomolecules - *Carbohydrates* -Sugars; Polysaccharides

Lipids -classification, structure and function. Lipids and biological membranes, Lipid linked proteins and lipoproteins, Atherosclerosis.

Module III

Metabolism and bioenergetics -First and second law, free energy and chemical equilibrium, Organic reaction mechanisms, Design of metabolism-concept of free energy, ATP-ADP cycle. Cellular energy transactions -role of mitochondria and chloroplast

Module IV

Carbohydrate metabolism-glycolysis pathway and reactions, Glycogen breakdown and synthesis, control of glycogen metabolism, glycogen storage and its diseases, Citric acid cycle -Overview, Metabolic sources of Acetyl Co-A, enzymes and regulation, The amphibolic nature of the Citric acid cycle Electron transport chain and oxidative photophosphorylation - mitochondrion and electron transport, phosphorylation and control of ATP production Gluconeogenesis, The glyoxylate pathway, Pentose phosphate pathway

Module V

Lipid metabolism -Lipid digestion, absorption and transport, fatty acid oxidation, ketone bodies, fatty acid biosynthesis, regulation of fatty acid metabolism. Cholesterol and Arachidonic Acid metabolism, Phospholipids, Sphingolipids and Glycolipids

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Harper's Biochemistry, K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw-Hill/Appleton and Lange.
- Biochemistry, L. Stryer, W.H. Freeman and Company
- Tools of Biochemistry, T.G. Cooper, John Wiley and Sons Inc.

References:

- Cellular Biophysics I & II, Thomas F. Weiss 1995, MIT Press
- Biochemical calculations, I.H. Segal. Publisher, John Wiley and Sons
- Biochemistry, C.K. Mathews, K.E. Van Holde and K.G. Ahern, Benjamin / Cummings.
- Devlin's Textbook of Biochemistry with Clinical correlations, John Wiley and Sons Inc.
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox, Worth Publishing

I. **Lecture Plan**

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction aims and scope	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
2	Chemical Foundations of Biology- Properties of water, acids, bases and buffers	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
3	Chemical Foundations of Biology- Properties of water, acids, bases and buffers	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
4	Covalent and Non-covalent interactions in biological systems	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
5	Introduction to biomolecules- Carbohydrates, Sugars, Polysaccharides	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
6	Introduction to biomolecules- Carbohydrates, Sugars, Polysaccharides	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
7	Lipids- Classification, Structure and Function	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
8	Lipids and biological membranes	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
9	Lipid linked proteins and lipoproteins, Atherosclerosis	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
10	Metabolism and bioenergetics- First and Second law	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
11	Free energy and chemical equilibrium	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
12	Organic reaction mechanisms	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
13	Design of metabolism-concept of free energy, ATP-ADP cycle	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
14	Cellular energy transactions- role of mitochondria and chloroplast	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
15	Carbohydrate pathway- glycolysis pathway and reactions	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
16	Glycogen breakdown and synthesis	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
17	Glycogen breakdown and synthesis	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
18	Control of glycogen metabolism, glycogen storage and its diseases	Lecture	BTB302.4	Quiz & End Sem Exam
19	Citric acid cycle-Overview, Metabolic sources of Acetyl Co-A	Lecture	BTB302.4	Quiz & End Sem Exam

20	Enzymes and regulation	Lecture	BTB302.4	Quiz & End Sem Exam
21	Amphibolic nature of the Citric acid cycle	Lecture	BTB302.4	Quiz & End Sem Exam

22	Electron transport chain	Lecture	BTB302.4	Quiz & End Sem Exam
23	Oxidative phosphorylation	Lecture	BTB302.4	Quiz & End Sem Exam
24	Mitochondrion and electron transport	Lecture	BTB302.4	Quiz & End Sem Exam
25	Phosphorylation and control of ATP production	Lecture	BTB302.4	Quiz & End Sem Exam
26	Gluconeogenesis	Lecture	BTB302.4	Quiz & End Sem Exam
27	Glyoxylate pathway	Lecture	BTB302.4	Quiz & End Sem Exam
28	Pentose phosphate pathway	Lecture	BTB302.4	Quiz & End Sem Exam
29	Lipid metabolism- Lipid digestion	Lecture	BTB302.5	Quiz & End Sem Exam
30	Absorption and transport	Lecture	BTB302.5	Quiz & End Sem Exam
31	Fatty acid oxidation, Ketone bodies	Lecture	BTB302.5	Quiz & End Sem Exam
32	Fatty acid biosynthesis	Lecture	BTB302.5	Quiz & End Sem Exam
33	Regulation of fatty acid metabolism	Lecture	BTB302.5	Quiz & End Sem Exam
34	Cholesterol and Arachidonic acid metabolism	Lecture	BTB302.5	Quiz & End Sem Exam
35	Phospholipids, Sphingolipids and Glycolipids	Lecture	BTB302.5	Quiz & End Sem Exam
36	Phospholipids, Sphingolipids and Glycolipids	Lecture	BTB302.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB302.1.	Learn about chemical interactions in biological system.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.2.	Develop the understanding between structure and function of carbohydrates & lipids.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.3.	Learn the concept of metabolism and energy involved in metabolic pathways.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.4.	Understand the metabolic pathways and regulations of carbohydrates metabolism.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.5.	Learn about the digestion, transport, anabolism and catabolism of lipids in the body.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2021-22						
Class: B.Tech. Biotechnology III Semester						
Subject Name: BTB 302 BIOCHEMISTRY-I		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biopolymers with examples.	3
CO1	Q.2a	What do you understand by proton hopping?	3
	Q.2b	How is monosaccharide different from polysaccharide?	3
CO1	Q.3	Give an account of lipid digestion in body.	6
CO2	Q.4	Explain the significance of lipoproteins in clinics.	3
CO2	Q.5a	What are the factors favoring glycogenolysis.	3
	Q.5b	Discuss the different factors affecting fat oxidation.	3
CO2	Q 6	Glycolysis and Gluconeogenesis will never occur simultaneously. Why?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry-I**/Course code **BTB-302** is level **3** for the academic year 2017-18.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2017-18

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR BIOLOGY
Course Code : BTB-304, Credits: 04, Session :2021-22 (Odd Sem.), Class : B.Tech. 2^{nd} Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. Course Outcomes: At the end of the course, students will be able to:

BTB304.1. Learn about the mechanism of replication of DNA in prokaryotes and eukaryotes.

BTB304.2. Learn and compare the mechanism of transcription in prokaryotes and eukaryotes.

BTB304.3. Learn the various post-transcriptional processes in cell.

BTB304.4. Learn about the mechanism of protein synthesis in prokaryotes and eukaryotes.

BTB304.5. Understand about gene expression regulation.

BTB304.6. Understand about various mechanisms of gene silencing.

C. Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriateconsideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: DNA Replication and repair
Nucleic Acid Structure and Functions, Mechanism of Prokaryotic and Eukaryotic DNA replication, Enzymes and accessory proteins involved in DNA replication, DNA repair Mechanism.

Module II: Transcription
Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements.

Module III: Modifications in RNA
5'-cap formation, transcription termination, 3 '-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA and mRNA stability.

Module IV: Translation
Prokaryotic and Eukaryotic translation, the translation Machinery; Mechanisms of initiation, elongation and termination, regulation of translation, co-and post-translational modifications of proteins.

Module V: Regulation of Gene Expression in prokaryotic and eukaryotic systems
Lac operon, Ara operan, regulation in Eukaryotes, Epigenetics.

Module VI: Antisense and Ribozyme technology
Molecular mechanism of antisense molecules, inhibition of spilicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of Ribozyme; Hammerhead, hairpin and other ribozymes, strategies for designing ribozymes, applications of antisense and ribozyme technologies.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education
- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Biology of the Cell. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing
- Gene VIII, Benjamin Lewin 2005, Oxford University Press

References:

- Molecular Cell Biology, H. Lodish, A.Berk, S. Zipursky, P Matsundaira, D.Baltimore and J.E. Barnell, W.H. Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Nucleic Acid Structure and Functions	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
2	Mechanism of Prokaryotic and Eukaryotic DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
3	Mechanism of Prokaryotic and Eukaryotic DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
4	Enzymes and accessory proteins involved in DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
5	Enzymes and accessory proteins involved in DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
6	DNA repair Mechanism	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
7	DNA repair Mechanism	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
8	Tutorial	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
9	Prokaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
10	Prokaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
11	Eukaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
12	Eukaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
13	RNA polymerase	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
14	General and specific transcription factors	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
15	Regulatory elements	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
16	Tutorial	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
17	5'-cap formation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
18	transcription termination	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
19	3'-end processing and polyadenylation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
20	3'-end processing and polyadenylation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
21	Splicing, Editing	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam

22	Nuclear export of mRNA and mRNA stability	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
23	Tutorial	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam

24	Prokaryotic and Eukaryotic translation	Lecture	BTB304.4	Mid Term, Quiz & End Sem Exam
25	Prokaryotic and Eukaryotic translation	Lecture	BTB304.4	Quiz & End Sem Exam
26	the translation Machinery	Lecture	BTB304.4	Quiz & End Sem Exam
27	Mechanisms of initiation	Lecture	BTB304.4	Quiz & End Sem Exam
28	elongation and termination	Lecture	BTB304.4	Quiz & End Sem Exam
29	regulation of translation	Lecture	BTB304.4	Quiz & End Sem Exam
30	co-and post-translational modifications of proteins	Lecture	BTB304.4	Quiz & End Sem Exam
31	Tutorial	Lecture	BTB304.4	Quiz & End Sem Exam
32	Lac operon	Lecture	BTB304.5	Quiz & End Sem Exam
33	Ara operon	Lecture	BTB304.5	Quiz & End Sem Exam
34	regulation in Eukaryotes	Lecture	BTB304.5	Quiz & End Sem Exam
35	Epigenetics	Lecture	BTB304.5	Quiz & End Sem Exam
36	Tutorial	Lecture	BTB304.5	Quiz & End Sem Exam
37	Molecular mechanism of antisense molecules	Lecture	BTB304.6	Quiz & End Sem Exam
38	Molecular mechanism of antisense molecules	Lecture	BTB304.6	Quiz & End Sem Exam
39	inhibition of spilicing, polyadenylation and translation	Lecture	BTB304.6	Quiz & End Sem Exam
40	disruption of RNA structure and capping	Lecture	BTB304.6	Quiz & End Sem Exam
41	Biochemistry of Ribozyme	Lecture	BTB304.6	Quiz & End Sem Exam
42	Hammerhead, hairpin and other ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
43	Hammerhead, hairpin and other ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
44	strategies for designing ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
45	applications of antisense	Lecture	BTB304.6	Quiz & End Sem Exam
46	ribozyme technologies	Lecture	BTB304.6	Quiz & End Sem Exam

47	Applications of ribozyme technologies	Lecture	BTB304.6	Quiz & End Sem Exam
48	Tutorial	Lecture	BTB304.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB304.1.	Learn about the mechanism of replication of DNA in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.2.	Learn and compare the mechanism of transcription in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.3.	Learn the various post-transcriptional processes in cell.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.4.	Learn about the mechanism of protein synthesis in prokaryotes and eukaryotes	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.5.	Understand about gene expression regulation.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.6.	Understand about various mechanisms of gene silencing.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2021-22						
Class: B.Tech. Biotechnology III Semester						
Subject Name: BTB 304 MOLECULAR BIOLOGY		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the nucleic acids with examples.	3
CO1	Q.2	What do you understand by semi discontinuous replication of DNA?	6
CO1	Q.3	Give an account of RNA synthesis in *E. coli*.	6
CO2	Q.4	Explain the significance of 5’-capping in RNA.	3
CO2	Q.5a	How does tRNA bring amino acid to ribosome for protein synthesis?	3
	Q.5b	Discuss the different mechanisms of gene silencing.	3
CO2	Q 6	How does cell ensure the correct incorporation of amino acids in translation?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology**/Course code **BTB-304** is level **2** for the academic year 2017-18.

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2017-18

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	3	3	3	3	-	1	2	2	2	3	1	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR BIOLOGY LAB
Course Code : BTB-323, Credits: 01, Session :2021-22 (Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB323.1. Practical based understanding of preparation of genomic and plasmid DNA.

BTB323.2. Practical based understanding of isolation of RNA.

BTB323.3. Practical based understanding of RFLP analysis.

BTB323.4. Practical based understanding of gel filtration.

BTB323.5. Practical based understanding of Preparation of Competent Cells.

BTB323.6. Practical based understanding of Restriction Digestion and Ligation of DNA.

C. **Programme Outcomes:**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriateconsideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

F. Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Preparation of DNA: genomic, Plasmid

Module II

Isolation of RNA

Module III
RFLP analysis
Module IV
Gel filtration
Module V
Preparation of Competent Cells
Module VI
Restriction Digestion and Ligation of DNA

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:
Text:
- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:
Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

I. Lecture Plan

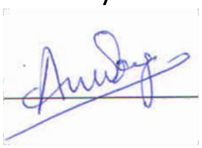
Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Preparation of DNA: genomic, Plasmid	Practical	BTB323.1	Class Test (Practical Based) & End Sem Exam
2	Preparation of DNA: genomic, Plasmid	Practical	BTB323.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of RNA	Practical	BTB323.2	Class Test (Practical Based) & End Sem Exam
4	Isolation of RNA	Practical	BTB323.2	Class Test (Practical Based) & End Sem Exam
5	RFLP analysis	Practical	BTB323.3	Class Test (Practical Based) & End Sem Exam
6	RFLP analysis	Practical	BTB323.3	Class Test (Practical Based) & End Sem Exam
7	Gel filtration	Practical	BTB323.4	Class Test (Practical Based) & End Sem Exam
8	Gel filtration	Practical	BTB323.4	Class Test (Practical Based) & End Sem Exam
9	Preparation of Competent Cells	Practical	BTB323.5	Class Test (Practical Based) & End Sem Exam
10	Preparation of Competent Cells	Practical	BTB323.5	Class Test (Practical Based) & End Sem Exam
11	Restriction Digestion and Ligation of DNA	Practical	BTB323.6	Class Test (Practical Based) & End Sem Exam
12	Restriction Digestion and Ligation of DNA	Practical	BTB323.6	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB323.1.	Practical based understanding of preparation of genomic and plasmid DNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.2.	Practical based understanding of isolation of RNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.3.	Practical based understanding of RFLP analysis.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.4.	Practical based understanding of gel filtration.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.5.	Practical based understanding of Preparation of Competent Cells.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.6.	Practical based understanding of Restriction Digestion and Ligation of DNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology Lab**/Course code **BTB-323** is level **3** for the academic year 2017-18.



AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2017-18

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
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Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

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PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY - II
Course Code : BTB-401, Credits : 04, Session :2021-22 (Even Sem.), Class : B. Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB401.1. Understand relationships between structure and functions Amino acids and Proteins and the concept of Enzymes, their mode of action and regulation.

BTB401.2. Understand the structure and properties of Nucleic acids – DNA and RNA.

BTB401.3. Learn and understand the amino acid metabolism.

BTB401.4. Understand the metabolism of purines and pyrimidines in the body.

C. **Programme Outcomes:**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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D. Programme Specific Outcomes:

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PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Proteins -Amino acids and peptides - classification, chemical reactions and physical properties. Introduction to protein structure and function. Cis-trans peptide bond formation. Glycoproteins -structure and function, *Vitamins and Coenzymes*: structure and function of water soluble vitamins.

Enzymes -Introduction to kinetic and catalytic mechanisms of enzymes; Regulation of enzyme activity; Effects of physical parameters on enzyme activity, enzyme inhibitors – types of inhibition.

Module II

Nucleic acids - nitrogenous bases, nucleotides, types, structure and properties of nucleic acids

Module III

Amino acid metabolism -Amino acid deamination, urea cycle, biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine,
Tyrosine. Specialized Products of Amino Acids, Nitrogen fixation

Module IV

Nucleotide Metabolism -structure and metabolism of purines and pyrimidines, biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN; Catabolism of heam and clinical significance of bilirubin.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Harper's Biochemistry, K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw-Hill/Appleton and Lange.
- Biochemistry, L. Stryer, W.H. Freeman and Company
- Tools of Biochemistry, T.G. Cooper, John Wiley and Sons Inc.

References:

- Cellular Biophysics I & II, Thomas F. Weiss 1995, MIT Press
- Biochemical calculations, I.H. Segal. Publisher, John Wiley and Sons
- Biochemistry, C.K. Mathews, K.E. Van Holde and K.G. Ahern, Benjamin / Cummings.
- Devlin's Textbook of Biochemistry with Clinical correlations, John Wiley and Sons Inc.
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox, Worth Publishing

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
2	Proteins - Amino acids and peptides - classification	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
3	Proteins - Amino acids and peptides - classification	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
4	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
5	Chemical reactions and physical properties	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
6	Introduction to protein structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
7	Introduction to protein structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
8	Glycoproteins -structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
9	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
10	Vitamins and Coenzymes: structure and function of water soluble vitamins	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
11	Vitamins and Coenzymes: structure and function of water soluble vitamins	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
12	Enzymes - Introduction to kinetic mechanisms of enzymes	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
13	Catalytic mechanisms of enzymes	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
14	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
15	Regulation of enzyme activity	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
16	Effects of physical parameters on enzyme activity	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
17	Enzyme inhibitors – types of inhibition.	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
18	Enzyme inhibitors – types of inhibition.	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
19	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
20	Nucleic acids - nitrogenous bases	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam

21	Nucleotides, types, structure and properties of nucleic acids	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam
22	Nucleotides, types, structure and properties of nucleic acids	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam

23	Amino acid metabolism - Amino acid deamination	Lecture	BTB401.3	Mid Term, Quiz & End Sem Exam
24	TUTORIAL	Lecture	BTB401.3	Mid Term, Quiz & End Sem Exam
25	Urea cycle	Lecture	BTB401.3	Quiz & End Sem Exam
26	Urea cycle	Lecture	BTB401.3	Quiz & End Sem Exam
27	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
28	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
29	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
30	Tutorial	Lecture	BTB401.3	Quiz & End Sem Exam
31	Specialized Products of Amino Acids	Lecture	BTB401.3	Quiz & End Sem Exam
32	Specialized Products of Amino Acids	Lecture	BTB401.3	Quiz & End Sem Exam
33	Nitrogen fixation	Lecture	BTB401.3	Quiz & End Sem Exam
34	Nitrogen fixation	Lecture	BTB401.3	Quiz & End Sem Exam
35	TUTORIAL	Lecture	BTB401.3	Quiz & End Sem Exam
36	Nucleotide Metabolism -structure of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
37	Nucleotide Metabolism -structure of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
38	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
39	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
40	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
41	Biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN)	Lecture	BTB401.4	Quiz & End Sem Exam

42	Biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN)	Lecture	BTB401.4	Quiz & End Sem Exam
43	Biosynthesis of nucleotide	Lecture	BTB401.4	Quiz & End Sem

	coenzymes (NAD, NADP, FAD, FMN)			Exam
44	TUTORIAL	Lecture	BTB401.4	Quiz & End Sem Exam
45	Catabolism of heam	Lecture	BTB401.4	Quiz & End Sem Exam
46	Catabolism of heam	Lecture	BTB401.4	Quiz & End Sem Exam
47	Clinical significance of bilirubin	Lecture	BTB401.4	Quiz & End Sem Exam
48	Clinical significance of bilirubin	Lecture	BTB401.4	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB401.1.	Understand relationships between structure and functions Amino acids and Proteins and the concept of Enzymes, their mode of action and regulation.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.2.	Understand the structure and properties of Nucleic acids – DNA and RNA.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.3.	Learn and understand the amino acid metabolism.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.4.	Understand the metabolism of purines and pyrimidines in the body.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –IV) 2021-22						
Class: B.Tech. Biotechnology IV Semester						
Subject Name: BTB 401 BIOCHEMISTRY-II		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the amino acids with examples.	3
CO1	Q.2	What do you understand by enzyme kinetics?	6
CO1	Q.3	Give an account of biochemistry of glycoproteins.	6
CO2	Q.4	Explain the significance of peptide bond.	3
CO2	Q.5a	How does inhibitors work against enzymes?	3
	Q.5b	Discuss the importance of SGOT and SGPT in liver and kidney function tests.	3
CO2	Q 6	Discuss the importance of mis regulation in nucleic acid metabolism.	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry-II**/Course code **BTB-401** is level **3** for the academic year 2017-18.

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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2017-18

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PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

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Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	3	3	3	3	-	1	2	2	2	3	1	2

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY LAB-II
Course Code : BTB-420, Credits: 01, Session :2021-22 (Even Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend understanding of the qualitative and quantitative estimation of proteins and nucleic acids.

B. **Course Outcomes:** At the end of the course, students will be able to:
BTB420.1. Practical based understanding of qualitative and quantitative tests of protein and amino acids.
BTB420.2. Practical based understanding of qualitative and quantitative tests of DNA and RNA.

C. **Programme Outcomes:**
[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriateconsideration for the public health and safety, and the cultural, societal, and environmental considerations.
[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
[PO.6]. **The engineer and society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.
[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

F. Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Colour reactions of proteins (Ninhydrin test, Biuret test, Xanthoprotein test).
Estimation of proteins.
Module II
Biochemical estimation of DNA
Biochemical estimation of RNA
Quantitative determination of DNA and RNA by spectrophotometric method using UV range.
Determination of melting temperature of DNA from thermal denaturation characteristics.

G. Examination Scheme:

IA			**EE**			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:
Text:
- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Ninhydrin test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Xanthoprotein test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
4	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
5	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
6	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
7	Biochemical estimation of DNA	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
8	Biochemical estimation of RNA	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
9	Quantitative determination of DNA and RNA by spectrophotometric method using UV range	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
10	Quantitative determination of DNA and RNA by spectrophotometric method using UV range	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
11	Determination of melting temperature of DNA from thermal denaturation characteristics	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
12	Determination of melting temperature of DNA from thermal denaturation characteristics	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB420.1.	Practical based understanding of qualitative and quantitative tests of protein and amino acids.	3	3	3	3	-	1	2	-	2	2	**-**	**2**	3	3	1	-
BTB420.2.	Practical based understanding of qualitative and quantitative tests of DNA and RNA.	3	3	3	3	-	1	2	-	2	2	**-**	**2**	3	3	1	-

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry lab-II**/Course code **BTB-420** is level **3** for the academic year 2017-18.

AMITY INSTITUTE OF BIOTECHNOLOGY

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AMITY UNIVERSITY
MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED GENOMICS & PROTEOMICS
Course Code : MSB 204, Crédits : 04, Session :2017-18(Even Sem.), Class : M.Sc. Ist Year
Faculty Name : Dr. MANISH KUMAR

A. **Introduction:** The course helps in developing a detailed understanding of eukaryotic genome complexity and organization. Current research on the molecular basis of the control of gene expression in eukaryotic has developed a detailed understanding of techniques of gene diagnostics and DNA profile to acquire the fundamental of genomics and bioinformatics, it is desirable to have in depth study on these lines.

B. **Course Outcomes:** At the end of the course, students will be able to:
MSB204.1 Understand the basic of genomics, Anatomy of genomics and human genome project
MSB204.2 Able to understand gene expression, and mapping
MSB204.3 Learn different DNA markers
MSB204.4 Understand Microarray and their applications in analysis of gene expression
MSB204.5 Develop knowledge of fundamental techniques in proteomics.
MSB204.6 Understand Post translational modification.
MSB204.7 Get detail knowledge and understanding of Protein – protein interaction.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technologicalchange.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction to Genomics: The human genome project "Anatomy of prokaryotic and eucaryotic genome: repetitive DNA and RNA Contents of genomes.

Module II
Transcriptomics and meta-transcriptomics: Introduction, method and uses. Genetic mapping

Module III

Microsatellite DNA markers, RFLP, DNA sequencing, Phylogeny

Module IV
Micro array: DNA micro array marker, computational methods.

PART-II: PROTEOMICS

Module V
Introduction to proteomics
Fundamental methods used in proteomics. 2-D gel electrophoresis + mass spectroscopy.

Module VI
Post translational protein modification

Module VII
Protein – protein interaction some examples

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Genes & Genomes, Maxine Singer and Paul Berg
- Genomes II, T.A. Brown

***References*:**

- A Primer of Genome Science, Greg Gibson and Spencer V. Muse
- Database Annotation in Molecular Biology: Principles and Practice, Arthur M. Lesk
- DNA: Structure and Function, Richard R. Sinden
- Recombinant DNA (Second Edition), James D. Watson and Mark Zoller
- Gene Cloning and DNA Analysis – An introduction (Fourth Edition), T.A. Brown
- www.panimatext.com

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
2	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
3	Human Genome project	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem

				Exam
4	Human Genome project	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem

				Exam
5	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
6	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
7	repetitive DNA and RNA Contents of genomes	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
8	repetitive DNA and RNA Contents of genomes	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
9	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
10	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
11	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
12	Introduction, method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
13	Introduction, method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
14	Introduction, method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
15	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
16	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
17	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
18	RFLP	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
19	RFLP	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
20	DNA sequencing, polyogemy	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
21	DNA sequencing,	Lecture	MSB204.	Mid Term-1,

	polyogemy		3	Quiz & End Sem Exam
22	DNA sequencing,	Lecture	MSB204.	Mid Term-1,

	polyogemy procedure		3	Quiz & End Sem Exam
23	DNA sequencing, polyogemy	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
24	Micro array	Lecture	MSB204. 4	Quiz & End Sem Exam
25	Micro array	Lecture	MSB204. 4	Quiz & End Sem Exam
26	Micro array	Lecture	MSB204. 4	Quiz & End Sem Exam
27	DNA micro array marker, computational methods	Lecture	MSB204. 4	Quiz & End Sem Exam
28	DNA micro array marker, computational methods	Lecture	MSB204. 4	Quiz & End Sem Exam
29	DNA micro array marker, computational methods	Lecture	MSB204. 4	Quiz & End Sem Exam
30	Introduction to proteomics	Lecture	MSB204. 5	Quiz & End Sem Exam
31	Introduction to proteomics	Lecture	MSB204. 5	Quiz & End Sem Exam
32	Fundamental methods used in proteomics	Lecture	MSB204. 5	Quiz & End Sem Exam
33	Fundamental methods used in proteomics	Lecture	MSB204. 5	Quiz & End Sem Exam
34	Fundamental methods used in proteomics	Lecture	MSB204. 5	Quiz & End Sem Exam
35	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204. 5	Quiz & End Sem Exam
36	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204. 5	Quiz & End Sem Exam
37	2-D gel electrophoresis + mass spectroscopy 2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204. 5	Quiz & End Sem Exam
38	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204. 5	Quiz & End Sem Exam
39	Post translational protein modification	Lecture	MSB204. 6	Quiz & End Sem Exam
40	Post translational protein modification	Lecture	MSB204. 6	Quiz & End Sem Exam
41	Post translational protein modification	Lecture	MSB204. 6	Quiz & End Sem Exam
42	Post translational protein modification	Lecture	MSB204. 6	Quiz & End Sem Exam
43	Protein – protein interaction some examples	Lecture	MSB204. 7	Quiz & End Sem Exam
44	Protein – protein interaction some examples	Lecture	MSB204. 7	Quiz & End Sem Exam

45	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
46	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam

47	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
48	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB204.1	Understand the basic of genomics, Anatomy of genomics and human genome project	3	3	1	3	1	1	1	-	2	1	3	1	-	1
MSB204.2	Able to understand gene expression, and mapping	3	3	**2**	3	1	-	-	-	2	1	3	1	-	1
MSB204.3	Learn different DNA markers	3	3	2	3	1	-	-	1	2	1	3	1	1	1
MSB204.4	Understand Microarray and their applications in analysis of gene expression	3	3	1	3	1	-	-	-	2	1	3	1	-	1
MSB204.5	Develop knowledge of fundamental techniques in proteomics.	3	3	1	3	1	-	-	-	2	1	3	1	-	1
MSB204.6	Understand Post translational modification.	3	3	1	3	1	-	-	-	2	1	3	1	1	1
MSB204.7	Get detail knowledge and understanding of Protein – protein interaction.	3	3	1	3	1	-	-	-	2	1	3	1	1	1

Amity Institute of Biotechnology
I MID-SEMESTER (SEM –II) 2017-18

Class: M.Sc Biotechnology II Semester

Subject Name: MSB 204 Advanced Genomics & Proteomics	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

Student will be able to
CO1: Understand the basics of genomics, Anatomy of genomics and human genome project.
CO2: understand gene expression, and mapping.

CO Map	Question No.	Question	Marks
CO1	Q.1	Differentiate between genomics and proteomics.	3
CO1	Q.2a	Discuss the separation processes in genomics.	3
	Q.2b	Discuss the separation processes in proteomics.	3
CO1	Q.3	Discuss physical mapping and use of restriction enzymes.	6
CO2	Q.4	Discuss linkage mapping with suitable example.	3
CO2	Q.5a	Write a short note on phylogeny.	3
	Q.5b	How genomic study is useful in the identification of genomes?	3
CO2	Q 6	Discuss the role of recombination and recombinants in the linkage mapping.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Genomics & Proteomics/MSB 204** is **level 3** for the academic year 2017-18.

Manish Kr


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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **COMPUTATIONAL BIOLOGY**
Course Code : MSB 205, Crédits : 03, Session :2017-18(Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. Introduction: The objective is to describe how molecular data can be used to construct a phylogenetic tree and characterize the rates and causes of nucleotide substitutions. The aim is also to explain how a gene/protein family arises and the mechanisms, which underlie evolutionat the molecular level.

B. Course Outcomes: After successful completion of the course student will be able to:

MSB 205.1 Understand and explain the development of computational biology.
MSB 205.2 Describe the fundamentals of bioinformatics databases and their application
MSB 205.3 Understand and explain the use of various computational methods for phylogenetic studies
MSB 205.4 Know the Use and apply the knowledge of different software and programs for sequence comparison, molecular modelling. Explain the applications of computational biology in different fields of sciences.

C. Program Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%

Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%

End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction to Computational Biology. History of Bioinformatics
Module II: Bioinformatics Fundamentals

1. Major information Resources & Databases in Bioinformatics
 a. Information Resources: NCBI, EBI, ExPasy Entrez & SRS System
 b. Primary Sequence & Structure Databases: Genbank, SwissProt/Uniprot, EMBL, PIR, PDB, MMDB, NDB, CSD, KEGG etc.
 c. Derived (Secondary) Databases of Sequences and structure:
  i. Prosite, PRODOM, PRINTS, Pfam, BLOCK, INTERPRO etc.
  ii. SCOP, CATH, DSSP, FSSP, RNAbase,
 d. Genome Databases (at NCBI, EBI, TIGR, SANGER), High-throughput genomics sequence (EST, STS, GSS), ENSEMBL.
2. Sequence File formats: fasta, genbank, embl, Swiss-prot, pdb, nbrf, pir and multiple sequences formats (Aln, Mega, Pileup, phylip etc.)
3. Sequence Similarity Basics: Similarity, Identity, Homology, Scoring, selectivity/Sensitivity, Gap cost, Linear and Affine Gap Penalty, Basic of scoring system and matrices (PAM, BIOSUM, GONNET etc.)
4. Pairwise Sequences Alignment: Brute Force method, Dot matrix method, Global (Needleman-Wunsch) and Local Alignment (Smith-Waterman) using Dynamic programming.
5. Scoring Matrices: Substitution Matrices, Concept log-odds, PAM & BLOSUM Series, Derivation of PAM & BLOSUM matrices, Distance and Similarity matrices.
6. Similarity Searching Tools: BLAST and FASTA, Theory and Algorithms, variants of BLAST and FASTA, PSI-BLAST and PHI BLAST, Statistical Significance.
7. Sequence Pattern and Profiles: Concepts of motif, pattern and profile, Profileconstruction and its application in Bioinformatics,

Module III: Computational Methods
Scoring methods of MSA (sum of pair, Multidimensional DP, Progressive, Iterative,Probabilistic)
Phylogenetics prediction methods: Basics, molecular clock, Substitution Models of evolution, Tree reconstruction methods (Distance based, character based method, statistical),Bootstrapping.
Suffix tree and its applications in Bioinformatics
Gene Identification Methods
Predictive Methods using DNA and Protein sequences.
Statistical Modeling: Log-likelihood, Bayesian network, Markov and hidden markov models.
Clustering Algorithms: K-means, Hierarchical and Mixture of Gaussion.

Module IV: Application and software tools
Software and Programmes for sequence comparison and analysis.
Phylogenetics analysis software.
Molecular Structure drawing tool.
Molecular modeling/Docking.
Application of computational biology/Bioinformatics in Agriculture, Human health,Environment, Biotechnology, Molecular Biology, Neurobiology, Drug Designing, Veterinary Science.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

• Bioinformatics: Sequence and Genome Analysis, D.W. Mount, Cold Spring Harbor Laboratory Press.

References:

• Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology, D. Gusfield, Cambridge University Press.
• Biocomputing hypertext coursebook at http://www.techfak.unibielefeld.de/bcd/Curric/welcome.html/
• Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, A.D. Baxevanis and B.F.F. Ouellette, Wiley-interscience.
• Computational Modeling of Genetic and Biochemical Networks, J.M. Bower and H. Bolouri, MIT Press
• Computational Molecular Biology: An Algorithmic Approach, P.A. Pevzner, MIT Press
• Computer Methods for Macromolecular Sequence Analysis, R.F. Doolittle, J.N, Abelson, M.I. Simon, Academic press
• Essentials of Genomics and Bioinformatics, C.W. Sensen, John Wiley and Sons Inc.
• Introduction to Bioinformatics, T. Attwood and D. Parry-Smith, Prentice Hall
• Introduction to Computational Biology: Maps, Sequences and Genomes, M. Waterman, Chapman and Hall
• Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit, G. V. Heijne and G.V. Heijne, Academic Press

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing CO**
1	Introduction to computational Biology & History of Bioinformatics	Lecture	**MSB 205.1**	Mid Term-1, Quiz & End Sem Exam
2	Major information Resources & Databases in Bioinformatics (a & b)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
3	Major information Resources & Databases in Bioinformatics (c & d)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
4	Sequence File formats & Multiple sequence formats	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
5	Sequence Similarity Basics	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
6	Basic of scoring system and matrices	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
7	Pairwise Sequences Alignment	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam

8	Local Alignment	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
9	Scoring Matrices	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam

10	Similarity Searching Tools (BLAST)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
11	Similarity Searching Tools (FASTA)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
12	Sequence Pattern and Profiles	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
13	Scoring methods of MSA	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
14	Phylogenetics prediction methods	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
15	Gene Identification Methods Predictive Methods using DNA and Protein sequences.	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
16	Statistical Modeling: Log-likelihood, Bayesian network, Markov	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
17	Hidden markov models	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
18	Clustering Algorithms: K-means, Hierarchical and Mixture of Gaussion	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
19	Software and Programmes for sequence comparison and analysis	Lecture	**MSB 205.4**	Mid Term-1, Quiz & End Sem Exam
20	Phylogenetics analysis software (I)	Lecture	**MSB 205.4**	Mid Term-1, Quiz & End Sem Exam
21	Molecular Structure drawing tool (I)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
22	Molecular Structure drawing tool (II)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
23	Molecular modeling/Docking (I)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
24	Molecular modeling/Docking (II)	Lecture	**MSB 205.4**	Quiz & End Sem Exam
25	Application of computational biology/Bioinformatics in Agriculture	Lecture	**MSB 205.4**	Quiz & End Sem Exam
26	Application of computational biology/Bioinformatics in Human health	Lecture	**MSB 205.4**	Quiz & End Sem Exam

27	Application of computational biology/Bioinformatics in Human health	Lecture	**MSB 205.4**	Quiz & End Sem Exam
28	Application of computational biology/Bioinformatics in	Lecture	**MSB 205.4**	Quiz & End Sem Exam

	Environment			
29	Application of computational biology/Bioinformatics in Environment	Lecture	**MSB 205.4**	Quiz & End Sem Exam
30	Application of computational biology/Bioinformatics in Neurobiology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
31	Application of computational biology/Bioinformatics in Neurobiology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
32	Application of computational biology/Bioinformatics in molecular Biology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
33	Application of computational biology/Bioinformatics in molecular Biology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
34	Application of computational biology/Bioinformatics in Drug Designing	Lecture	**MSB 205.4**	Quiz & End Sem Exam
35	Application of computational biology/Bioinformatics in Drug Designing	Lecture	**MSB 205.4**	Quiz & End Sem Exam
36	Application of computational biology/Bioinformatics in Veterinary Science	Lecture	**MSB 205.4**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 205.1	Understand and explain the development of computational biology	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.2	Describe the fundamentals of bioinformatics databases and their application	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.3	Understand and explain the use of various computational methods for phylogenetic studies	3	3	3	1	1	-	-	1	2	1	3	1	3	1

MSB 205.3	Know the Use and apply the knowledge of different software and programs for sequence comparison, molecular modelling.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

	Explain the applications of computational biology in different fields of sciences														

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
MID-SEMESTER 2017-18</td></tr>
<tr><td colspan="7">Class: M.Sc. (Biotech) II Semester</td></tr>
<tr><td colspan="2">Subject Name:
MSB 205
Computational Biology</td><td colspan="3">Time: 2 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q. 1,4</td><td>Q. 2,3</td><td>Q. 4</td><td>Q. 2,5,6</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to
CO1: Understand the broad perspective of computational biology in sequence analysis.
CO2: Utilize the types of molecular and literature databases
(HGT, ESTs, SNPs, Pubmed, Pubmed Central).</td></tr>
</table>

<table>
<tr><th>CO Map</th><th>Question No.</th><th>Question</th><th>Marks</th></tr>
<tr><td>CO1</td><td>Q.1</td><td>Explain in brief the fundamentals of computational biology.</td><td>3</td></tr>
<tr><td rowspan="2">CO1</td><td>Q.2a</td><td>What are different literature databases?</td><td>3</td></tr>
<tr><td>Q.2b</td><td>How literature databases are different from molecular databases.</td><td>3</td></tr>
<tr><td>CO1</td><td>Q.3</td><td>How nucleotide and protein data can be analyzed using database model?</td><td>6</td></tr>
<tr><td>CO2</td><td>Q.4</td><td>Explain the application of computational biology in disease diagnosis and treatment.</td><td>3</td></tr>
</table>

Attainments	**Rubric**

Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2

Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Computational Biology/MSB 205** is **level 3** for the academic year 2017-18.


AMITY INSTITUTE OF BIOTECHNOLOGY
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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M.Sc.) BT, Academic Year – 2017-18

M.Sc Biotechnology (Four Semesters)

Programme Outcomes:

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
II SEM	**MSB 206**	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**3**	**1**	**-**	**1**

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL BIOTECHNOLOGY
Course Code : MSB 206, Crédits : 03, Session :2017-18 (Odd Sem.), Class : M.Sc.. 1st Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques used in *Environmental* biotechnology. To introduce the students to regenerate clean environment using biotechnology as the key tool and provide them the insight for eco-friendly approach along with the concept of sustainable development.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB 206.1. Understand concept of climate change, pollution and mitigation approaches.
MSB 206.2. Understand concept of energy sustainability, clean fuel technology, Biomass energy and biofuels.
MSB 206.3. Understand concept of Biodegradation, Bioremediation and Phytoremediation. Advances in bioleaching and biomineralization.
MSB 206.4. Understand Advanced waste water treatments.
MSB 206.5. Understand Agriculture Sustainability and Clean agricultural practices, Biosensors and biomarkers, Principles of ecotoxicity
MSB 206.6. Understand the Environmental impact assessment and Environmental audit, Related case studies from India.

C. **Programme Outcomes:**
M.Sc Biotechnology (Four Semesters)

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%

Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Environmental pollution and its major impacts on human beings, plants, animals and climate, concept of Global warming and climate change, Global Ozone Problem, Eutrophication, Land degradation, Biomagnification.

Module II

Non-renewable and renewable energy resources, concept of clean fuel technology, Biomass energy and biofuels

Module III

Biodegradation, Bioremediation and Phytoremediation of major pollutants (PAH, Pesticides etc), Use of microbial technology for mining of metals (Bioleaching) and Concept of Biomineralisation.

Module IV

Waste water engineering: physicochemical characteristic of water, waste water treatment of municipal wastes and industrial effluents with special focus on use of biological methods, Advanced waste water treatments

Module V

Bioassessment of environmental quality: Biosensors and biomarkers, Principles of ecotoxicity.
Agriculture Sustainability and Clean agricultural practices: Biofertilizers, Biopesticides and vermi composting

Module VI

Environmental impact assessment and Environmental audit, Related case studies from India.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Environmental Science, S.C. Santra
- Environmental Biotechnology, Pradipta Kumar Mohapatra
- Environmental Biotechnology – Concepts and Applications" by Hans-Joachim Jordening and Jesef Winter

- Waste Water Engineering by Metcalf and Eddy. Publisher: Tata McGraw hill
- Environmental Microbiology: Methods and Protocols by Alicia L. Ragout De Spencer, John F.T. Spencer
- Introduction to Environmental Biotechnology by Milton Wainwright
- Principles of Environmental Engineering by Gilbert Masters

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Environmental pollution and its major impacts	Lecture	MSB 206.1.	Mid Term-1, Quiz & End Sem Exam
2	Environmental pollution and its major impacts	Lecture		Mid Term-1, Quiz & End Sem Exam
3	concept of Global warming and climate change,	Lecture		Mid Term-1, Quiz & End Sem Exam
4	concept of Global warming and climate change,	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Global Ozone Problem,	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Eutrophication,	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Land degradation, Biomagnification.	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Non-renewable energy resources,	Lecture	MSB 206.2.	Mid Term-1, Quiz & End Sem Exam
9	Non-renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
12	concept of clean fuel technology,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture	MSB 206.3.	Quiz & End Sem Exam
16	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture		Quiz & End Sem Exam
17	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture		Mid Term-1, Quiz & End Sem Exam

18	Microbial technology for mining of metals (Bioleaching)	Lecture		Quiz & End Sem Exam

19	Microbial technology for mining of metals (Bioleaching)	Lecture		Quiz & End Sem Exam
20	Concept of Biomineralisation.	Lecture		Quiz & End Sem Exam
21	Waste water engineering: physicochemical characteristic of water,	Lecture	MSB 206.4.	Quiz & End Sem Exam
22	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
23	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
24	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
25	Advanced waste water treatments	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Bioassessment of environmental quality: Biosensors and biomarkers,	Lecture	MSB 206.5.	Quiz & End Sem Exam
27	Bioassessment of environmental quality: Biosensors and biomarkers,	Lecture		Quiz & End Sem Exam
28	Bioassessment of environmental quality: Principles of ecotoxicity.	Lecture		Quiz & End Sem Exam
29	Agriculture Sustainability and Clean agricultural practices:	Lecture		Quiz & End Sem Exam
30	Biofertilizers,	Lecture		Quiz & End Sem Exam
31	Biopesticides	Lecture		Quiz & End Sem Exam
32	Vermi composting	Lecture		Quiz & End Sem Exam
33	Environmental impact assessment	Lecture	MSB 206.6.	Quiz & End Sem Exam
34	Environmental impact assessment	Lecture		Quiz & End Sem Exam
35	Environmental audit,	Lecture		Quiz & End Sem Exam

36	Environmental audit,	Lecture		Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
MSB 206.1.	Understand concept of climate change, pollution and mitigation approaches.	3	2	2	-	-	1	-	3	1	-	-	3	1	-	1
MSB 206.2.	Understand concept of energy sustainability, clean fuel technology, Biomass energy and biofuels.	3	2	1	-	-	1	-	3	1	-	-	3	1	-	1
MSB 206.3.	Understand concept of Biodegradation, Bioremediation and Phytoremediation. Advances in bioleaching and biomineralization.	3	-	1	1	-	1	-	3	1	-	-	3	1	-	1
MSB 206.4.	Understand Advanced waste water treatments.	3	-	1	1	-	1	-	3	1	-	-	3	1	-	1

MSB 206.5.	Understand Agriculture Sustainability and Clean agricultural practices, Biosensors and biomarkers, Principles of ecotoxicity	3	1	2	1	-	1	-	3	1	-	-	3	1	-	1

	Understand the Environmental impact assessment and Environmental audit, Related case studies from India.															

Sample Question Paper

Amity Institute Biotechnology 2017-18						
Class: M.Sc.Biotechnology II Semester						
Subject Name: ENVIRONMENTAL BIOTECHNOLOGY		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,6	Q.2, 3, 7	Q.5,10	Q. 4, 8,	Q. 9,	
Student will be able to:						

CO Map	Question No.	Questi on	Marks
CO1	Q.1	Briefly explain the following (i) Activated sludge (ii) Biomethanation.	6
CO1	Q.2	Write a short note on different tools of conducting EIA.	6
	Q.3	Define clean fuels and their advantages? How they differ from fossil fuels?	6
CO2	Q.4	Write a short note on the problems associated with prolonged and indiscriminate use of chemical fertilizers and pesticides in present agriculture system.	6

CO5	Q.5	Briefly discuss the role and benefits of biofertilizers in sustainable agriculture system.	6

CO4	Q.6	Write a short note on modes of dispersion of toxic substances in the environment.	6
CO 1	Q.7	What is biodegradation? Discuss role of microbial enzymes especially microbial Dehalogenases and Phosphotriesterase (PTEs) in biodegradation of pesticides in soil.	10
CO3	Q.8	(a) Explain the Solar energy and Wind energy, point out their significance in context of environment and energy (b) Sustainability	10
CO3	Q.9	(c) Explain Explain the following with suitable example. (i) Rhizofilteration (ii) Biomagnification.	10
CO4	Q.10	Discuss the following in detail. (d) What is microbial leaching of metal ores? Explain any two ex-situ methods of microbial leaching from metal ore. How these methods are better eco-friendly options over conventional chemical metal extraction process? (e) Describe secondary treatment of municipal waste water through advanced biofilm based approaches. What impurities and toxic pollutants are usually removed during secondary waste water treatment?	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental Biotechnology*** /Course code ***MSB 206*** is level **3** for the academic year ***2017-18***.


AMITY INSTITUTE OF BIOTECHNOLOGY
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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M.Sc.) BT, Academic Year – 2017-18

M.Sc Biotechnology (Four Semesters)

Programme Outcomes:

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of

technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem

solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "-

ROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
III SEM	MSB 303	3	2	2	2	2	1	1	1	1	3	-	3	1	-	1

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED ANIMAL BIOTECHNOLOGY
Course Code : MSB 303, Crédits : 03, Session :2017-18 (Odd Sem.), Class : M.Sc.. 2nd Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques used in Animal biotechnology. It aims to promote an understanding and knowledge of animal cell culture and function with particular emphasis on in vitro proliferation and differentiation, applications in gene therapy, enzyme therapy, vaccine production, and development of transgenics.

B. Course Outcomes: At the end of the course, students will be able to:

MSB 303.1. Understand conventional and advanced aspects of Animal biotechnology. Learn the cell culture media, cell culture methods and their maintenance
MSB 303.2. Identify therapeutic enzymes, strategies of efficient enzyme replacement therapy methods. .
MSB 303.3. Understand concept of DNA vaccines and other vaccines using animal cell culture.
MSB 303.4. Address the concepts and technology behind Gene therapy**.**
MSB 303.5. Learn molecular mechanism of transgenic animal technology., Gene knockout tech.

C. Programme Outcomes:

M.Sc Biotechnology (Four Semesters)

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%

Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination.The allowance of 25% includes all types of leaves	A	5%

	including medical leaves.		
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction of animal cell culture-culture substrate, culture media, maintenance of cell lines. Stem cell Therapy: Methods and applications.

Module II

Enzyme therapy –introduction, therapeutic enzymes- Dnase I, adenosine deaminase, dihydrfolate reductase,streptokinase

Module III

DNA based vaccines, subunit vaccines, peptide vaccines, recombinant DNA vaccines, attenuated vaccines, vector vaccines.

Module IV

Gene therapy - SCID, cystic fibrosis, familial by hypercholestremia, prospects and problem, Biotechnological applications for HIV diagnostics and possible gene therapy for cancer.

Module V

Transgenic animal production and application in production of therapeutic proteins, gene Knock out and mice model for human genetic disorder, baculo virus for expression of foreign gene mapping of human genome

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag
- Cell Culture Lab FAx, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Animal cell culture: An Overview	Lecture	MSB 303.1.	Mid Term-1, Quiz & End Sem Exam
2	ell culture attachment substrates: Types, Advantages and Applications	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Animal Cell culture Media: Natural Media.	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Animal Cell culture Media: Artificial Media.	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Applications, advantages and limitations of media	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Method of Initiation of of Cell culture (primary/secondary etc)	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Method of Initiation of of Cell culture (primary/secondary etc)	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Maintenance of cell lines and subculturing	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Stem cell therapy:Method an applications	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Enzyme replacement therapy: An Overview	Lecture	MSB 303.2.	Mid Term-1, Quiz & End Sem Exam
11	Mechanism and role in SCID disease treatment using ERT Adagen-1	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Mechanism and role in CSID disease treatment using ERT DNAse-1.	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Mechanism and role in cronory blockage disease treatment using ERT Streptokinase	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Mechanism and role of DHFR in ERT.	Lecture		Mid Term-1, Quiz & End Sem Exam
15	DNA vaccines:An Overview.	Lecture	MSB 303.3.	Quiz & End Sem Exam
16	Subunit vaccines and Peptide vaccines	Lecture		Quiz & End Sem Exam

17	DNA based vaccines: Recombinant vaccines.	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Method and production of recombinant vaccines	Lecture		Quiz & End Sem Exam

19	Attenuated vaccines and their limitations	Lecture		Quiz & End Sem Exam
20	Advantages and Applications of DNA vaccines.	Lecture		Quiz & End Sem Exam
21	Gene Therapy - An Overview	Lecture	MSB 303.4.	Quiz & End Sem Exam
22	Methods of Gene Therapy	Lecture		Quiz & End Sem Exam
23	Gene therapy -Mechanism and treatment of SCID disease	Lecture		Quiz & End Sem Exam
24	Gene therapy -Mechanism and treatment of CF disease	Lecture		Quiz & End Sem Exam
25	Gene therapy -Mechanism and treatment of hypercholestremia disease	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Gene therapy-Applications and current advancement	Lecture		Quiz & End Sem Exam
27	Applications for HIV diagnostics and therapy.	Lecture		Quiz & End Sem Exam
28	Introduction of Transgenic Animals	Lecture	MSB 303.5.	Quiz & End Sem Exam
29	transgene transfer methods in animal cells	Lecture		Quiz & End Sem Exam
30	transgene transfer methods in animal cells	Lecture		Quiz & End Sem Exam
31	Transgenic Animals: Application in production of therapeutic proteins	Lecture		Quiz & End Sem Exam
32	Transgenic Animals: Application in production of therapeutic proteins	Lecture		Quiz & End Sem Exam
33	Production of Gene Knock out mice.			Quiz & End Sem Exam
34	Applications of Knockout mice model for human genetic disorder,	Lecture		Quiz & End Sem Exam
35	Baculo virus for expression of foreign gene	Lecture		Quiz & End Sem Exam
36	Mapping of human genome	Lecture		Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME

														SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
MSB 303.1.	Understand conventional and advanced aspects of Animal biotechnology. Learn the cell culture media, cell culture methods and their maintenance	3	2	3	2	-	-	1	-	1	-	-	3	2	-	1
MSB 303.2.	Identify therapeutic enzymes, strategies of efficient enzyme replacement therapy methods.	3	2	3	1	-	-	-	-	1	-	-	3	2	-	1
MSB 303.3.	Understand concept of DNA vaccines and other vaccines using animal cell culture.	3	2	2	2	-	-	-	-	1	-	-	3	2	-	1
MSB 303.4.	Address the concepts and technology behind Gene therapy**.**	3	2	1	2	-	-	-	-	1	-	-	3	2	-	1
MSB 303.5.	Learn molecular mechanism of transgenic animal technology., Gene knockout tech.	3	2	3	2	-	-	1	-	1	-	-	3	2	-	1

Sample Question Paper

Amity Institute Biotechnology 2017-18		
Class: B.Sc.(H) Biotechnology VI Semester		
Subject Name: ADVANCED ANIMAL BIOTECHNOLOGY	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,2,	Q.3,4,6	Q.5,10	Q. 8, 7	Q. 9,	

Student will be able to:

CO Map	Question No.	Question	Marks
CO1	Q.1	What is primary cell culture? How it differs from cell lines?	6
CO1	Q.2	Name the different plant sources for following enzymes (i) Bromelain (ii) Rutin (iii) Papain.	6
	Q.3	Write a short note on subunit vaccines? How it differs from attenuated vaccine?	6
CO2	Q.4	Write a short note on Congenital sucrase-isomaltase deficiency (CSID) and its treatment method.	6
CO5	Q.5	Write a brief note on particle gun method and liposome method for gene delivery.	6
CO4	Q.6	Briefly explain about DNA vaccine	6
CO 1	Q.7	Discuss the following enzymes and their role in cell separation in animal cell culture. (a) Collagenase (b) Trypsin	10
CO3	Q.8	What is Media? Describe the natural cell culture media and its advantage and limitations. Why artificial media is preferred over natural media for proliferation of specific cell culture?	10

CO3	Q.9	What is Gene Augmentation therapy? Explain the symptoms and method of treatment of severe combined immune deficiency syndrome (SCID) in humans using this method with suitable illustrations.	10

CO4 CO5	Q.10	Explain the following in detail. (a) Familial Hypercholesterolemia (FH). It is an inherited disorder that leads to aggressive and premature cardiovascular disease. What are the causes of this disease? Clearly indicate the name of the genes affected (mutated) and their subsequent impact. Explain the strategy to overcome the effect of this disease. Why this disease is unnoticed in children and young people. (b) Explain the Gene directed enzyme prodrug therapy (GDEPT) for the treatment of cancer cells.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advance Animal Biotechnology***/Course code ***MSB 303*** is level **3** for the academic year ***2017-18***.


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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M.Sc.) BT, Academic Year – 2017-18

M.Sc Biotechnology (Four Semesters)

Programme Outcomes:

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
III SEM	MSB 322	3	2	3	3	1	-	-	-	1	-	-	3	2	-	1


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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED ANIMAL BIOTECHNOLOGY & PLANT BIOTECHNOLOGY LAB
Course Code : MSB 322, Crédits : 01, Session :2017-18 (Odd Sem.), Class : M.Sc.. 2nd Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques used in Animal biotechnology and plant biotechnology. It aims to promote an understanding and knowledge of animal cell culture and function with particular emphasis on in vitro proliferation and differentiation. In plant biotech aim to quint the students with plant tissue culture techniques.

B. Course Outcomes: At the end of the course, students will be able to:

MSB 322.1. Learn preparation of the cell culture media, cell culture methods of chicken fibroblast cells
MSB 322.2. Learn the maintenance of cell culture by subculturing.
.
MSB 322.3. Learn the preparation of, stock solutions, Plant tissue culture Media, sterilization etc.
MSB 322.4. Learn the callus development, anther culture embryo culture etc.

C. Programme Outcomes:
[M.Sc Biotechnology (Four Semesters)

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of

professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

D. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

ADVANCED ANIMAL BIOTECHNOLOGY

1. Histological study of important animal tissues.
2. Estimation of enzyme activity from animal tissues.
3. Study of toxicity on invitro model.
4. Culture and maintenance of animal cell lines.
5. Culture of chickenfibroblasts.
6. Invitro expression of proteins in animal cell lines.

PLANT BIOTECHNOLOGY

1. Tissue culture lab and organization.Sterilisation of glasswares, tools and equipments.
2. Preparation of stocks and media.Surface sterilization of various explants
3. ORGAN CULTURE
4. Callus culture
5. Anther culture
6. Embryo culture, Protoplast isolation and culture

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

IA	EE

Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag
- Cell Culture Lab FAx, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Histological study of important animal tissues.		MSB 322.1.	Mid Term-1, Quiz & End Sem Exam
2	Estimation of enzyme activity from animal tissues.			Mid Term-1, Quiz & End Sem Exam
3	Study of toxicity on invitro model.			Mid Term-1, Quiz & End Sem Exam
4	Culture and maintenance of animal cell lines.			Mid Term-1, Quiz & End Sem Exam
5	Culture of chickenfibroblasts.			Mid Term-1, Quiz & End Sem Exam
6	Invitro expression of proteins in animal cell lines.			Mid Term-1, Quiz & End Sem Exam
7	**PLANT BIOTECHNOLOGY** Tissue culture lab and organization.Sterilisation of glasswares, tools and equipments.			Mid Term-1, Quiz & End Sem Exam
8	Preparation of stocks and media.Surface sterilization of various explants			Mid Term-1, Quiz & End Sem Exam

9	ORGAN CULTURE			Mid Term-1, Quiz & End Sem Exam
10	Callus culture		MSB	Mid Term-1, Quiz

			322.2.	& End Sem Exam
11	Anther culture			Mid Term-1, Quiz & End Sem Exam
12	Embryo culture, Protoplast isolation and culture			Mid Term-1, Quiz & End Sem Exam

H. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MSB 322.1.	Learn preparation of the cell culture media, cell culture methods of chicken fibroblast cells	3	1	3	3	1	-	-	-	1	-	-	3	2	-	**-**
MSB 322.2.	Learn the maintenance of cell culture by subculturing. .	3	2	3	3	1	-	-	-	1	-	-	3	2	-	1
MSB 322.3.	Learn the preparation of, stock solutions, Plant tissue culture Media, sterilization etc.	3	1	2	3	1	-	-	-	1	-	-	3	2	-	1
MSB 322.4.	Learn the callus development, anther culture embryo culture etc.	3	**1**	2	3	1	-	-	-	1	-	-	3	2	-	1
MSB 322.5.		3	2	3	3	1	-	-	-	1	-	-	3	2	-	1


AMITY INSTITUTE OF BIOTECHNOLOGY

Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advance Animal and Plant Biotechnology***/Course code ***MSB 322*** is level **3** for the academic year ***2017-18***.


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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2017-18

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM SPECIFIC OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

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Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3: Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MSB101	3	3	2	3	1	3	2	2	2	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED BIOCHEMISTRY
Course Code : MSB 101, Credits: 04, Session :2021-22 (Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: Objective of this course is to help students navigate the discipline of biochemistry that explains how the collection of inanimate molecules that constitute the living systems interact, to maintain and perpetuate life. This knowledge has its roots in medicine, nutrition, agriculture, fermentation and natural products chemistry. It also aims to provide an understanding of the principles and application of primary and secondary metabolites.

B. Course Outcomes: At the end of the course, students will be able to:

MSB101.1. Understand the basics of structures of biopolymers.

MSB101.2. Learn carbohydrate metabolism in detail by analyzing all the pathways.

MSB101.3. Learn the various aspects of lipid metabolism and their regulation.

MSB101.4. Understand the metabolism of Nitrogen and excretion of urea from body.

MSB101.5. Learn Nucleotide metabolism and clinical disorders of purine metabolism.

MSB101.6. Develop advanced knowledge of action of major hormones.

MSB101.7. Understand the principles and application of primary and secondary metabolites.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

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and national issues.

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PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

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E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination.The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Basics of structures of biopolymers; Carbohydrates, Lipids, Proteins and Nucleic Acids.

Module II

Carbohydrates Metabolsm – I

Anaerobic processes in generating metabolic energy

Glycolysis, fates of pyruvate: Lactate and ethanol metabolism, regulation of glycolysis, glycogen mobilization, regulation of glycogen breakdown.

Oxidative processes: Pyruvate oxidation, coenzymes involved in pyruvate oxidation and citric acid cycle, action of PDH, Complex, Krebs Cycle, Regulation of PDH and Krebs Cycle, anaplerotic sequences, glyoxylate cycle, PPP, Human genetic disorder involving PPP enzymes.

ETC and OP: Electron carriers in respiratory chain, OP, enzyme system for ATP synthesis, chemiosmotic coupling.

Carbohydrate Metabolism – II

Gluconeogenesis. Ethanol consumption and gluconeogenesis, reciprocal regulation of glycolysis and gluconeogenesis, glycogen metabolism in humans, photosynthesis.

Module III: Lipid Metabolism

Utilization and transport of fat and cholesterol, lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain, control of fatty acid oxidation, biosynthesis of fatty acids, fatty acid desaturation, control of fatty acid synthesis, variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.

Module IV: Nitrogen Metabolism
Utilization of ammonia – GDH, GS, transamination, Biosynthetic of amino acids, amino acids degradation, detoxification and excretion of ammonia, urea cycle, transport of ammonia to liver, porphyrin and hememetabolism – The succinate-glycine pathway, Biological Nitrogen fixation.
Module V: Nucleotide Metabolism
De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides, purine degradation and clinical disorders of purine metabolism (Gout, lesch – nyhan syndrome, immuno deficiency), pyrimidine breakdown, reduction of ribonucleotides to deoxyibonucleotides, thymidylate synthetase – a target enzyme for chemotheraphy.
Module VI: Integration of cellular metabolism and hormonal regulation
Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation.
Module VII: Secondary Plant Metabolism
Importance of secondary metabolites, terpenes, classification, mevalonic acid pathway, phenolic compounds, shikimic acid pathway, alkaloids.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox. , Worth Publishing

References:
- Harper's Biochemistry K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw Hill/ Appleton and Lange.
- Biochemistry (Fifth Edition), Lubert Stryer

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Basics of structures of Carbohydrates	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
2	Basics of structures of Carbohydrates	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
3	Basics of structures of Lipids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
4	Basics of structures of Lipids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
5	Basics of structures of Proteins	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
6	Basics of structures of Proteins	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
7	Basics of structures of Nucleic Acids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
8	Basics of structures of Nucleic Acids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
9	Anaerobic processes in generating metabolic energy	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
10	Glycolysis, fates of pyruvate: Lactate and ethanol metabolism	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
11	Glycolysis, fates of pyruvate: Lactate and ethanol metabolism	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
12	regulation of glycolysis, glycogen mobilization	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
13	glycogen breakdown	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
14	Oxidative processes: Pyruvate oxidation, coenzymes involved in pyruvate oxidation	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
15	citric acid cycle, action of PDH, Complex	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
16	Krebs Cycle, Regulation of PDH and Krebs Cycle, anaplerotic sequences	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
17	glyoxylate cycle, PPP, Human genetic disorder involving PPP enzymes.	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
18	ETC and OP: Electron carriers in respiratory chain, OP.	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
19	enzyme system for ATP synthesis, chemiosmotic coupling	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
20	Gluconeogenesis. Ethanol consumption and gluconeogenesis	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam

21	reciprocal regulation of glycolysis and gluconeogenesis, glycogen metabolism in humans	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
22	Photosynthesis	Lecture	MSB101.2	Mid Term, Quiz

				& End Sem Exam
23	Utilization and transport of fat and cholesterol	Lecture	MSB101.3	Mid Term, Quiz & End Sem Exam
24	lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain	Lecture	MSB101.3	Mid Term, Quiz & End Sem Exam
25	lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain	Lecture	MSB101.3	Quiz & End Sem Exam
26	control of fatty acid oxidation	Lecture	MSB101.3	Quiz & End Sem Exam
27	biosynthesis of fatty acids, fatty acid desaturation	Lecture	MSB101.3	Quiz & End Sem Exam
28	control of fatty acid synthesis	Lecture	MSB1013	Quiz & End Sem Exam
29	variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.	Lecture	MSB101.3	Quiz & End Sem Exam
30	variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.	Lecture	MSB101.3	Quiz & End Sem Exam
31	Utilization of ammonia, transamination	Lecture	MSB101.4	Quiz & End Sem Exam
32	Biosynthetic of amino acids, amino acids degradation	Lecture	MSB101.4	Quiz & End Sem Exam
33	detoxification and excretion of ammonia	Lecture	MSB101.4	Quiz & End Sem Exam
34	urea cycle, transport of ammonia to liver	Lecture	MSB101.4	Quiz & End Sem Exam
35	porphyrin and hememetabolism	Lecture	MSB101.4	Quiz & End Sem Exam
36	The succinate-glycine pathway, Biological Nitrogen fixation	Lecture	MSB101.4	Quiz & End Sem Exam
37	De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
38	De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
39	purine degradation and clinical disorders of purine metabolism (Gout, lesch – nyhan syndrome, immuno deficiency)	Lecture	MSB101.5	Quiz & End Sem Exam

40	pyrimidine breakdown, reduction of ribonucleotides to deoxyribonucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
41	pyrimidine breakdown, reduction of ribonucleotides to	Lecture	MSB101.5	Quiz & End Sem Exam

	deoxyribonucleotides			
42	thymidylate synthetase – a target enzyme for chemotheraphy	Lecture	MSB101.5	Quiz & End Sem Exam
43	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
44	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
45	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
46	Importance of secondary metabolites-terpenes, classification	Lecture	MSB101.7	Quiz & End Sem Exam
47	mevalonic acid pathway, phenolic compounds	Lecture	MSB101.7	Quiz & End Sem Exam
48	shikimic acid pathway, alkaloids	Lecture	MSB101.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB101.1.	Understand the basics of structures of biopolymers.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.2 .	Learn carbohydrate metabolism in detail by analyzing all the pathways.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

MSB101.3.	Learn the various aspects of lipid metabolism and their regulation.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.4.	Understand the metabolism of Nitrogen and excretion of urea from body.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.5 .	Learn Nucleotide metabolism and clinical disorders of purine metabolism.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.6 .	Develop advanced knowledge of action of major hormones.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.7 .	Understand the principles and application of primary and secondary metabolites.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –I) 2021-22						
Class: M.Sc. Biotechnology I Semester						
Subject Name: MSB 101 ADVANCED BIOCHEMISTRY		Time: 1.5 Hrs		Max. Marks: 30		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biomolecules with examples.	3
CO1	Q.2a	What do you understand by phosphorylation?	3
	Q.2b	Discuss secondary metabolites in brief.	3
CO1	Q.3	Give an account of lipid transport in body.	6
CO2	Q.4	Explain the significance of urea cycle in clinics.	3
CO2	Q.5a	What are the factors favoring nucleic acid synthesis?	3
	Q.5b	Discuss the different factors affecting cholesterol synthesis.	3
CO2	Q 6	Phosphofructokinase I is the pace maker of glycolysis. Why?	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Biochemistry**/Course code **MSB-101** is level **3** for the academic year 2017-18.

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Amity Institute of Biotechnology
Course Handout
Course : Advanced Microbial Technology
Course Code : MSB102, Credits : 03, Session : 2017-18(Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To acquaint the students to understand the basic concept of microbiology and role of various microorganisms in different biotechnological applications, various techniques for their cultivation and control.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB102.1. Study morphology, classification, forms, of bacteria, archaebacteria, mycoplasma and PPLO. Different types of media & their preparations. Isolation of pure cultures, maintenance and preservation. Culture characteristics and Bacterialgrowth, growth curve, batch and continuous cultures di auxic and synchronous growth enumeration of cells by direct and indirect methods.

MSB102.2. Able to understand the Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals, antiviral etc.

MSB102.3. Know about the Molecular classification of microbes, microbial genetics, prokaryotic gene organization, DNA, replication, transcription and translation. Microbial regulation of gene expression: trp and lac operon. Gene Transfer andGenetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics and Reproductive cycles of bacteriophage, T4 phage and lambda.

MSB102.4. Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms. Applications of microbiology in effective diagnosis,

treatment and prevention of infectious disease.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate the most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need for professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize students to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques,

advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology,

advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Introduction to Microbiology: Bacteria Morphology and classification. Abnormal forms of bacteria, archaebacteria, mycoplasma and PPLO, cultivation of bacteria nutritional requirements of microorganism, physical requirements, different typesof media & their preparations. Isolation of pure cultures, maintenance and preservation of the pure cultures. Culture characteristics Bacterial growth Growth curve, batch and continuous cultures di-auxic and synchronous growth enumeration of cells by direct and indirect methods.

Module II: Control of Microorganisms: Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals, antiviral etc.

Module III: Microbial Genetics: Molecular classification of microbes, The Basics of microbial genetics, prokaryotic gene organization. The basic principles of microbial DNA, replication, transcription and translation. Microbial regulation of gene expression: the trp and lac operon. Gene Transfer Genetic change: transformation, transduction,conjugation, plasmids, transposons. Viral Genetics Reproductive cycles of bacteriophage, T4 and lambda.

Module IV: Medical Microbiology: Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms (bacteria, fungi, parasites, and viruses), applications of the basic principles of microbiology in effective diagnosis, treatment and prevention of infectious disease.

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill

- General Microbiology, R.Y. Stanier, J.L. Ingraham, M. L. Wheelis and P.R. Painter, Macmillian

- Principles of Microbiology, R.M. Atlas, Wm C. Brown Publisher.
- The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing Benjamin Cummings.
- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin & Cummings.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction to Microbiology	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
2	Discovery of Microbial World	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
3	Spontaneous Generation	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
4	Role of microbes in disease causation	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
5	Development of Pure Culture	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
6	Methods in Microbiology	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
7	Principle of Microbial Nutrition	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
8	Culture Media Types	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
9	Theory of Sterilization	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
10	Practice of Sterilization	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
11	Concept of Sterilization	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam

12	Disinfection	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam

13	Methods of Control	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
14	Chemotherapeutics	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
15	Mode of Action of Antibiotics	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
16	Penicillin and Ampicillin	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
17	Sulfonamide and Vanomycin	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
18	Streptomycin and Tatracycline	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
19	Chloramphenicol	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
20	Antifungals and Antivirals	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
21	Basics of Microbial Genetics and Prokaryotic gene organization	Lecture	MSB 102.3	Quiz & End Sem Exam
22	Principles of Microbial DNA	Lecture	MSB 102.3	Quiz & End Sem Exam
23	Replication, Transcription, Translation	Lecture	MSB 102.3	Quiz & End Sem Exam
24	Regulation of Gene Expression: Trp and Lac Operon	Lecture	MSB 102.3	Quiz & End Sem Exam
25	Transformation, Transduction, Conjugation	Lecture	MSB 102.3	Quiz & End Sem Exam
26	Plasmids and Transposons	Lecture	MSB 102.3	Quiz & End Sem Exam
27	Viral Genetics	Lecture	MSB 102.3	Quiz & End Sem Exam

28	Reproductive Cycles of Bacteriophage, T4 and Lambda	Lecture	MSB 102.3	Quiz & End Sem Exam
29	Normal Microflora of Host	Lecture	MSB 102.4	Quiz & End Sem Exam

30	Host Parasite Interactions	Lecture	MSB 102.4	Quiz & End Sem Exam
31	Mechanisms of Pathogenesis	Lecture	MSB 102.4	Quiz & End Sem Exam
32	Clinical manifestations associated to medically important pathogens	Lecture	MSB 102.4	Quiz & End Sem Exam
33	Applications of Microbiology	Lecture	MSB 102.4	Quiz & End Sem Exam
34	Diagnosis of Diseases	Lecture	MSB 102.4	Quiz & End Sem Exam
35	Treatment of different microbial diseases	Lecture	MSB 102.4	Quiz & End Sem Exam
36	Prevention of different microbial diseases	Lecture	MSB 102.4	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4

MSB 102.1	Study morphology, classification, forms of bacteria, archaebacteria, mycoplasma and PPLO. Different types of media & their preparations. Isolation of pure cultures, maintenance and preservation. Culture characteristics and Bacterial growth, growth curve, batch and continuous cultures di auxic and synchronous growth Eneumeration of	3	2	2	2	2	2	2	2	2	1	3	2	2	2

	cells by direct and indirect methods.														
MSB 102.2	Able to understand the Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals antiviral	3	2	2	2	2	2	2	2	2	1	3	2	2	2
MSB 102.3	Know about the Molecular classification of microbes, microbial genetics, prokaryotic gene organization, DNA, replication, transcription and translation. Microbial regulation of gene expression: trp and lac operon. Gene Transfer and Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics and Reproductive cycles of bacteriophage, T4 phage and lambda.	3	2	2	2	2	2	2	2	2	1	3	2	2	2

MSB 102.4	Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms (bacteria, fungi, parasites, and viruses),	3	2	2	2	2	2	2	2	2	1	3	2	2	2

	applications of the basic principles of microbiology in effective diagnosis, treatment and prevention of infectious disease.														

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
MID-SEMESTER 2017-18</td></tr>
<tr><td colspan="7">Class: M.Sc. (Biotech) I Semester</td></tr>
<tr><td colspan="2">Subject Name:
MSB 102
Advanced Microbial Technology</td><td colspan="3">Time: 2 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q. 1,4</td><td>Q. 2,3</td><td>Q. 4</td><td>Q. 2,5,6</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to
CO1: List the broad perspective of microbiology and microbial technology.
CO2: Apply the knowledge to different types of microbes
(Bacteria, Virus, Algae, Fungus and Protozoa).</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the microbial nutritional requirement.	3
CO1	Q.2a	What are different sterilization techniques?	3
	Q.2b	How the mode of action of Penicillin and chloramphenicol are different from each other?	3
CO1	Q.3	How Lactose Operon works in presence and absence of Lactose as a positive or negative regulation?	6
CO2	Q.4	Explain the application of microbiology in effective diagnosis, treatment and prevention of infectious diseases.	3

Attainments		Rubric
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Microbial Technology/MSB 102** is **level 3** for the academic year 2017-18.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2017-18

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess

technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MSB120	3	3	3	3	-	1	2	-	2	2

AMITY UNIVERSITY
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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY LAB
Course Code : MSB 120, Credits: 02, Session :2021-22 (Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend advanced understanding of the qualitative and quantitative estimation of proteins and nucleic acids.

B. Course Outcomes: At the end of the course, students will be able to:

MSB120.1. Understand the practical based learning of estimation of proteins.
MSB120.2. Understand the practical based learning of enzyme activity.
MSB120.3. Understand the practical based learning of estimation of DNA & RNA.
MSB120.4. Understand the practical based learning of estimation of carbohydrate.
MSB120.5. Understand the practical based learning of estimation of lipid.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination.The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Proteins
Identification of protein by Biuret test.
Quantization of protein by Bradford method
Separation of proteins by SDS-PAGE
Module II: Enzyme
Enzyme activity study of serum alkaline phosphates.
Module III: Nucleic Acid
Biochemical estimation of DNA
Biochemical estimation of RNA
Separation of DNA on Agarose gel.
Module IV: Carbohydrate
Biochemical estimation of blood sugar
Module V: Lipids
Blood Cholesterol estimation.

G. Examination Scheme:

IA	EE

Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
4	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
5	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
6	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
7	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
8	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
9	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
10	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
11	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
12	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
13	Biochemical estimation of DNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
14	Biochemical estimation of DNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam

15	Biochemical estimation of RNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
16	Biochemical estimation of RNA	Practical	MSB120.3	Class Test

				(Practical Based) & End Sem Exam
17	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
18	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
19	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
20	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
21	Biochemical estimation of blood sugar	Practical	MSB120.4	Class Test (Practical Based) & End Sem Exam
22	Biochemical estimation of blood sugar	Practical	MSB120.4	Class Test (Practical Based) & End Sem Exam
23	Blood Cholesterol estimation	Practical	MSB120.5	Class Test (Practical Based) & End Sem Exam
24	Blood Cholesterol estimation	Practical	MSB120.5	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB120.1.	Understand the practical based learning of estimation of proteins.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.2.	Understand the practical based learning of enzyme activity.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.3.	Understand the practical based learning of estimation of DNA & RNA.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.4.	Understand the practical based learning of estimation of carbohydrate.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.5.	Understand the practical based learning of estimation of lipid.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Biochemistry Lab**/Course code **MSB-120** is level **3** for the academic year 2017-18.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2017-18

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics,

advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MSB201	3	3	2	3	1	3	2	2	2	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED MOLECULAR BIOLOGY
Course Code : MSB 201, Credits: 04, Session :2021-22 (Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The objective of the course is to provide a clear understanding of DNA (genetic material) so that they can manipulate it and understand basic tools and techniques involved in its manipulation. Strong foundation in molecular biology enables the students to familiarize themselves with Genetic engineering technology.

B. Course Outcomes: At the end of the course, students will be able to:

MSB201.1. Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes.

MSB201.2. Learn the advanced mechanism of transcription in prokaryotes and eukaryotes.

MSB201.3. Develop understanding of various post-transcriptional processes in cell.

MSB201.4. Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes.

MSB201.5. Understand about the advances of gene expression regulation.

MSB201.6. Develop advanced knowledge of various mechanisms of gene silencing.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal

and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination.The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: DNA replication and repair

DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork; termination of replication DNA repair, photo reaction, base excision repair, nucleotide excision repair, transcription coupled repair, mismatch repair , error pone repair recombinational repair.

Module II: Transcription of DNA

Transcription in prokaryotes and eukaryotes, RNA polymerase – Composition and function; transcription mechanism; transcription factor and their role, inhibition of RNA synthesis.

Module III: Processing of RNA

Procession of ribosomal and transfer RNA"s processing of mRNA-5'cap formation; 3' polyadenylation ; RNA splicing , RNA editing , RNA degradation.

Module IV: Translation

Translation mechanism in prokaryotes and eukaryotes; ribosomes, initiation of translation, elongation, termination, amino acid activation; translational recoding inhibitors, post translation modification of protein.

Module V: Regulation of gene expression

Regulation in prokaryotes – repressors and negative control, positive control, role of c AMP, Ampreceptor protein, lac, tryp, His and

ara operons, Regulation in Eukaryotes=promoters and enhancers, transcriptional regulatory protein, transcriptional activators, eukaryotic repressor.

Module VI: Gene Silencing

RNAi (SiRNA and MiRNA) molecular mechanism and current application in gene silencing, Antisense RNA technology, Biochemistry of ribozyme, Hammer head, hairpin ribozymes. Application of antisense and ribozymes in genetic engineering.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education

References:

- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Biology of the Cell by Alberts Bruce, Bray Demos, and Watson James D.
- Gene VIII, Benjamin Lewin 2005, Oxford University Press
- Molecular Cell Biology, H. Lodish, A. Berk, S. Zipursky, P Matsundaira, D. Baltimore and J.E. Barnell, W.H. Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing.

Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley and Sons Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
2	DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
3	termination of replication DNA repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
4	photo reaction	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
5	base excision repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
6	nucleotide excision repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
7	transcription coupled repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
8	mismatch repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
9	error pone repair, recombinational repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
10	Transcription in prokaryotes and eukaryotes	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
11	Transcription in prokaryotes and eukaryotes	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
12	RNA polymerase – Composition and function	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
13	transcription mechanism	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
14	transcription mechanism	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
15	transcription factor and their role	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
16	inhibition of RNA synthesis	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
17	Procession of ribosomal and transfer RNA	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
18	Procession of ribosomal and transfer RNA	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam

19	processing of mRNA-5’cap formation	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
20	3’ polyadenylation	Lecture	MSB201.3	Mid Term, Quiz

				& End Sem Exam
21	RNA splicing	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
22	RNA editing	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
23	RNA degradation	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
24	Translation mechanism in prokaryotes and eukaryotes	Lecture	MSB201.4	Mid Term, Quiz & End Sem Exam
25	Translation mechanism in prokaryotes and eukaryotes	Lecture	MSB201.4	Quiz & End Sem Exam
26	ribosomes, initiation of translation	Lecture	MSB201.4	Quiz & End Sem Exam
27	Elongation	Lecture	MSB201.4	Quiz & End Sem Exam
28	termination	Lecture	MSB2014	Quiz & End Sem Exam
29	amino acid activation	Lecture	MSB201.4	Quiz & End Sem Exam
30	inhibitors, post translation modification of protein	Lecture	MSB201.4	Quiz & End Sem Exam
31	Regulation in prokaryotes	Lecture	MSB201.5	Quiz & End Sem Exam
32	repressors and negative control	Lecture	MSB201.5	Quiz & End Sem Exam
33	positive control, role of cAMP	Lecture	MSB201.5	Quiz & End Sem Exam
34	Ampreceptor protein	Lecture	MSB201.5	Quiz & End Sem Exam
35	Lac operon	Lecture	MSB201.5	Quiz & End Sem Exam
36	Tryp operon	Lecture	MSB201.5	Quiz & End Sem Exam
37	His operon	Lecture	MSB201.5	Quiz & End Sem Exam
38	His operon	Lecture	MSB201.5	Quiz & End Sem Exam
39	Regulation in Eukaryotes=promoters and enhancers	Lecture	MSB201.5	Quiz & End Sem Exam
40	transcriptional regulatory protein	Lecture	MSB201.5	Quiz & End Sem Exam

41	transcriptional activators, eukaryotic repressor	Lecture	MSB201.5	Quiz & End Sem Exam
42	RNAi (SiRNA and MiRNA)	Lecture	MSB201.6	Quiz & End Sem

				Exam
43	RNAi (SiRNA and MiRNA)	Lecture	MSB201.6	Quiz & End Sem Exam
44	molecular mechanism and current application in gene silencing	Lecture	MSB201.6	Quiz & End Sem Exam
45	Antisense RNA technology, Biochemistry of ribozyme	Lecture	MSB201.6	Quiz & End Sem Exam
46	Hammer head and hairpin ribozymes	Lecture	MSB201.6	Quiz & End Sem Exam
47	Application of antisense and ribozymes in genetic engineering	Lecture	MSB201.6	Quiz & End Sem Exam
48	Application of antisense and ribozymes in genetic engineering	Lecture	MSB201.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB201.1.	Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.2.	Learn the advanced mechanism of transcription in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.3.	Develop understanding of various post-transcriptional processes in cell.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.4.	Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.5.	Understand about the advances of gene expression regulation.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.6 .	Develop advanced knowledge of various mechanisms of gene silencing.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –II) 2021-22		
Class: M.Sc. Biotechnology II Semester		
Subject Name: MSB 101 ADVANCED MOLECULAR BIOLOGY	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the types of nucleic acids with examples.	3
CO1	Q.2	What do you understand by semi conservative mode of DNA replication?	6
CO1	Q.3	Give an account of transcription termination in *E. coli*.	6
CO2	Q.4	Explain the significance of poly A tail in RNA.	3
CO2	Q.5a	tRNA acts as an adapter molecule in translation. Discuss.	3
	Q.5b	Discuss the different mechanisms of antisense technology.	3
CO2	Q 6	How does post-translation modification ensure the functionality of a protein? Discuss.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Molecular Biology** /Course code **MSB-201** is level **3** for the academic year 2017-18.

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2017-18

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics,

advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MSB220	3	3	2	3	1	3	2	2	2	3

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED MOLECULAR BIOLOGY LAB
Course Code : MSB 220, Credits: 02, Session :2021-22 (Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend the advanced understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB220.1. Understand the practical based learning of isolation of nucleic acids and DNA protein interaction.

MSB220.2. Understand the practical based learning in-vitro transcription, translation and repair mechanism.

MSB220.3. Understand the practical based learning of PCR and Gradient PCR.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination.The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

1. Isolation of genomic DNA from prokaryotic and Eukaryotes.
2. Isolation of plasmid.
3. Study of DNA protein interaction.
4. Study of in vitro transcription.
5. Study of DNA methylation.
6. Study of DNA repair mechanism.
7. Invitro study of translation
8. Isolation of RNA
9. PCR and Gradient PCR

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:

Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of genomic DNA from prokaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
2	Isolation of genomic DNA from prokaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of genomic DNA from eukaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
4	Isolation of genomic DNA from eukaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
5	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
6	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
7	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
8	Study of DNA protein interaction	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
9	Study of DNA protein interaction	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
10	Study of in vitro transcription	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
11	Study of in vitro transcription	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
12	Study of DNA methylation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
13	Study of DNA methylation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
14	Study of DNA repair mechanism	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam

15	Study of DNA repair mechanism	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
16	Invitro study of translation	Practical	MSB220.2	Class Test

				(Practical Based) & End Sem Exam
17	Invitro study of translation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
18	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
19	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
20	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
21	PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
22	PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
23	Gradient PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
24	Gradient PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB220.1.	Understand the practical based learning of isolation of nucleic acids and DNA protein interaction.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB220.2.	Understand the practical based learning in-vitro transcription, translation and repair mechanism.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB220.3.	Understand the practical based learning of PCR and Gradient PCR.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology Lab**/Course code **MSB-220** is level **3** for the academic year 2017-18.

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2017-18

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess

technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
III SEM	MSB302	3	3	2	3	1	3	2	2	2	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENZYME TECHNOLOGY
Course Code : MSB 302, Credits: 03, Session :2021-22 (Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The course aims to provide an understanding of the principles and application of proteins, secondary metabolites and enzyme biochemistry in therapeutic applications and clinical diagnosis. The theoretical understanding of biochemical systems would certainly help to interpret the results of laboratory experiments.

B. Course Outcomes: At the end of the course, students will be able to:

MSB302.1. Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action.

MSB302.2. Understand about various modes of inhibition of enzyme actions with examples.

MSB302.3. Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc.

MSB302.4. Learn enzyme reactors and various parameters for bio-process design.

MSB302.5. Learn about the concepts of bio-process design.

MSB302.6. Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal

and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination.The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Enzymes

Introduction and scope, Nomenclature, Mechanism of Catalysis, enzyme catalysis in organic media, Industrial applications.

Module II: Enzyme Kinetics

Single substrate steady state kinetics; King-Altman's method; Inhibitors and activators; Multi-substrate systems; Effect of pH and temperature; Allosteric enzymes. Thermodynamic explanation for transition complex formation, limitations of Michaelis – Menten equation, LB plot method to study enzyme kinetics, effect of pH

And temperature on kinetics,allosteric enzyme kinetics,models as WMC, KNF with examples of ACTase and Hb.

Module III: Immobilization of Enzymes

Advantages, Carriers, adsorption, covalent coupling, cross-linking and entrapment methods, Micro-environmental effects

Module IV: Enzyme Reactors

Reactors for batch/continuous enzymatic processing, Choice ot reactor type: idealized enzyme reactor systems; Mass Transfer in Enzyme Reactors: Steady state analysis of mass transfer and biochemical reaction in enzyme reactors.

Module V: Bio-process Design

Physical parameters, reactor operational stability; Immobilized cells.

Module VI: Challenges and future trends

Catalytic antibodies and Non-protein biomolecules as catalysts, Biocatalysts from Extreme Thermoph!lic and Hyperthermophilic

Archaea and Bacteria.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Enzyme Technology, M.F. Chaplin and C. Bucke, Cambridge University Press.

References:

- Biotechnological Innovations in Chemical Synthesis, R.C.B. Currell, V.D. Mieras, Biotol Partners Staff, Butterworth Heinemann.
- Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis, R.A. Copeland, John Wiley and Sons Inc.
- Enzymes Biochemistry, Biotechnology, Clinical Chemistry, Trevor Palner
- Enzyme Kinetics: Behaviour and Analysis of Rapid Equilibrium and Steady State Enzyme Systems, I.H. Segel, Wiley-Interscience
- Industrial Enzymes & their applications, H. Uhlig, John Wiley and Sons Inc

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction and scope	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
2	Nomenclature	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
3	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
4	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
5	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
6	enzyme catalysis in organic media	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
7	Industrial applications	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
8	Single substrate steady state kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
9	Single substrate steady state kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
10	King-Altman's method	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
11	Inhibitors and activators	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
12	Multi-substrate systems	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam

13	Effect of pH and temperature	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
14	Allosteric enzymes	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam

15	Thermodynamic explanation for transition complex formation	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
16	limitations of Michaelis – Menten equation	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
17	LB plot method to study enzyme kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
18	effect of pH and temperature on kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
19	allosteric enzyme kinetics	Lecture	MSB302.2	Quiz & End Sem Exam
20	models as WMC, KNF with examples of ACTase and Hb	Lecture	MSB302.2	Quiz & End Sem Exam
21	models as WMC, KNF with examples of ACTase and Hb	Lecture	MSB302.2	Quiz & End Sem Exam
22	Advantages, Carriers, adsorption	Lecture	MSB302.3	Quiz & End Sem Exam
23	covalent coupling, cross-linking and entrapment methods	Lecture	MSB302.3	Quiz & End Sem Exam
24	covalent coupling, cross-linking and entrapment methods	Lecture	MSB302.3	Quiz & End Sem Exam
25	Micro-environmental effects	Lecture	MSB302.3	Quiz & End Sem Exam
26	Reactors for batch/continuous enzymatic processing	Lecture	MSB302.4	Quiz & End Sem Exam
27	Choice of reactor type: idealized enzyme reactor systems	Lecture	MSB302.4	Quiz & End Sem Exam
28	Mass Transfer in Enzyme Reactors	Lecture	MSB302.4	Quiz & End Sem Exam
29	Steady state analysis of mass transfer	Lecture	MSB302.4	Quiz & End Sem Exam
30	biochemical reaction in enzyme reactors	Lecture	MSB302.4	Quiz & End Sem Exam
31	Physical parameters	Lecture	MSB302.5	Quiz & End Sem Exam
32	reactor operational stability	Lecture	MSB302.5	Quiz & End Sem Exam
33	Immobilized cells	Lecture	MSB302.5	Quiz & End Sem Exam
34	Catalytic antibodies and Non-protein biomolecules as catalysts	Lecture	MSB302.6	Quiz & End Sem Exam
35	Biocatalysts from Extreme Thermophilic bacteria	Lecture	MSB302.6	Quiz & End Sem Exam
36	Hyperthermophilic Archaea and Bacteria	Lecture	MSB302.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB302.1.	Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.2.	Understand about various modes of inhibition of enzyme actions with examples.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.3.	Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.4.	Learn enzyme reactors and various parameters for bio-process design.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.5.	Learn about the concepts of bio-process design.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

MSB30 2.6.	Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2021-22		
Class: M.Sc. Biotechnology III Semester		
Subject Name: MSB 302 ENZYME TECHNOLOGY	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss in brief about the nomenclature of Enzymes.	3
CO1	Q.2	Explain the Lineweaver Burk plot & its significance.	6
CO1	Q.3	Give a brief account on enzyme kinetics.	6
CO2	Q.4	Briefly discuss the properties of an inhibitor.	3
CO2	Q.5a	Discuss the acid-base catalysis in brief.	3
	Q.5b	What is reversible inhibition? Discuss in brief.	3
CO2	Q 6	Discuss the Michaelis-Menten equation. Derive the double reciprocal plot with this equation.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Enzyme Technology**/Course code **MSB-302** is level **3** for the academic year 2017-18.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR

AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2017-18

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess

technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
III SEM	MSB321	3	3	2	3	1	3	2	2	2	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENZYME TECHNOLOGY LAB
Course Code : MSB 321, Credits: 01, Session :2021-22 (Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend advanced understanding of isolation, recovery, and immobilization of enzymes.

B. Course Outcomes: At the end of the course, students will be able to:

MSB321.1. Understand the practical based learning of Isolation of industrially important microorganisms and growth curve.

MSB321.2. Understand the practical based learning ethanol production, production of antibiotics and fermentation.

MSB321.3. Understand the practical based learning of downstream processing.

MSB321.4. Understand the practical based learning of enzyme assay, enzyme purification and kinetics.

MSB321.5. Understand the practical based learning of enzyme production and immobilization.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination.The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Isolation of industrially important microorganisms for microbial processes.
Determination of Thermal Death Point and Thermal death time of microorganisms for design of a sterilizer
Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.

Module II
Comparative studied of ethanol production using different substrates.
Microbial production of antibiotics (Penicillin)
Production and estimation of alkaline protease
Sauer Krant fermentation

Module III: Downstream processing
Conventional filtration
Protein precipitation and recovery
Aqueous two-phase separation
Ion exchange chromatography
Gel filtration

Membrane based filtration i.e. Micro filtration and cross filtration in cross flow Modules.

Module IV

Isolation of Enzymes from plant and microbial sources.

Enzyme assay; activity and specific activity – determination of amylase, nitrate reductase, cellulose, protease.

Purification of Enzyme by ammonium sulphate fractionation.
Enzyme Kinetics: Effect of varying substrate concentration on enzyme activity
Effect of Temperature and pH on enzyme activity.

Module V

Production of enzyme on industrial scale using solid and state fermentation
Enzyme immobilization

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of industrially important microorganisms for microbial processes.	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
2	Determination of Thermal Death Point and Thermal death time of microorganisms for design of a sterilizer	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
3	Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
4	Comparative studied of ethanol production using different substrates. Microbial production of antibiotics (Penicillin)	Practical	MSB321.2	Class Test (Practical Based) & End Sem Exam
5	Production and estimation of alkaline protease Sauer Krant fermentation	Practical	MSB321.2	Class Test (Practical Based) & End Sem Exam

6	Conventional filtration Protein precipitation and recovery	Practical	MSB321.3	Class Test (Practical Based) & End Sem Exam
7	Aqueous two-phase separation	Practical	MSB321.3	Class Test

	Ion exchange chromatography Gel filtration			(Practical Based) & End Sem Exam
8	Membrane based filtration i.e. Micro filtration and cross filtration in cross flow Modules.	Practical	MSB321.3	Class Test (Practical Based) & End Sem Exam
9	Isolation of Enzymes from plant and microbial sources. Enzyme assay; activity and specific activity – determination of amylase, nitrate reductase, cellulose, protease.	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
10	Purification of Enzyme by ammonium sulphate fractionation. Enzyme Kinetics: Effect of varying substrate concentration on enzyme activity	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
11	Effect of Temperature and pH on enzyme activity	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
12	Production of enzyme on industrial scale using solid and state fermentation Enzyme immobilization	Practical	MSB321.5	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB321.1.	Understand the practical based learning of Isolation of industrially important microorganisms and growth curve.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.2.	Understand the practical based learning ethanol production, production of antibiotics and fermentation.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.3.	Understand the practical based learning of downstream processing.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.4.	Understand the practical based learning of enzyme assay, enzyme purification and kinetics.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.5.	Understand the practical based learning of enzyme production and immobilization.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Enzyme Technology Lab**/Course code **MSB-321** is level **3** for the academic year 2017-18.

AMITY UNIVERSITY
MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Technology (M.Tech.) BT, Academic Year – 2017-18

M. Tech. Biotechnology (Four Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF M.TECH. BIOTECHNOLOGY

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practicalexperience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.
PO9. Inculcation of ability to think independently for problem solving.
PO10. Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
II	MTB 206	3	2	3	2	1	-	1	2	1	2		3	3	1	1

SEM																

AMITY UNIVERSITY
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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL BIOTECHNOLOGY
Course Code : MTB 206, Crédits : 03, Session :2017-18 (Odd Sem.), Class : M.Tech 1st Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques used in *Environmental* biotechnology. To introduce the students to regenerate clean environment using biotechnology as the key tool and provide them the insight for eco-friendly approach along with the concept of sustainable development.

B. Course Outcomes: At the end of the course, students will be able to:

MTB 206.1. Understand concept of climate change, pollution and mitigation approaches.
MTB 206.2. Understand concept of energy sustainability, clean fuel technology, Biomass energy and biofuels.
MTB 206.3. Understand concept of Biodegradation, Bioremediation and Phytoremediation. Advances in bioleaching and biomineralization.
MTB 206.4. Understand Advanced waste water treatments.
MTB 206.5. Understand Agriculture Sustainability and Clean agricultural practices, Biosensors and biomarkers, Principles of ecotoxicity
MTB 206.6. Understand the Environmental impact assessment and Environmental audit, Related case studies from India.

C. Programme Outcomes:
M. Tech. Biotechnology (Four Semesters)

PROGRAMME OUTCOMES OF M.TECH. BIOTECHNOLOGY

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to

enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project.

Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9. Inculcation of ability to think independently for problem solving.

PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Environmental pollution and its major impacts on human beings, plants, animals and climate, concept of Global warming and climate change, Global Ozone Problem, Eutrophication, Land degradation, Biomagnification.

Module II

Non-renewable and renewable energy resources, concept of clean fuel technology, Biomass energy and biofuels

Module III

Biodegradation, Bioremediation and Phytoremediation of major pollutants (PAH, Pesticides etc), Use of microbial technology for mining of metals (Bioleaching) and Concept of Biomineralisation.

Module IV

Waste water engineering: physicochemical characteristic of water, waste water treatment of municipal wastes and industrial effluents with special focus on use of biological methods, Advanced waste water treatments

Module V

Bioassessment of environmental quality: Biosensors and biomarkers, Principles of ecotoxicity.

Agriculture Sustainability and Clean agricultural practices: Biofertilizers, Biopesticides and vermi composting

Module VI

Environmental impact assessment and Environmental audit, Related case studies from India.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Environmental Science, S.C. Santra
- Environmental Biotechnology, Pradipta Kumar Mohapatra
- Environmental Biotechnology – Concepts and Applications" by Hans-Joachim Jordening and Jesef Winter
- Waste Water Engineering by Metcalf and Eddy. Publisher: Tata McGraw hill
- Environmental Microbiology: Methods and Protocols by Alicia L. Ragout De Spencer, John F.T. Spencer
- Introduction to Environmental Biotechnology by Milton Wainwright
- Principles of Environmental Engineering by Gilbert Masters

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Environmental pollution and its major impacts	Lecture	MTB 206.1.	Mid Term-1, Quiz & End Sem Exam
2	Environmental pollution and its major impacts	Lecture		Mid Term-1, Quiz & End Sem Exam
3	concept of Global warming and climate change,	Lecture		Mid Term-1, Quiz & End Sem Exam
4	concept of Global warming and climate change,	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Global Ozone Problem,	Lecture		Mid Term-1, Quiz & End Sem Exam

6	Eutrophication,	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Land degradation, Biomagnification.	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Non-renewable energy resources,	Lecture	MTB 206.2.	Mid Term-1, Quiz & End Sem Exam
9	Non-renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
12	concept of clean fuel technology,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture	MTB 206.3.	Quiz & End Sem Exam
16	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture		Quiz & End Sem Exam
17	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Microbial technology for mining of metals (Bioleaching)	Lecture		Quiz & End Sem Exam
19	Microbial technology for mining of metals (Bioleaching)	Lecture		Quiz & End Sem Exam
20	Concept of Biomineralisation.	Lecture		Quiz & End Sem Exam
21	Waste water engineering: physicochemical characteristic of water,	Lecture	MTB 206.4.	Quiz & End Sem Exam
22	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
23	waste water treatment of	Lecture		Quiz & End Sem

	municipal wastes and industrial effluents			Exam
24	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
25	Advanced waste water treatments	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Bioassessment of environmental quality: Biosensors and biomarkers,	Lecture	MTB 206.5.	Quiz & End Sem Exam
27	Bioassessment of environmental quality: Biosensors and biomarkers,	Lecture		Quiz & End Sem Exam
28	Bioassessment of environmental quality: Principles of ecotoxicity.	Lecture		Quiz & End Sem Exam
29	Agriculture Sustainability and Clean agricultural practices:	Lecture		Quiz & End Sem Exam
30	Biofertilizers,	Lecture		Quiz & End Sem Exam
31	Biopesticides	Lecture		Quiz & End Sem Exam
32	Vermi composting	Lecture		Quiz & End Sem Exam
33	Environmental impact assessment	Lecture	MTB 206.6.	Quiz & End Sem Exam
34	Environmental impact assessment	Lecture		Quiz & End Sem Exam
35	Environmental audit,	Lecture		Quiz & End Sem Exam
36	Environmental audit,	Lecture		Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MTB 206.1.	Understand concept of climate change, pollution and mitigation approaches.	3	3	3	2	1	-	-	2	1	-		3	3	-	-
MTB 206.2.	Understand concept of energy sustainability, clean fuel technology, Biomass energy and biofuels.	3	3	3	2	1	-	-	2	1	-		3	3	1	1
MTB 206.3.	Understand concept of Biodegradation, Bioremediation and Phytoremediation. Advances in bioleaching and biomineralization.	3	2	3	2	1	-	-	2	1	-		3	3	-	-
MTB 206.4.	Understand Advanced waste water treatments.	3	3	3	2	1	-	-	2	1	-		3	3	1	-
MTB 206.5.	Understand Agriculture Sustainability and Clean agricultural practices, Biosensors and biomarkers, Principles of ecotoxicity	3	3	2	2	1	-	-	2	1	-		3	3	-	-

MTB 206.6.	Understand the Environmental impact assessment and Environmental	3	2	3	2	-	-	-	2	1	-		3	3	-	-

	audit, Relatedcase studies fromIndia.															

Sample Question Paper

Amity Institute Biotechnology 2017-18						
Class: M. Tech Biotechnology II Semester						
Subject Name: ENVIRONMENTAL BIOTECHNOLOGY		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,6	Q.2, 3, 7	Q.5,10	Q. 4, 8,	Q. 9,	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	Briefly explain the following (i) Activated sludge (ii) Biomethanation.	6
CO6	Q.2	Write a short note on different tools of conducting EIA	6
CO1	Q.3	Define clean fuels and their advantages? How they differ from fossil fuels?	6
CO2	Q.4	Write a short note on the problems associated with prolonged and indiscriminate use of chemical fertilizers and pesticides in present agriculture system.	6

CO5	Q.5	Briefly discuss the role and benefits of biofertilizers in sustainable agriculture system.	6

CO4	Q.6	Write a short note on modes of dispersion of toxic substances in the environment.	6
CO 1	Q.7	What is biodegradation? Discuss role of microbial enzymes especially microbial Dehalogenases and Phosphotriesterase (PTEs) in biodegradation of pesticides in soil.	10
CO3	Q.8	(a) Explain the Solar energy and Wind energy, point out their significance in context of environment and energy (b) Sustainability	10
CO5	Q.9	(c) Explain Explain the following with suitable example. (i) Rhizofilteration (ii) Biomagnification.	10
CO4	Q.10	Discuss the following in detail. (d) What is microbial leaching of metal ores? Explain any two ex-situ methods of microbial leaching from metal ore. How these methods are better eco-friendly options over conventional chemical metal extraction process? (e) Describe secondary treatment of municipal waste water through advanced biofilm based approaches. What impurities and toxic pollutants are usually removed during secondary waste water treatment?	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental Biotechnology/***Course code ***MTB 206*** is level **3** for the academic year ***2017-18***.

AMITY UNIVERSITY
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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MICROBIOLOGY
Course Code : BMB 302, Crédits : 04, Session :2018-19 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: The course imparts the knowledge of different types of microorganisms that are invisible to our naked eyes. Discovery origin and evaluation of different forms of bacteria, fungi, protozoa and viruses constitute the basics of biotechnology.

B. Course Outcomes: After successful completion of the course student will be able to:

BMB 302.1. Understand the microbiological techniques for the isolation and characterization of microbes.
BMB 302.2. Understand the mechanism of different metabolic processes.
BMB 302.3. Know the physiology and survival mechanism of extremophilic bacteria.
BMB 302.4. Know the concept of virus lytic and lysogenic cycle is quite clear to students.
BMB 302.5. Understand the epidemiology and microbial pathogenesis.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.
PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.
PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.
PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/ HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the

causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization,

Module II

Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, continuous culture, culture collection and maintenance of cultures.

Module III

Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV

Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archaea

Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles Viruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI

Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII

Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott

- The microbes – An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

References:

- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin & Cummings
- Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
- Industrial Microbiology, Casida, New Age International
- Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC. Brown Publisher.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
2	Role of microorganisms in transformation of organic matter and in the causation of diseases,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
3	Development of pure culture methods.	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
4	Methods in Microbiology -Principles of microbial nutrition,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
5	Culture media,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
6	Culture media,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
7	Physical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
8	Physical Sterilization	Lecture	BMB 302.1.	Mid Term-

				1, Quiz & End Sem Exam
9	Chemical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
10	Chemical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
11	Prokaryotic structure and function	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
12	Cell wall	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
13	Cell cytoplasmic membrane	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
14	Capsule	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
15	Surface appendages	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
16	Cytoplasm and cytoplasmic inclusion	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
17	Bacterial growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
18	Mathematical expression of growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam

19	Growth curve	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
20	Measurement of growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
21	Synchronous growth,	Lecture	BMB 302.2	Quiz & End Sem Exam
22	Continuous culture,	Lecture	BMB 302.2	Quiz & End Sem Exam
23	Culture collection and maintenance of cultures.	Lecture	BMB 302.2	Quiz & End Sem Exam
24	Systematics and taxonomy - new approaches to bacterial taxonomy,	Lecture	BMB 302.2	Quiz & End Sem Exam
25	Classification including ribotyping, ribosomal RNA sequencing,	Lecture	BMB 302.2	Quiz & End Sem Exam
26	Characteristics of primary domains, taxonomy, nomenclature and Bergey's manual	Lecture	BMB 302.2	Quiz & End Sem Exam
27	Metabolic Diversity among microorganisms- photosynthesis in microorganisms	Lecture	BMB 302.2	Quiz & End Sem Exam
28	Role of bacteriochlorophylls	Lecture	BMB 302.2	Quiz & End Sem Exam
29	carotenoids and phycobilins	Lecture	BMB 302.2	Quiz & End Sem Exam
30	Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria,	Lecture	BMB 302.2	Quiz & End Sem Exam
31	nitrate and sulphate reduction,	Lecture	BMB 302.2	Quiz & End Sem Exam
32	methanogenesis and acetogenesis,	Lecture	BMB 302.2	Quiz & End Sem Exam
33	Fermentations,	Lecture	BMB 302.2	Quiz & End Sem Exam
34	Nitrogen fixation,	Lecture	BMB 302.2	Quiz & End Sem Exam
35	Plant microbe interactions	Lecture	BMB 302.2	Quiz & End Sem Exam
36	Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BMB 302.3	Quiz & End Sem Exam
37	*Viruses: Bacterial, animal;*	Lecture	BMB	Quiz & End Sem

	structure of viruses;		302.4	Exam
38	*Reproduction and life cycle of RNA and DNA viruses; Viroids and prions.*	Lecture	BMB 302.4	Quiz & End Sem Exam
39	*Algae: Classification and Reproduction.*	Lecture	BMB 302.4	Quiz & End Sem Exam
40	*Fungi: Classification and Reproduction.*	Lecture	BMB 302.4	Quiz & End Sem Exam
41	Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract,	Lecture	BMB 302.5	Quiz & End Sem Exam
42	Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo) and their mode of actions,	Lecture	BMB 302.5	Quiz & End Sem Exam
43	Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission;	Lecture	BMB 302.5	Quiz & End Sem Exam
44	Sexually transmitted disease including AIDS, Food and water-borne diseases; pathogenic fungi.	Lecture	BMB 302.5	Quiz & End Sem Exam
45	Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins,	Lecture	BMB 302.5	Quiz & End Sem Exam
45	Broad spectrum antibiotics	Lecture	BMB 302.5	Quiz & End Sem Exam
46	Antifungal antibiotics	Lecture	BMB 302.5	Quiz & End Sem Exam
47	Antibiotics mode of action.	Lecture	BMB 302.5	Quiz & End Sem Exam
48	Antibiotics mode of action.	Lecture	BMB 302.5	Quiz & End Sem Exam

J. **Course Articulation Matrix (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 302.1	Understand the microbiological techniques for the isolation and characterization of microbes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.2	Understand the mechanism of different metabolic processes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.3	Know the physiology and survival mechanism of extremophilic bacteria.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.4	Learn structure and function of the cell cytoskeleton, cilia and flagella.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.5	Understand the epidemiology and microbial pathogenesis	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

Amity Institute Biotechnology
2018-19

Class: B.Sc.-M.Sc. (Dual Degree) Biotechnology
III Semester

Subject Name: Microbiology	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

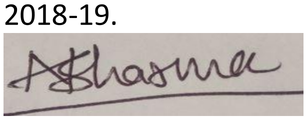
- Understand the microbiological techniques for the isolation and characterization of microbes.
- Understand the mechanism of different metabolic processes.
- Know the physiology and survival mechanism of extremophilic bacteria.
- Know the concept of virus lytic and lysogenic cycle is quite clear to students.
- Understand the epidemiology and microbial pathogenesis.

CO Map	Question No.	Question	Marks
CO1	Q.1	Write the historical contributions of Louis Pasteur and Robert Koch in the field of microbiology.	6
CO2	Q.2	Write down the steps involved in Gram's staining procedure. Differentiate between Gram positive and gram negative bacteria.	6
	Q.3	Explain the importance of extracellular appendages present in bacteria.	6
CO4	Q.4	Describe polyphasic taxonomy and discuss some of its advantages	6
CO4	Q.5	Discuss about the mechanism of photo-phosphorylation in bacterial system.	6
CO3	Q.6	Give an outline the nitrogen fixation, and explain the roles of microorganisms in this cycle	6
	Q.7	What are the archaea? Briefly describe the major ways in which they differ from bacteria and eucaryotes.	10
CO4	Q.8	Write a note on viroids and prions with suitable example of disease.	10

CO3	Q.9	Discuss about normal microbiota present on different body region with suitable features	10
CO3	Q.10	What is penicillinase? Explain the role of penicillin against the synthesis of bacterial cell wall. How does a low concentration of penicillin G select for penicillin-resistant bacteria?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Microbiology***/Course code ***BMB 302*** is level **2** for the academic year 2018-19.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BMB 401	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **Bioinformatics**
Course Code : BMB 401, Crédits : 3, Session :2018-19 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The course involves a basic understanding of computer and bioinformatics tools and skills in the field of biology

B. **Course Outcomes:** After successful completion of the course student will be able to:

BMB 401.1. Understand and explain the structural organization and characteristics of computers and its parts

BMB 401.2. Describe the concept of use of internet in bioinformatics.

BMB 401.3. Explain the concept and organization of biological databases..

BMB 401.4. Understand and explain the structure and functions of the phylogenetic analytic tools.

BMB 401.5. Interrogate major database sources and be able to integrate this information with clinical data.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Computers
General introduction (characteristics, capabilities, generations), software, hardware : organization of hardware (input devices, memory, control unit arithmetic logic unit, output devices); software : (System software; application software, languages -low level, high level), interpreter, compiler, data processing; batch, on-line, real-time (examples from bioindustries; e.g. application of computers in co-ordination of solute concentration, ph, temperature, etc., of a fermenter in operation); internet application.

Module II: Basic Bioinformatics
Introduction to Internet, Search Engines (Google, Yahoo, Entrez etc)

Module III: Biological Databases
Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL), Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc), Cluster databases-An Introduction, Specialised databases (KEGG, etc), Database technologies (Flat-file), Structural databases (PDB)

Module IV: Phylogenetic Analysis
Trees-splits and metrices on trees, tree interpretation, Distance – additive, ultrameric and nonadditive distances,tree building methods, phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains, estimating the rate of change, likelihood and trees; analysis software.

Module V: Genome analysis
Annotation, comparison of different methods; ESTs – databases, clustering, gene discovery and identification, and functional classification. Reconstruction of metabolic pathways; Genome analysis, genome anatomy, genome rearrangements with inversions, signed inversions, gene identification, gene expression, expression analysis, gene identification and functional classification

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
• Computer Science, J.G. Brookshear, Pearson, Addison Wesley
• Introduction to Bioinformation – T.Attawood
References:
• A book on C by Kelley : Programming in C, Addison-Wesley Publishing
• Introduction to C++ for Engineers and Scientists, Prentice-Hall
• Schaum's Outline of Introduction of Computer Science, P. Cushman and R. Mata-Toledo, McGraw Hill
Trade
• Bioinformatics – Managing Scientific Data, Zoe' Lacroix and Terence Critchlow
• Bioinformatics – Sequence, Structure and Databanks, Des Higgins & Willie Taylor
• Structural Bioinformatics, Philip E. Bourne, Helge Weissig 2003
• Statistical Methods in Bioinformatics: An Introduction, G.R. Grant, W.J. Ewens, Springer Verlag

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**
1	General introduction (characteristics, capabilities, generations),	Lecture	**BMB 401.1**.	Mid Term-1, Quiz & End Sem Exam
2	software, hardware : organization of hardware (input devices, memory, control unit	Lecture	**BMB 401.1**.	Mid Term-1, Quiz & End Sem Exam

	arithmetic logic unit, output devices),			
3	organization of hardware	Lecture	**BMB 401.2**.	Mid Term-1, Quiz & End Sem Exam
4	*organization of software*	Lecture	**BMB 401.2**.	Mid Term-1, Quiz & End Sem Exam
5	Interpreter, compiler, data processing; batch, on-line, real-time	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
6	Introduction and application of Internet	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
7	Search Engines (Google, Yahoo, Entrez etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
8	Revision	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
9	Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
10	Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
11	Cluster data bases-An Introduction. Specialized databases (KEGG, etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
12	Database technologies (Flat-file)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
13	Revision	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
14	Introduction of phylogenetics analysis	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
15	Trees-splits and metrices on trees, tree interpretation	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
16	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
17	phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
18	Estimating the rate of change, likelihood and trees; analysis software	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
19	Annotation, comparison of different methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
20	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
21	Revision	Lecture	**BMB 401.4**	Quiz & End Sem

				Exam
22	ESTs – databases, clustering	Lecture	**BMB 401.4**	Quiz & End Sem Exam
23	Gene discovery	Lecture	**BMB 401.4**	Mid Term-2, Quiz & End Sem Exam
24	Identification and classification	Lecture	**BMB 401.5**	Quiz & End Sem Exam
25	Revision	Lecture	**BMB 401.5**	Quiz & End Sem Exam
26	Reconstruction of metabolic pathways	Lecture	**BMB 401.5**	Quiz & End Sem Exam
27	Genome analysis, genome anatomy	Lecture	**BMB 401.4**	Quiz & End Sem Exam
28	Genome rearrangements with inversions	Lecture	**BMB 401.4**	Quiz & End Sem Exam
29	signed inversions, gene identification	Lecture	**BMB 401.4**	Quiz & End Sem Exam
30	Reconstruction of metabolic pathways	Lecture	**BMB 401.4**	Quiz & End Sem Exam
31	Genome analysis, genome anatomy	Lecture	**BMB 401.4**	Quiz & End Sem Exam
32	Gene expression	Lecture	**BMB 401.4**	Quiz & End Sem Exam
33	Gene expression analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
34	Gene identification methods	Lecture	**BMB 401.1**	Quiz & End Sem Exam
35	Functional classification	Lecture	**BMB 401.1**	Quiz & End Sem Exam
36	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
37	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
38	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam
39	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam
40	Gene expression	Lecture	**BMB 401.1**	Quiz & End Sem Exam
41	Gene expression analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
42	Gene identification methods	Lecture	**BMB 401.1**	Quiz & End Sem Exam
43	Functional classification	Lecture	**BMB 401.1**	Quiz & End Sem Exam
44	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
45	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
45	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 401.1	Understand and explain the structural organization and characteristics of computers and its parts	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.2	Describe the concept of use of internet in bioinformatics.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.3	Explain the concept and organization of biological databases	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.4	Understand and explain the structure and functions of the phylogenetic analytic tools.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.5	Interrogate major database sources and be able to integrate this information with clinical data.	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

Amity Institute Biotechnology 2018-19						
Class: B.Sc. Biotechnology IV Semester						
Subject Name: **Bioinformatics**		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

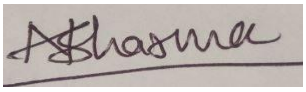
- Understand the basic knowledge of computer hardware and software.
- Understand the advanced techniques of bioinformatics.
- Understand the application of bioinformatics in different area.
- Understand the role of computational biology in drug designing.
- Understand the importance of phylogenetic analysis in species development.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about the importance of input and output device of computer. Also differentiate between input and output devices.	6
CO2	Q.2	Discuss about the anatomy of E. mail and www.	6
	Q.3	Explain about the different databases present in NCBI. Give a comparison between protein databases and nucleotide databases with examples.	6
CO4	Q.4	Discuss about the different terminology used in phylogenetic tree with the suitable diagram.	6
CO4	Q.5	Write about the genome of between prokaryotic and eukaryotic organism.	6
CO3	Q.6	Discuss a general classification of computer generations with suitable examples, merits and demerits	6
	Q.7	What is topology of computer networking? Write advantages and disadvantages of different topology networking.	10
CO4	Q.8	Write a detail note on RCSB, Genbank, and DDBJ with advantages.	10
CO3	Q.9	What is sequence similarity? Explain about the different quantitative methods of sequence similarity	10
CO3	Q.10	. A. Explain the different methods used for gene prediction. Discuss one of the methods in detail with suitable diagram. B. By writing the corresponding match states into columns we get the following alignment: ATGA AGTA	20

		What is its score under the following scoring scheme? Match +2, Mismatch -1 and Gap +1.Explain with global alignment algorithm.	

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Bioinformatics** /Course code ***BMB 401*** is level **2** for the academic year 2018-19.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BMB 403	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **IMMUNOLOGY & IMMUNOTECHNOLOGY**
Course Code : BMB 403, Crédits : 04, Session :2018-19 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. Course Outcomes: After successful completion of the course student will be able to:

BMB 403.1. Understand and explain the phylogeny of immune system, types of immunity, immune response.
BMB 403.2. Describe the concept of clonal selection theory, humoral and cell mediated immunity.
BMB 403.3. Understand and explain the structure and functions of the organs and cells of the immune system.
BMB 403.4. Understand the mechanism of antigen-antibody interaction.
BMB 403.5. Describe the structure of antibodies, their types and functions in immunity.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.
PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.
PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.
PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I :
Descriptors/Topics
Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.

Module II:
Descriptors/Topics
The organs and cells of the immune system.

Module III :

Descriptors/Topics

Histocompatibility: structure of MHC class I, II & III antigens & their mode of antigen presentation, MHC restriction; Antigens & antigenicity;

Module IV :

Descriptors/Topics

Antibody structure in relation to function and antigen-binding; Types of antibodies and their structures: isotypes, allotypes, idiotypes. Antibodies in targeting therapeutic agents. Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application

Module V :

Descriptors/Topics

Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.

Module VI :

Descriptors/Topics

Measurement of antigen – antibody interaction: agglutination, precipitation immunodiffusion, immuno-electrophoresis, ELISA, RIE

Module VII :

Descriptors/Topics

Tissue and organ transplantation

Module VIIII :

Descriptors/Topics

Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.

Autoimmunity and autoimmune diseases: Hashimoto's thyroiditis; Myasthenia gravis; Rheumatoid Arthritis, Pernicious anemia, Asthma.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Freeman

References:

- Immunology, Roitt, Mosby – Yearbook Inc.
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.1**.	Mid Term-1, Quiz & End Sem Exam
2	Innate and specific immunity. Humoral immunity,	Lecture	**BMB 403.1**.	Mid Term-1, Quiz & End Sem Exam
3	Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.2**.	Mid Term-1, Quiz & End Sem Exam
4	Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.2**.	Mid Term-1, Quiz & End Sem Exam
5	The organs of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
6	The organs of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
7	The cells of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
8	The cells of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
9	Histocompatibility: structure of MHC class I, II & III	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
10	Histocompatibility: structure of MHC class I, II & III	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
11	Antigens	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
12	Mode of antigen presentation,	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
13	MHC restriction; Antigens & antigenicity	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
14	MHC restriction; Antigens & antigenicity	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
15	Antibody structure in relation to	Lecture	**BMB 403.4**	Mid Term-1,

	function and antigen-binding			Quiz & End Sem Exam
16	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
17	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
18	Antibodies in targeting therapeutic agents.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
19	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
20	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
21	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application,	Lecture	**BMB 403.4**	Quiz & End Sem Exam
22	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Quiz & End Sem Exam
23	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.4**	Mid Term-2, Quiz & End Sem Exam
24	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam
25	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam
26	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam
27	Measurement of antigen – antibody interaction: agglutination,	Lecture	**BMB 403.5**	Quiz & End Sem Exam
28	Precipitation	Lecture	**BMB 403.5**	Quiz & End Sem Exam
29	immunodiffusion,	Lecture	**BMB 403.5**	Quiz & End Sem

				Exam
30	immuno-electrophoresis,	Lecture	**BMB 403.5**	Quiz & End Sem Exam
31	ELISA,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
32	RIE,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
33	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
34	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
35	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
36	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
37	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
38	Autoimmunity	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
39	Autoimmunity	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
40	Autoimmune diseases: Hashimoto's thyroiditis;	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
41	Myasthenia gravis;	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
42	Rheumatoid Arthritis,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
43	Pernicious anemia,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
44	Pernicious anemia,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
45	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
45	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
46	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
47	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
48	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 403.1	Understand and explain the phylogeny of immune system, types of immunity, immune response.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.2	Describe the concept of clonal selection theory, humoral and cell mediated immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.3	Understand and explain the structure and functions of the organs and cells of the immune system	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.4	Understand the mechanism of antigen-antibody interaction	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.5	Describe the structure of antibodies, their types and functions in immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

Amity Institute Biotechnology 2018-19						
Class: B.Sc.-M.Sc. (Dual Degree) Biotechnology IV Semester						
Subject Name: **Immunology & Immunotechnology**		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

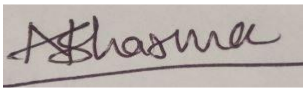
- Understand and explain the phylogeny of immune system, types of immunity, immune response.
- Describe the concept of clonal selection theory, humoral and cell mediated immunity.
- Understand and explain the structure and functions of the organs and cells of the immune system.
- Understand the mechanism of antigen-antibody interaction.
- Describe the structure of antibodies, their types and functions in immunity.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about innate and adaptive immunity. Discuss about the different types of innate immunity with characters.	6
CO2	Q.2	Write a note on different phases of cytotoxic cell mediated targeting killing mechanism.	6
	Q.3	Write a general organization of class I and class II MHC molecules with suitable diagram.	6
CO4	Q.4	Discuss the role of IgG immunoglobulin in immune system.	6
CO4	Q.5	What is antibody diversity? Discuss the role of light chain gene rearrangement in antibody diversity.	6
CO3	Q.6	Draw a well labeled diagram of hybridoma technology with production of monoclonal antibody.	6
	Q.7	Discuss the role of innate and adaptive immunity in tissue grafting. Explain with suitable example.	10
CO4	Q.8	Give a comparison between all type of vaccine with examples and applications.	10
CO3	Q.9	Discuss about features of any two primary lymphoid organs with suitable diagram	10
CO3	Q.10	A. Although all lymphocytes are formed in bone marrow. Explain how these cells get differentiated into B cell and T cell. B Where the CDR regions located on an antibody molecule and what are	20

		are their functions? Discuss the ELISA method on the basis of antigen and antibody interaction.	

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Immunology and immunotechnology**/Course code ***BMB 403*** is level **2** for the academic year 2018-19.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2018-19

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant

and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

	PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
	BSB 202	3	2	2	3	-	-	-	1	2	1			3	2	-	
														-	-	-	
														-	-	-	
II SEM														-	-	-	
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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOANALYTICAL TECHNIQUES
Course Code : BSB 202, Crédits : 03, Session :2018-19 (Even Sem.), Class : B.Sc. 1st Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in Bioanalytical techniques The student will be exposed to principles, instrumentation & application of various instruments & techniques used in biological research.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 202.1. Develop deep theoretical understanding of analytical instruments and their practical use in the laboratory, it includes the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc.
BSB 202.2. Understand principle instrumentation of chromatographic techniques and their types.
BSB 202.3. Principle and applications of electrophoresis i.e., PAGE (Native and SDS), Immunoelectrophoresis etc.
BSB 202.4. Understand about radioisotope and tracer techniques in life sciences.

C. **Programme Outcomes:**

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.
PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Instruments, basic principles and usage
pH meter, absorption and emission spectroscopy, Principle and law of absorption, fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), polarography, centrifugation, atomic absorption, NMR, X-ray crystallography, Circular Dichorism.

Module II: Chromatography techniques
Paper chromatography, thin layer chromatography, affinity chromatography, column chromatography, HPLC, gas chromatography, gel filtration and ion exchange chromatography,

Module III: Electrophoresis
Agarose gel electrophoresis, SDS polyacrylamide electrophoresis, immunoelectrophoresis, Isoelectric focussing.

Module IV: Radioisotope tracer techniques and autoradiography

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
- Bioinstrumentation, Webster
- Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
- Crystal Structure Analysis, J.P. Glusker and K.N. Trueblood, Oxford University Press
- Modern Spectroscopy, J.M. Hollas, John Wiley and Son Ltd.
- NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry, H. Gunther, John Wiley and Sons Ltd.
- Principles of Physical Biochemistry, K.E. Van Holde, Prentice Hall.
- Principles and Practice of Bioanalysis, Richard F. Venn
- Microscopic Techniques in Biotechnology, Michael Hoppert
- Principles of Fermentation Technology, P.F. Stanbury, A. Whitaker, S.J. Hall

I. **Lecture Plan**

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction of instrumentation	Lecture	BSB 202.1.	Mid Term-1, Quiz & End Sem Exam
2	pH meter,	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Absorption and emission spectroscopy,	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Absorption and emission spectroscopy,	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Principle and law of absorption,	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Principal and applications fluorimetry,	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Principal and applications Colorimetry	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Principal and applications spectrophotometry (visible, UV, infra-red),	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Principal and applications Polorography	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Principal and applications Centrifugation	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Principal and applications NMR	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Principal and applications X-ray Crystellography	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Principal and applications Circular Dichorism.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Principal and applications of Paper Chramatography	Lecture	BSB 202.2.	Mid Term-1, Quiz & End Sem Exam
15	Principal and applications thin layer chromatography	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Principal and applications Column Chromatography	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Principal and applications Column Chromatography	Lecture		Quiz & End Sem Exam
18	Principal and applications Affinity chromatography	Lecture		Quiz & End Sem Exam
19	Principal and applications gel filtration Chromatography	Lecture		Quiz & End Sem Exam
20	Principal and applications ion exchange Chromatography	Lecture		Quiz & End Sem Exam
21	Principal and applications	Lecture		Quiz & End Sem

	Gas Chromatography			Exam
22	Principal and applications of HPLC	Lecture		Quiz & End Sem Exam
23	Agarose gel electrophoresis,	Lecture	BSB 202.3.	Quiz & End Sem Exam
24	Agarose gel electrophoresis,	Lecture		Quiz & End Sem Exam
25	Native polyacrylamide electrophoresis (PAGE)	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Native polyacrylamide electrophoresis (PAGE)	Lecture		Quiz & End Sem Exam
27	SDS polyacrylamide electrophoresis (SDS-PAGE)	Lecture		Quiz & End Sem Exam
28	SDS polyacrylamide electrophoresis (SDS-PAGE)	Lecture		Quiz & End Sem Exam
29	Immunoelectrophoresis	Lecture		Quiz & End Sem Exam
30	Imunoelectrophoresis	Lecture		Quiz & End Sem Exam
31	Isoelectric focussing.	Lecture	BSB 202.4.	Quiz & End Sem Exam
32	Radioisotopes in life sciences	Lecture		Quiz & End Sem Exam
33	Radioisotope tracer techniques	Lecture		Quiz & End Sem Exam
34	Radioisotope tracer techniques	Lecture		Quiz & End Sem Exam
35	Autoradiography	Lecture		Quiz & End Sem Exam
36	Autoradiography	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
BSB 202.1.	Develop deep theoretical understanding of analytical instruments and their practical use	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**

	in the laboratory, it includes the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc.															
BSB 202.2.	Understand basic instrumentation of chromatographic techniques and their types.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**
BSB 202.3	Principle and applications of electrophoresis i.e., PAGE (Native and SDS), Immunoelectrophoresis etc.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**
BSB 202.4	Understand about radioisotope and tracer techniques in life sciences.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**2**	**2**	**1**			**3**	**1**	**-**

Sample Question Paper

<table>
<tr><td colspan="7" align="center">Amity Institute Biotechnology
2018-19</td></tr>
<tr><td colspan="7" align="center">Class: B.Sc. (H) Biotechnology
II Semester</td></tr>
<tr><td colspan="2">Subject Name:
BIOANALYTICAL TECHNIQUES</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.2, 10</td><td>Q. 7, 8, 9,</td><td></td></tr>
<tr><td colspan="7">Student will be able to:</td></tr>
</table>

CO Map	Question No.	Question	Marks

CO1	Q.1	Write the standard definition of pH? How does pH meter measures the pH?	6
CO2	Q.2	Differentiate between Ascending and Descending paper chromatography.	6
	Q.3	Write short note on of counter-current imunoelectrophoresis.	6
CO4	Q.4	Define radioisotopes tracer technique and its applications in biological research.	6
CO4	Q.5	Write a short note on autoradiography and its applications in biological research.	6
CO3	Q.6	Define retention factor (Rf) value, write its significance.	6
	Q.7	Discuss polyacrylamide gel electrophoresis, Why low molecular weight proteins are separated on high el percentage in PAGE? How PAGE offers advantage over Agarose gel electrophoresis?	10
CO1	Q.8	Explain the principle and instrumentation of UV/Vis spectrophotometer. Draw its block diagramme and enlist its applications.	10
CO3	Q.9	Explain the working principle and methodology of Thin Layer Chromatography (TLC). Enlist its applications.	10
CO3	Q.10	. A Design the affinity column to separate the eukaryotic mRNA from mixture of different types of RNAs (rRNA, t-RNA, mRNA, and other snRNA)? Write the detailed description.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioanalytical techniques***/Course code ***BSB 202*** is level **3** for the academic year ***2018-19***.

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Genetics
Course Code : BSB301, Credits : 03, Session : 2018-19 (Odd Sem.), Class : B.Sc. 2^{nd} Year
Faculty Name : Dr. Manish Kumar

A. Introduction: To acquaint the students to understand the basic concept of genetics incorporating the concepts of classical, molecular genetics. Students will learn about Mendelian Laws, Extension of Mendels Law, Multiple allele and isoallele, etc. Mutation, Mutagen, Chromosomal Aberrations, Human Genetic Disorders. Knowledge of methods of sex determination, Chromosomal non-disjunction, Chromosomal theory of inheritance, Sex linked, Sex limited and Sex limited Inheritance, Extra-chromosomal inheritance. Understanding of Population Genetics, Hardy-Weinberg Equilibrium, Gene and Genotype Frequencies.

B. Course Outcomes: At the end of the course, students will be able to:

BSB301.1. Students will develop an understanding of History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance.

BSB301.2. Understanding the pre-Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation.

BSB301.3. To study the classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage.

BSB301.4. Students will develop a basic understanding of Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders.

BSB301.5. Knowledge of Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance.

BSB301.6. Students will learn about extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA.

BSB301.7. Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies.

C. Programme Outcomes:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course

also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Program Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Brief history, scope and significance of Genetics. Mendelian law of inheritance. Lethality and interaction of gene. Multiple allele and isoallele. Penetrance and Expressivity. Linkage and crossing over. Mapping of genes. interference and coincidence.

Module II: Basic microbial genetics, Conjugation, transformation, transduction and their use in genetic mapping.

Module III: Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over and complementation test, Benzers work on rII locus in T4 Bacteriophage.

Module IV: Mutation; spontaneous and induced, Mutagen;chemical and physical. Chromosomal aberrations; structural and numerical. Economic importance of mutation. Genetic disorders in human; Kleinefelter, Turner, Cri-du-Chat and Down syndrome.

Module V: Sex determination in plant and animal. Non disjunction as a proof of chromosomal theory of inheritance. Sex linked, sex influenced and sex limited inheritance.

Module VI: Extra chromosomal inheritance; cytoplasmic inheritance, Mitochondrial and Chloroplast genetic system.

Module VII: Population genetics; Hardy-Weinberg equilibrium law, Gene and genotype frequencies.

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

Principles of Genetics, E. J. Gardner, John Wiley & Sons Inc.

Genetics, P.K. Gupta, Rastogi Publication.

Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, Pearson Education.

Genetics, M.W. Strickberger, Prentice Hall College Division.

Genetics, P.J. Russell, Benjamin/Cummings.

Genetics, R. Goodenough, International Thomson Publishing.

Introduction to Genetic Analysis, A.J. F. Griffiths, W.H. Freeman and Company.

Principles of Genetics, D.P. Snustad& M.J. Simmons, John Wiley and Sons Inc.

Molecular Biology of the Gene (Fifth Edition), J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison Wiesley Publishing.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Brief history, scope and significance of Genetics	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
2	Mendelian law of inheritance	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
3	Lethality and interaction of gene. Multiple allele and isoallele.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
4	Penetrance and Expressivity. Linkage and crossing over.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
5	Mapping of genes. Interference and coincidence.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
6	Basic microbial genetics	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
7	Conjugation	Lecture	BSB301.2	Mid Term, Quiz & End

				Sem Exam
8	Transformation	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
9	Transduction	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
10	Genetic Mapping	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
11	Classical and modern concept of gene	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
12	Pseudoallelism, position effect	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
13	Intragenic crossing over	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
14	Mapping of genes	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
15	Interference and coincidence	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
16	Mutation; spontaneous and induced	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
17	Mutagen; chemical and physical	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
18	Chromosomal aberrations	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
19	Structural and numerical Aberration	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
20	Economic importance of mutation	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
21	Genetic disorders in human	Lecture	BSB301.4	Quiz & End Sem Exam
22	Sex determination in plant	Lecture	BSB301.5	Quiz & End Sem Exam
23	Sex determination in animal	Lecture	BSB301.5	Quiz & End Sem Exam

24	Non disjunction	Lecture	BSB301.5	Quiz & End Sem Exam
25	Non disjunction as a proof of chromosomal theory of inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
26	Sex linked inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
27	Sex influenced and sex limited inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
28	Extra chromosomal inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
29	Cytoplasmic inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
30	Mitochondrial DNA	Lecture	BSB301.6	Quiz & End Sem Exam
31	Chloroplast genetic system	Lecture	BSB301.6	Quiz & End Sem Exam
32	Significance of Extra chromosomal inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
33	Significance of cytoplasmic inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
34	Population genetics	Lecture	BSB301.7	Quiz & End Sem Exam
35	Hardy-Weinberg equilibrium law	Lecture	BSB301.7	Quiz & End Sem Exam
36	Gene and genotype frequencies	Lecture	BSB301.7	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB301.1	History and scope of Genetics, Linkage, Crossing Over,	3	2	2	2	2	2	2	2	2	2	3	2	2

	Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance													
BSB301.2	Pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB301.3	Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage	3	2	2	2	2	2	2	2	3	3	3	2	2
BSB301.4	Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders	3	3	2	3	2	2	2	2	2	2	3	2	2
BSB301.5	Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance	3	2	3	2	2	3	2	2	2	2	3	2	2
BSB301.6	Extra-chromosomal inheritance, cytoplasmic inheritance,	3	3	2	3	2	2	2	2	2	2	3	2	2

	Mitochondrial and Chloroplast DNA													
BSB301.7	Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies	3	2	2	3	2	2	2	2	2	2	3	2	2

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
MID-SEMESTER 2018-19</td></tr>
<tr><td colspan="7">Class: B.Sc. (Biotech) III Semester</td></tr>
<tr><td colspan="2">Subject Name:
BSB 301 GENETICS</td><td colspan="3">Time: 2 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q. 1,4</td><td>Q. 2,3</td><td>Q. 4</td><td>Q. 2,5,6</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to
CO1: History and scope of Genetics
CO2: Understanding the pre Mendelian genetic concepts</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the scope and significance of genetics.	3
CO1	Q.2a	What are different steps involved in genetic mapping ?	3
	Q.2b	How is mechanism of conjugation is different from transformation ?	3
CO1	Q.3	How classical concept of gene is different from modern concept of gene ?	6
CO2	Q.4	Explain the significance of extra-chromosomal inheritance and cytoplasmic inheritance.	3

Attainments	**Rubric**

Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **GENETICS/BSB 301** is **level 3** for the academic year 2018-19.

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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
III	BSB 302	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MICROBIOLOGY
Course Code : BSB 302, Crédits : 04, Session :2018-19 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: The course imparts the knowledge of different types of microorganisms that are invisible to our naked eyes. Discovery origin and evaluation of different forms of bacteria, fungi, protozoa and viruses constitute the basics of biotechnology.

B. Course Outcomes: After successful completion of the course student will be able to:

BSB 302.1. Understand the microbiological techniques for the isolation and characterization of microbes.

BSB 302.2. Understand the mechanism of different metabolic processes.

BSB 302.3. Know the physiology and survival mechanism of extremophilic bacteria.

BSB 302.4. Know the concept of virus lytic and lysogenic cycle is quite clear to students.

BSB 302.5. Understand the epidemiology and microbial pathogenesis.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.
PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/ HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the

causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization,

Module II

Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, continuous culture, culture collection and maintenance of cultures.

Module III

Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV

Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archaea

Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles Viruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI

Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII

Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott

- The microbes – An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

References:

- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin & Cummings
- Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
- Industrial Microbiology, Casida, New Age International
- Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC. Brown Publisher.

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing CO**
1	Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
2	Role of microorganisms in transformation of organic matter and in the causation of diseases,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
3	Development of pure culture methods.	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
4	Methods in Microbiology -Principles of microbial nutrition,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
5	Culture media,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
6	Culture media,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem

				Exam
7	Physical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
8	Physical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
9	Chemical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
10	Chemical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
11	Prokaryotic structure and function	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
12	Cell wall	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
13	Cell cytoplasmic membrane	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
14	Capsule	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
15	Surface appendages	Lecture	BSB 302.2	Mid Term-1,

				Quiz & End Sem Exam
16	Cytoplasm and cytoplasmic inclusion	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
17	Bacterial growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
18	Mathematical expression of growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
19	Growth curve	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
20	Measurement of growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
21	Synchronous growth,	Lecture	BSB 302.2	Quiz & End Sem Exam
22	Continuous culture,	Lecture	BSB 302.2	Quiz & End Sem Exam
23	Culture collection and maintenance of cultures.	Lecture	BSB 302.2	Quiz & End Sem Exam
24	Systematics and taxonomy - new approaches to bacterial taxonomy,	Lecture	BSB 302.2	Quiz & End Sem Exam
25	Classification including ribotyping, ribosomal RNA sequencing,	Lecture	BSB 302.2	Quiz & End Sem Exam

26	Characteristics of primary domains, taxonomy, nomenclature and Bergey's manual	Lecture	BSB 302.2	Quiz & End Sem Exam
27	Metabolic Diversity among microorganisms- photosynthesis in microorganisms	Lecture	BSB 302.2	Quiz & End Sem Exam
28	Role of bacteriochlorophylls	Lecture	BSB 302.2	Quiz & End Sem Exam
29	carotenoids and phycobilins	Lecture	BSB 302.2	Quiz & End Sem Exam
30	Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria,	Lecture	BSB 302.2	Quiz & End Sem Exam
31	nitrate and sulphate reduction,	Lecture	BSB 302.2	Quiz & End Sem Exam
32	methanogenesis and acetogenesis,	Lecture	BSB 302.2	Quiz & End Sem Exam
33	Fermentations,	Lecture	BSB 302.2	Quiz & End Sem Exam
34	Nitrogen fixation,	Lecture	BSB 302.2	Quiz & End Sem Exam
35	Plant microbe interactions	Lecture	BSB 302.2	Quiz & End Sem Exam
36	Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BSB 302.3	Quiz & End Sem Exam
37	*Viruses: Bacterial, animal; structure of viruses;*	Lecture	BSB 302.4	Quiz & End Sem Exam
38	*Reproduction and life cycle of RNA and DNA viruses; Viroids and prions.*	Lecture	BSB 302.4	Quiz & End Sem Exam
39	*Algae: Classification and Reproduction.*	Lecture	BSB 302.4	Quiz & End Sem Exam

40	*Fungi: Classification and Reproduction.*	Lecture	BSB 302.4	Quiz & End Sem Exam
41	Host-parasite relationship - Normal micro flora of skin, oral cavity, gastrointestinal tract,	Lecture	BSB 302.5	Quiz & End Sem Exam
42	Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo) and their mode of actions,	Lecture	BSB 302.5	Quiz & End Sem Exam
43	Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission;	Lecture	BSB 302.5	Quiz & End Sem Exam
44	Sexually transmitted disease including AIDS, Food and water-borne diseases; pathogenic fungi.	Lecture	BSB 302.5	Quiz & End Sem Exam
45	Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins,	Lecture	BSB 302.5	Quiz & End Sem Exam
45	Broad spectrum antibiotics	Lecture	BSB 302.5	Quiz & End Sem Exam
46	Antifungal antibiotics;	Lecture	BSB 302.5	Quiz & End Sem Exam
47	Antibiotics mode of action.	Lecture	BSB 302.5	Quiz & End Sem Exam
48	Antibiotics mode of action.	Lecture	BSB 302.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB 302.1	Understand the microbiological techniques for the isolation and characterization of microbes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.2	Understand the mechanism of different metabolic processes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.3	Know the physiology and survival mechanism of extremophilic bacteria.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.4	Learn structure and function of the cell cytoskeleton, cilia and flagella.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.5	Understand the epidemiology and microbial pathogenesis	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

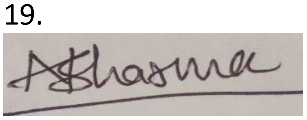
<table>
<tr><td colspan="7">Amity Institute Biotechnology
2018-19</td></tr>
<tr><td colspan="7">Class: B.Sc. Biotechnology
III Semester</td></tr>
<tr><td colspan="2">Subject Name: Microbiology</td><td colspan="2">Time: 3 Hrs</td><td colspan="3">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.7</td><td>Q. 8, 9,</td><td>Q. 10</td></tr>
<tr><td colspan="7">Student will be able to:
• Understand the microbiological techniques for the isolation and characterization of microbes.
• Understand the mechanism of different metabolic processes.
• Know the physiology and survival mechanism of extremophilic bacteria.
• Know the concept of virus lytic and lysogenic cycle is quite clear to students.
• Understand the epidemiology and microbial pathogenesis.</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Write the historical contributions of Louis Pasteur and Robert Koch in the field of microbiology.	6
CO2	Q.2	Write down the steps involved in Gram's staining procedure. Differentiate between Gram positive and gram negative bacteria.	6
	Q.3	Explain the importance of extracellular appendages present in bacteria.	6
CO4	Q.4	Describe polyphasic taxonomy and discuss some of its advantages	6
CO4	Q.5	Discuss about the mechanism of photo-phosphorylation in bacterial system.	6
CO3	Q.6	Give an outline the nitrogen fixation, and explain the roles of microorganisms in this cycle	6
	Q.7	What are the archaea? Briefly describe the major ways in which they differ from bacteria and eucaryotes.	10
CO4	Q.8	Write a note on viroids and prions with suitable example of disease.	10

CO3	Q.9	Discuss about normal microbiota present on different body region with suitable features	10
CO3	Q.10	What is penicillinase? Explain the role of penicillin against the synthesis of bacterial cell wall. How does a low concentration of penicillin G select for penicillin-resistant bacteria?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Microbiology***/Course code ***BSB 302*** is level **3** for the academic year 2018-19.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BSB 401	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **Bioinformatics**
Course Code : BSB 401, Crédits : 3, Session :2018-19 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The course involves a basic understanding of computer and bioinformatics tools and skills in the field of biology

B. **Course Outcomes:** After successful completion of the course student will be able to:

BMB 401.1. Understand and explain the structural organization and characteristics of computers and its parts

BMB 401.2. Describe the concept of use of internet in bioinformatics.

BMB 401.3. Explain the concept and organization of biological databases..

BMB 401.4. Understand and explain the structure and functions of the phylogenetic analytic tools.

BMB 401.5. Interrogate major database sources and be able to integrate this information with clinical data.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Computers
General introduction (characteristics, capabilities, generations), software, hardware : organization of hardware (input devices, memory, control unit arithmetic logic unit, output devices); software : (System software; application software, languages -low level, high level), interpreter, compiler, data processing; batch, on-line, real-time (examples from bioindustries; e.g. application of computers in co-ordination of solute concentration, ph, temperature, etc., of a fermenter in operation); internet application.

Module II: Basic Bioinformatics
Introduction to Internet, Search Engines (Google, Yahoo, Entrez etc)

Module III: Biological Databases
Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL), Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc), Cluster databases-An Introduction, Specialised databases (KEGG, etc), Database technologies (Flat-file), Structural databases (PDB)

Module IV: Phylogenetic Analysis
Trees-splits and metrices on trees, tree interpretation, Distance – additive, ultrameric and nonadditive distances,tree building methods, phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains, estimating the rate of change, likelihood and trees; analysis software.

Module V: Genome analysis
Annotation, comparison of different methods; ESTs – databases, clustering, gene discovery and identification, and functional classification. Reconstruction of metabolic pathways; Genome analysis, genome anatomy, genome rearrangements with inversions, signed inversions, gene identification, gene expression, expression analysis, gene identification and functional classification

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Computer Science, J.G. Brookshear, Pearson, Addison Wesley
- Introduction to Bioinformation – T.Attawood

References:

- A book on C by Kelley : Programming in C, Addison-Wesley Publishing
- Introduction to C++ for Engineers and Scientists, Prentice-Hall
- Schaum's Outline of Introduction of Computer Science, P. Cushman and R. Mata-Toledo, McGraw Hill

Trade

- Bioinformatics – Managing Scientific Data, Zoe' Lacroix and Terence Critchlow
- Bioinformatics – Sequence, Structure and Databanks, Des Higgins & Willie Taylor
- Structural Bioinformatics, Philip E. Bourne, Helge Weissig 2003
- Statistical Methods in Bioinformatics: An Introduction, G.R. Grant, W.J. Ewens, Springer Verlag

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**
1	General introduction (characteristics, capabilities, generations),	Lecture	**BSB 401.1**.	Mid Term-1, Quiz & End Sem Exam
2	software, hardware : organization of hardware (input devices, memory, control unit	Lecture	**BSB 401.1**.	Mid Term-1, Quiz & End Sem Exam

	arithmetic logic unit, output devices),			
3	organization of hardware	Lecture	**BSB 401.2**.	Mid Term-1, Quiz & End Sem Exam
4	*organization of software*	Lecture	**BSB 401.2**.	Mid Term-1, Quiz & End Sem Exam
5	Interpreter, compiler, data processing; batch, on-line, real-time	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
6	Introduction and application of Internet	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
7	Search Engines (Google, Yahoo, Entrez etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
8	Revision	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
9	Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
10	Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
11	Cluster data bases-An Introduction. Specialized databases (KEGG, etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
12	Database technologies (Flat-file)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
13	Revision	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
14	Introduction of phylogenetics analysis	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
15	Trees-splits and metrices on trees, tree interpretation	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
16	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
17	phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
18	Estimating the rate of change, likelihood and trees; analysis software	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
19	Annotation, comparison of different methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
20	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
21	Revision	Lecture	**BSB 401.4**	Quiz & End Sem

				Exam
22	ESTs – databases, clustering	Lecture	**BSB 401.4**	Quiz & End Sem Exam
23	Gene discovery	Lecture	**BSB 401.4**	Mid Term-2, Quiz & End Sem Exam
24	Identification and classification	Lecture	**BSB 401.5**	Quiz & End Sem Exam
25	Revision	Lecture	**BSB 401.5**	Quiz & End Sem Exam
26	Reconstruction of metabolic pathways	Lecture	**BSB 401.5**	Quiz & End Sem Exam
27	Genome analysis, genome anatomy	Lecture	**BSB 401.4**	Quiz & End Sem Exam
28	Genome rearrangements with inversions	Lecture	**BSB 401.4**	Quiz & End Sem Exam
29	signed inversions, gene identification	Lecture	**BSB 401.4**	Quiz & End Sem Exam
30	Reconstruction of metabolic pathways	Lecture	**BSB 401.4**	Quiz & End Sem Exam
31	Genome analysis, genome anatomy	Lecture	**BSB 401.4**	Quiz & End Sem Exam
32	Gene expression	Lecture	**BSB 401.4**	Quiz & End Sem Exam
33	Gene expression analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
34	Gene identification methods	Lecture	**BSB 401.1**	Quiz & End Sem Exam
35	Functional classification	Lecture	**BSB 401.1**	Quiz & End Sem Exam
36	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
37	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
38	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam
39	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam
40	Gene expression	Lecture	**BSB 401.1**	Quiz & End Sem Exam
41	Gene expression analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
42	Gene identification methods	Lecture	**BSB 401.1**	Quiz & End Sem Exam
43	Functional classification	Lecture	**BSB 401.1**	Quiz & End Sem Exam
44	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
45	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
45	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB 401.1	Understand and explain the structural organization and characteristics of computers and its parts	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.2	Describe the concept of use of internet in bioinformatics.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.3	Explain the concept and organization of biological databases	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.4	Understand and explain the structure and functions of the phylogenetic analytic tools.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.5	Interrogate major database sources and be able to integrate this information with clinical data.	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

<table>
<tr><td colspan="8">Amity Institute Biotechnology
2018-19</td></tr>
<tr><td colspan="8">Class: B.Sc. Biotechnology
IV Semester</td></tr>
<tr><td colspan="2">Subject Name:
Bioinformatics</td><td colspan="2">Time: 3 Hrs</td><td colspan="4">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td colspan="2">Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.7</td><td>Q. 8, 9,</td><td colspan="2">Q. 10</td></tr>
</table>

Student will be able to:

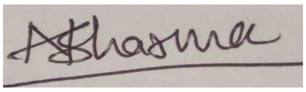
- Understand the basic knowledge of computer hardware and software.
- Understand the advanced techniques of bioinformatics.
- Understand the application of bioinformatics in different area.
- Understand the role of computational biology in drug designing.
- Understand the importance of phylogenetic analysis in species development.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about the importance of input and output device of computer. Also differentiate between input and output devices.	6
CO2	Q.2	Discuss about the anatomy of E. mail and www.	6
	Q.3	Explain about the different databases present in NCBI. Give a comparison between protein databases and nucleotide databases with examples.	6
CO4	Q.4	Discuss about the different terminology used in phylogenetic tree with the suitable diagram.	6
CO4	Q.5	Write about the genome of between prokaryotic and eukaryotic organism.	6
CO3	Q.6	Discuss a general classification of computer generations with suitable examples, merits and demerits	6
	Q.7	What is topology of computer networking? Write advantages and disadvantages of different topology networking.	10
CO4	Q.8	Write a detail note on RCSB, Genbank, and DDBJ with advantages.	10
CO3	Q.9	What is sequence similarity? Explain about the different quantitative methods of sequence similarity	10
CO3	Q.10	. A. Explain the different methods used for gene prediction. Discuss one of the methods in detail with suitable diagram. B. By writing the corresponding match states into columns we get the following alignment: ATGA AGTA	20

		What is its score under the following scoring scheme? Match +2, Mismatch -1 and Gap +1.Explain with global alignment algorithm.	

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Bioinformatics** /Course code ***BSB 401*** is level **2** for the academic year 2018-19.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2018-19

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
IV SEM	BSB 402	3	2	3	3	1	-	-	-	1	1			3	2	1

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR CELL BIOLOGY
Course Code : BSB 402, Crédits : 03, Session :2018-19 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in Molecular Cell Biology, further to extend understanding of the molecular mechanisms via which genetic information's are stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 402.1. Develop deep understanding of DNA/ RNA structure, and mechanism of DNA replication.
BSB 402.2. Understand Genetic Codes and Transposable elements
BSB 402.3. Understand mechanism of transcription and translation in prokaryotes and eukaryotes.
BSB 402.4. Enhance fine molecular understanding of operon gene regulation ion in prokaryotes.
BSB402.5. Understand the mechanism of Oncogenes and Tumor suppressor genes.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:
PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and

recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**

Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction to Moleculer Biology,
Structure and composition of DNA, RNA structure and its types, Basic techniques in molecular biology (Agarose gel electrophoresis, PCR etc.) and its applications.
Molecular basis of life:DNA replication in prokaryotes and eukaryotes; DNA recombination molecular mechanisms.

Module II: Insertion elements, transposons and retrotransposons
Mobile genetic elements and its types in both prokaryotes and eukaryotes and their applications.
Application of genetic engineering, Organisation of genetic material: Split genes; overlapping genes; pseudogenes; cryptic genes
Genetic Code: Properties of genetic code, codon assignment, chain termination codons, wobble hypothesis.

Module III: Structure of prokaryotic and eukaryotic genes
Transcription mechanism in prokaryotes and eukaryotes. Translation: Translation mechanisms in prokaryotes and eukaryotes.

Module IV: Gene Expression in prokaryotes

Operon concept, Positive and Negative control of operon (Lac, Tryptophan and Arabinose operon)

Module V: Eukaryotic geneExpression
Overview of gene expression, polyadenylation, cap formation, RNA degradation.

Module VI: Oncogenes and Tumor Suppressor genes
Oncogenes, tumorsuppressor genes in humans, role of genes in cancer development.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Gene VIII, Benjamin Lewin 2005, Oxford University Press
- Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing.

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education
- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Cell Biology, H. Lodish, A.Berk, S. Zipursky, P Matsundaira, D.Baltimore and J.E. Barnell,W. H Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing
- .Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley and Sons Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Structure and composition of DNA, RNA structure and its types	Lecture	BSB 402.1.	Mid Term-1, Quiz & End Sem Exam
2	Structure and composition of DNA, RNA structure and	Lecture		Mid Term-1, Quiz & End Sem Exam

	its types			
3	Structure and composition of DNA, RNA structure and its types	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Structure and composition of DNA, RNA structure and its types	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Basic techniques in molecular biology: PCR etc.) and its applications.	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Basic techniques in molecular biology (Agarose gel electrophoresis, and its applications.	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Mobile genetic elements and its types in prokaryotes	Lecture	BSB 402.2.	Mid Term-1, Quiz & End Sem Exam
8	Mobile genetic elements and its types in prokaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Mobile genetic elements and its types in eukaryotes	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Organisation of genetic material: Split genes; overlapping genes; pseudogenes; cryptic genes	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Application of genetic engineering,	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Genetic Code: Properties of genetic code, codon assignment, chain termination codons,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	, wobble hypothesis.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Structure of prokaryotic and eukaryotic genes	Lecture	BSB 402.3.	Mid Term-1, Quiz & End Sem Exam
15	Transcription mechanism in prokaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Transcription mechanism in eukaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Translation :Translation mechanisms in prokaryotes	Lecture		Quiz & End Sem Exam

18	Translation :Translation mechanisms in prokaryotes	Lecture		Quiz & End Sem Exam
19	Translation :Translation mechanisms in eukaryotes.	Lecture		Quiz & End Sem Exam
20	Operon concept, Positive and Negative control of operon	Lecture	BSB 402.4.	Quiz & End Sem Exam
21	Operon concept, Positive and Negative control of operon Lac Operon	Lecture		Quiz & End Sem Exam
22	Operon concept, Positive and Negative control of operon Lac Operon	Lecture		Quiz & End Sem Exam
23	Operon concept, Positive and Negative control of operon Trp operon	Lecture		Quiz & End Sem Exam
24	Operon concept, Positive and Negative control of operon Trp operon	Lecture		Quiz & End Sem Exam
25	Operon concept, Positive and Negative control of operon Ara Operon	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Overview of Eukaryotic gene expression,	Lecture	BSB 402.5.	Quiz & End Sem Exam
27	Mechanism of polyadenylation,	Lecture		Quiz & End Sem Exam
28	Mechanism of cap formation.	Lecture		Quiz & End Sem Exam
29	Mechanism of RNA degradation.	Lecture		Quiz & End Sem Exam
30	Oncogene in humans,	Lecture	BSB 402.6.	Quiz & End Sem Exam
31	Oncogenes in humans,	Lecture		Quiz & End Sem Exam
32	Tumorsuppressor genes in humans.	Lecture		Quiz & End Sem Exam
33		Lecture		Quiz & End Sem Exam
34	Tumorsuppressor genes in humans.	Lecture		Quiz & End Sem Exam
35	Role of genes in cancer	Lecture		Quiz & End Sem Exam
36	Role of genes in cancer	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
BSB 402.1.	Develop deep understanding of DNA/ RNA structure, and mechanism of DNA replication.	**3**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.2.	Understand Genetic Codes and Transposable elements	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.3	Understand mechanism of transcription and translation in prokaryotes and eukaryotes.	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.4	Enhance fine molecular understanding of operon gene regulation ion in prokaryotes	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.5.	Understand the mechanism of Oncogenes and Tumor suppressor genes.	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**1**

Sample Question Paper

Amity Institute Biotechnology 2018-19						
Class: B.Sc.(H)Biotechnology IV Semester						
Subject Name: MOLECULAR CELL BIOLOGY		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,6,2	Q.4,3	Q.7,6	Q.5,8	Q. 9, 10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	What is melting temperature (Tm). How Tm varies with increasing GC content and pH?	6
CO1	Q.2	Write a note on the bacterial insertion elements (IS).	6
	Q.3	Write the functions of the following. (i) Carboxyl terminal domain (CTD) (ii) Primosome (iii) Sigma (σ) Factor	6
CO2	Q.4	Define degeneracy of genetic codes and its significance.	6
CO1	Q.5	Write the function of the following proteins (i) Helicase (ii) Gyrase (iii) Primase	6
CO3	Q.6	Write short note on 5'Cap in eukaryotic mRNA.	6
	Q.7	Design the experiment to proof that DNA replication is (i) Semiconservative (ii) Bidirectional.	10
CO4	Q.8	Explain the structure and function of *Lac* operon in *E.coli*. Discuss the mechanism of *Lac* operon expression regulation under following conditions (I) When lactose sugar present in growth medium (ii) When lactose sugar absent in growth medium.	10

CO5	Q.9	Define Oncogenes, discuss the different classes andproperties of oncogenes. How Proto-oncogenes converted into oncogenes?	10
CO3	Q.10	What is the basic mechanism of PCR? and explain the following variants of PCR and their advantages (i) RT- PCR (ii) Touch Down PCR (iii) Hot start PCR.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Molecular cell Biology***/Course code ***BSB 402*** is level **3** for the academic year ***2018-19***.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BSB 403	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **IMMUNOLOGY & IMMUNOTECHNOLOGY**
Course Code : BSB 403, Crédits : 04, Session :2018-19 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. **Course Outcomes:** After successful completion of the course student will be able to:

BSB 403.1. Understand and explain the phylogeny of immune system, types of immunity, immune response.

BSB 403.2. Describe the concept of clonal selection theory, humoral and cell mediated immunity.

BSB 403.3. Understand and explain the structure and functions of the organs and cells of the immune system.

BSB 403.4. Understand the mechanism of antigen-antibody interaction.

BSB 403.5. Describe the structure of antibodies, their types and functions in immunity.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.
PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I :
Descriptors/Topics
Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.

Module II:
Descriptors/Topics
The organs and cells of the immune system.

Module III :
Descriptors/Topics
Histocompatibility: structure of MHC class I, II & III antigens & their mode of antigen presentation, MHC restriction; Antigens & antigenicity;

Module IV :
Descriptors/Topics
Antibody structure in relation to function and antigen-binding; Types of antibodies and their structures: isotypes, allotypes, idiotypes. Antibodies in targeting therapeutic agents. Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application

Module V :
Descriptors/Topics
Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.

Module VI :
Descriptors/Topics
Measurement of antigen – antibody interaction: agglutination, precipitation immunodiffusion, immuno-electrophoresis, ELISA, RIE

Module VII :
Descriptors/Topics
Tissue and organ transplantation

Module VIIII :
Descriptors/Topics
Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.
Autoimmunity and autoimmune diseases: Hashimoto's thyroiditis; Myasthenia gravis; Rheumatoid Arthritis, Pernicious anemia, Asthma.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Freeman

References:

- Immunology, Roitt, Mosby – Yearbook Inc.
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.

I. **Lecture Plan**

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.1**.	Mid Term-1, Quiz & End Sem Exam
2	Innate and specific immunity. Humoral immunity,	Lecture	**BSB 403.1**.	Mid Term-1, Quiz & End Sem Exam
3	Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.2**.	Mid Term-1, Quiz & End Sem Exam
4	Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.2**.	Mid Term-1, Quiz & End Sem Exam
5	The organs of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
6	The organs of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
7	The cells of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
8	The cells of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
9	Histocompatibility: structure of MHC class I, II & III	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
10	Histocompatibility: structure of MHC class I, II & III	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
11	Antigens	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
12	Mode of antigen presentation,	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
13	MHC restriction; Antigens & antigenicity	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
14	MHC restriction; Antigens &	Lecture	**BSB 403.3**	Mid Term-1,

	antigenicity			Quiz & End Sem Exam
15	Antibody structure in relation to function and antigen-binding	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
16	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
17	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
18	Antibodies in targeting therapeutic agents.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
19	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
20	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
21	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
22	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Quiz & End Sem Exam
23	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.4**	Mid Term-2, Quiz & End Sem Exam
24	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam
25	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam
26	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam
27	Measurement of antigen – antibody interaction: agglutination,	Lecture	**BSB 403.4**	Quiz & End Sem Exam

28	Precipitation	Lecture	**BSB 403.4**	Quiz & End Sem Exam
29	immunodiffusion,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
30	immuno-electrophoresis,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
31	ELISA,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
32	RIE,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
33	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
34	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
35	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
36	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
37	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
38	Autoimmunity	Lecture	**BSB 403.1**	Quiz & End Sem Exam
39	Autoimmunity	Lecture	**BSB 403.1**	Quiz & End Sem Exam
40	Autoimmune diseases: Hashimoto’s thyroiditis;	Lecture	**BSB 403.1**	Quiz & End Sem Exam
41	Myasthenia gravis;	Lecture	**BSB 403.1**	Quiz & End Sem Exam
42	Rheumatoid Arthritis,	Lecture	**BSB 403.1**	Quiz & End Sem Exam
43	Pernicious anemia,	Lecture	**BSB 403.1**	Quiz & End Sem Exam
44	Pernicious anemia,	Lecture	**BSB 403.1**	Quiz & End Sem Exam
45	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
45	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
46	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
47	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
48	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 403.1	Understand and explain the phylogeny of immune system, types of immunity, immune response.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.2	Describe the concept of clonal selection theory, humoral and cell mediated immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.3	Understand and explain the structure and functions of the organs and cells of the immune system	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.4	Understand the mechanism of antigen-antibody interaction	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.5	Describe the structure of antibodies, their types and functions in immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-

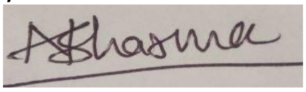
Sample Question Paper

<table>
<tr><td colspan="8">Amity Institute Biotechnology
2018-19</td></tr>
<tr><td colspan="8">Class: B.Sc. Biotechnology
IV Semester</td></tr>
<tr><td colspan="2">Subject Name:
Immunology & Immunotechnology</td><td colspan="3">Time: 3 Hrs</td><td colspan="3">Max.Marks:70</td></tr>
<tr><td colspan="2">Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td colspan="2">Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.7</td><td>Q. 8, 9,</td><td>Q. 10</td></tr>
<tr><td colspan="8">Student will be able to:
• Understand and explain the phylogeny of immune system, types of immunity, immune response.
• Describe the concept of clonal selection theory, humoral and cell mediated immunity.
• Understand and explain the structure and functions of the organs and cells of the immune system.
• Understand the mechanism of antigen-antibody interaction.
• Describe the structure of antibodies, their types and functions in immunity.</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about innate and adaptive immunity. Discuss about the different types of innate immunity with characters.	6
CO2	Q.2	Write a note on different phases of cytotoxic cell mediated targeting killing mechanism.	6
	Q.3	Write a general organization of class I and class II MHC molecules with suitable diagram.	6
CO4	Q.4	Discuss the role of IgG immunoglobulin in immune system.	6
CO4	Q.5	What is antibody diversity? Discuss the role of light chain gene rearrangement in antibody diversity.	6
CO3	Q.6	Draw a well labeled diagram of hybridoma technology with production of monoclonal antibody.	6
	Q.7	Discuss the role of innate and adaptive immunity in tissue grafting. Explain with suitable example.	10
CO4	Q.8	Give a comparison between all type of vaccine with examples and applications.	10
CO3	Q.9	Discuss about features of any two primary lymphoid organs with suitable diagram	10
CO3	Q.10	A. Although all lymphocytes are formed in bone marrow. Explain how these cells get differentiated into B cell and T cell. B Where the CDR regions located on an antibody molecule and what are are their functions? Discuss the ELISA method on the basis of antigen and antibody interaction.	20

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Immunology and immunotechnology**/Course code ***BSB 403*** is level **2** for the academic year 2018-19.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2018-19

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business

leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
	BSB 502	3	2	3	3	-	1	2	1	1	-			3	2	1
														-	-	-
														-	-	-
														-	-	-
V SEM														-	-	-

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ANIMAL BIOTECHNOLOGY
Course Code : BSB 502, Crédits : 03, Session :2018-19 (Odd Sem.), Class : B.Sc. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in animal biotechnology like in vitro fertilization, animal cell and tissue culture, hormone vaccine and important enzyme production through animal biotechnology.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 502.1. Understand theory of animal cell culture, culture media, methods to develop cell lines. and their maintenance for commercial applications.
BSB 502.2. Understand scale up production of monoclonal antibodies and hybridoma technology.
BSB 502.3. Understand the structure and function of variety of hormones and growth factors.
BSB 502.4. Understand the technology and concepts of invitro fertilization and embryo transfer, and development of superior live stocks.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of

Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I:

Introduction of animal cell culture substrate, culture media, preservation and maintenance of cell lines

Module II:

Production of monoclonal antibodies. Bioreactors for large scale culture of cells

Module III:

Growth factors promoting proliferation of animal cells (EGF, FGF, PDGF, IL-1, IL-2, NGF,erythropoietin).

Module IV:

Transgenic animals. In vitro fertilization and embryo transfer.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss. References:
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford.
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag.
- Cell Culture LabFax, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press.
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Animal Cell Culture: Overview	Lecture	BSB 502.1.	Mid Term-1, Quiz & End Sem Exam
2	Animal Cell culture substrates for attatchment	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Broad outline of Animal Cell culture Media	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Animal Cell Culture Media: Natural media	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Animal Cell Culture Media: Artificial media	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Advantages and limitations of natural and artificial media.	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Methods of Initiation of Cell culture	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Methods of Initiation of Cell culture	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Preversation and maintenance of cell culture.	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Monoclonal antibodies:	Lecture	BSB 502.2.	Mid Term-1, Quiz & End Sem Exam
11	Methods of somatic cell fusion	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Hybridoma technology for MAbs production	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Hybridoma technology for	Lecture		Mid Term-1, Quiz

	MAbs production			& End Sem Exam
14	Bioreactors	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Bioreactors	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Applications of bioreactoras and MAbs	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Growth factors: epidermal growth factor (EGF), receptor, structure and functions.	Lecture	BSB 502.3.	Quiz & End Sem Exam
18	Growth Factors:Fibroblast growth factor (FGF), receptor, structure and functions FGF.	Lecture		Quiz & End Sem Exam
19	Growth Factors: Platelates derived growth factor (PDGF), receptor, structure and functions PDGF.	Lecture		Quiz & End Sem Exam
20	Growth Factors:Neural growth factor (NGF), receptor, structure and functions NGF.	Lecture		Quiz & End Sem Exam
21	Growth Factors:Interleukins IL1 and IL2 structure and functions.	Lecture		Quiz & End Sem Exam
22	Growth Factors: erythropoiten (EP) structure and functions.	Lecture		Quiz & End Sem Exam
23	Applications of growth factors.	Lecture		Quiz & End Sem Exam
24	Transgenic Animals: overview	Lecture	BSB 502.4.	Quiz & End Sem Exam
25	Vectors for transgene transfer	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Methods of transgenic animal production	Lecture		Quiz & End Sem Exam
27	Application of transgenic animals	Lecture		Quiz & End Sem Exam
28	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
29	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
30	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
31	Embryo transfer technique	Lecture		Quiz & End Sem

				Exam
32	Embryo transfer technique	Lecture		Quiz & End Sem Exam
33	Embryo transfer technique	Lecture		Quiz & End Sem Exam
34	Embryo transfer technique	Lecture		Quiz & End Sem Exam
35	Application of embryo transfer technique	Lecture		Quiz & End Sem Exam
36	Application of embryo transfer technique	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
BSB 502.1.	Understand theory of animal cell culture, culture media, methods to develop cell lines. and their maintenance for commercial applications.	3	2	3	3	-	1	-	1	1	-			**3**	**2**	**1**
BSB 502.2.	Understand scale up production of monoclonal antibodies and hybridoma technology.	3	2	3	3	-	1	-	1	1	-			**3**	**2**	**1**
BSB 502.3	Understand the structure and function of variety of hormones and growth factors.	3	2	3	3	-	2	-	-	1	-			**3**	**2**	**1**

BSB 502.4	Understand the technology and concepts of *invitro* fertilization and embryo transfer, and development of superior live stocks.	3	2	3	3	-	2	3	-	1	-			**3**	**2**	**1**

Sample Question Paper

Amity Institute Biotechnology 2018-19		
Class: B.Sc.(H) Biotechnology V Semester		
Subject Name: ANIMAL BIOTECHNOLOGY	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4,6	Q.2,5,3	Q.7,8	Q.9	Q. 10	

Student will be able to:

CO Map	Question No.	Question	Marks
CO1	Q.1	Write a short note on primary cell culture including its advantages and limitations.	6
CO1	Q.2	Write a short note on reporter genes used during cloning in animal cells.	6
	Q.3	Briefly discuss moist heat sterilization method including its advantages and limitations.	6
CO2	Q.4	Write a short note on Stirred tanked bioreactor.	6
CO2	Q.5	Explain the selection method of hybridoma cells for vaccine production.	6

CO1	Q.6	Define bioethics? Enlist the initiatives of CSIRO's animal ethics committee.	6
	Q.7	Explain various methods of cell separation from animal tissue, clearly indicating their merits and demerits. How is cell culture maintained in the laboratory?	10
CO3	Q.8	Explain the following- (a) Method of selection of myeloma cells form bone marrow. (b) Recombinant erythropoietin (EPO) and its commercial applications.	10
CO4	Q.9	Discuss the principal and steps involved in Intra-cytoplasmic Sperm Injection (ICSI) with suitable diagramme during IVF for genetically superior livestock development. Enlist the risks associated with IVF.	10
CO4	Q.10	Discuss the following in detail (a) Various selection criteria for grading best embryos for embryo transfer technology (ETT). (b) Natural animal cell culture media.	20

Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Animal Biotechnology***/Course code ***BSB 502*** is level **3** for the academic year ***2018-19***.

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B. Sc.) Academic Year – 2018-19

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context

of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
VII SEM	BSB 601	3	1	2	2	-	1	-	3	-	-	-		3	2	-

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL BIOTECHNOLOGY
Course Code : BSB 601, Crédits : 03, Session :2018-19 (Even Sem.), Class : B.Sc. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with different processes and use of microbial technology that can be employed for a cleaner environment. The course also aims to make the students aware of legislation and rules prevalent to control the degradation of our environment.

B. Course Outcomes: At the end of the course, students will be able to:

BSB 601.1. Understand the delicate interrelationship of different components of environment.
BSB 601.2. Understand conventional fuels, their impact and concept of clean fuel technology.
BSB 601.3. Learn approaches and concepts behind bioremediation xenobiotic compounds, mechanism of microbial leaching and mining.
BSB 601.4. Learn the concept of municipal solid and liquid wastes management. environmental impact assessment (EIA) and assessment of environmental quality.
BSB 601.5. Learn the concept of biopesticides and biofertilizers and Bioassessment of assessment of environmental quality.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on

distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic

regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Environmental components, Environmental pollution and its types, Non-renewable and renewable energy resources.

Module II

Conventional fuels and their major impacts: Global warming and greenhouse effect, Global Ozone Problem, Acid rain, Eutrophication, Biomagnification, Concept of clean fuel technology: Biomass energy and biofuels

Module III

Biodegradation of Xenobiotic compounds i.e. oil, pesticide and PAHs and bioremediation of major pollutants

Biomineralisation: Use of microbial technology for mining

Module IV

Treatment of municipal solid and liquid wastes

Environmental impact assessment and Environmental audit

odule V

Bioassessment of Environmental Quality,

Biofertilizers and Biopesticides

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Environmental Science, S.C. Santra
- Environmental Biotechnology, Pradipta Kumar Mohapatra
- Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
- Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill
- Agricultural Biotechnology, S.S. Purohit
- Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer
- Introduction to Environmental Biotechnology, Milton Wainwright
- Principles of Environmental Engineering, Gilbert Masters
- Principles of fermentation Technology, Salisbury, Whitaker and Hall
- Industrial Microbiology – Cassida
- Agricultural Biotechnology – S.S. Purohit
- Wastewater Engineering – Metcalf & Eddy.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Introduction of Environmental components.	Lecture	BSB 601.1.	Mid Term-1, Quiz & End Sem Exam
2	Environmental components. (Biotic)	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Environmental components. (Abiotic)	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Introduction to Environmental pollution.	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Environmental pollution and its types.	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Environmental pollution:Air	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Environmental pollution:Water	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Environmental pollution:Water	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Environmental pollution:Soil	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Environmental pollution:Impact	Lecture	BSB 601.2.	Mid Term-1, Quiz & End Sem Exam
11	Non-renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Non-renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam

15	Conventional fuels and their major impacts.	Lecture	BSB 601.2.	Mid Term-1, Quiz & End Sem Exam
16	Global Warming and GHGs	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Global Ozone Problem,	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Acid rain,	Lecture		Mid Term-1, Quiz & End Sem Exam
19	Eutrophication, Biomagnification,	Lecture		Mid Term-1, Quiz & End Sem Exam
20	Concept of clean fuel technology: Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
21	Concept of clean fuel technology: Biomass energy and biofuels	Lecture		Mid Term-1, & End Sem Exam
22	Concept of clean fuel technology: Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
23	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
24	Xenobiotic compounds	Lecture	BSB 601.3.	Quiz & End Sem Exam
25	Biodegradation of Xenobiotic compounds	Lecture		Quiz & End Sem Exam
26	Biodegradation of Xenobiotic compounds	Lecture		Quiz & End Sem Exam
27	Bioremediation of major pollutants	Lecture		Quiz & End Sem Exam
28	Bioremediation of major pollutants	Lecture		Quiz & End Sem Exam
29	Biomineralisation: Use of microbial technology for mining.	Lecture		Quiz & End Sem Exam
30	Biomineralisation: Use of microbial technology for mining.	Lecture		Quiz & End Sem Exam
31	Biomineralisation: Use of microbial technology for mining.	Lecture		Quiz & End Sem Exam
32	Biomineralisation: Use of microbial technology for	Lecture		Quiz & End Sem Exam

	mining.			
33	Treatment of municipal solid and liquid wastes	Lecture	BSB 601.4.	Quiz & End Sem Exam
34	Treatment of municipal solid and liquid wastes	Lecture		Quiz & End Sem Exam
35	Treatment of municipal solid and liquid wastes	Lecture		Quiz & End Sem Exam
36	Environmental impact assessment and Environmental audit	Lecture		Quiz & End Sem Exam
37	Environmental impact assessment and Environmental audit	Lecture		Quiz & End Sem Exam
38	Environmental impact assessment and Environmental audit	Lecture		Quiz & End Sem Exam
39	Bioassessment of Environmental Quality	Lecture	BSB 601.5.	Quiz & End Sem Exam
40	Bioassessment of Environmental Quality.	Lecture		Quiz & End Sem Exam
41	Bioassessment of Environmental Quality.	Lecture		Quiz & End Sem Exam
42	Biofertilizers and Biopesticides	Lecture		Quiz & End Sem Exam
43	Biofertilizers and Biopesticides	Lecture		Quiz & End Sem Exam
44	Biofertilizers and Biopesticides	Lecture		Quiz & End Sem Exam
45	Revision	Lecture		Quiz & End Sem Exam
46	Revision	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

BSB 601.1.	Understand the delicate interrelationship of different components of environment.	3	1	-	-	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.2.	Understand conventional fuels, their impact and concept of clean fuel technology.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.3.	Learn approaches and concepts behind bioremediation xenobiotic compounds, mechanism of microbial leaching and mining.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.4.	Learn the concept of municipal solid and liquid wastes management. environmental impact assessment (EIA) and assessment of environmental quality.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.5.	Learn the concept of Biopesticides and biofertilizers and assessment of environmental quality.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**

Sample Question Paper

Amity Institute Biotechnology 2018-19						
Class: B.Sc.(H) Biotechnology VI Semester						
Subject Name: ENVIRONMENTAL BIOTECHNOLOGY		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,2,6	Q.3,4	Q.5,7,10	Q.6,8	Q. 9,	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	What is biological oxygen demand (BOD)? How it differs from Dissolved oxygen (DO) of water bodies?	6
CO1	Q.2	Define ecosystem and its major components.	6
	Q.3	Write a short note on concept of clean fuel technology.	6
CO2	Q.4	Write a brief note on Noise pollution. Point out WHO recommended day and night noise level.	6
CO5	Q.5	Write brief note on neem based bio-pesticides and its role in agricultural sustainability.	6
CO4	Q.6	Briefly explain Environment Impact assessment (EIA). Why it is important?	6
CO 1	Q.7	What is trophic level in ecosystem? Explain different levels in context of energy flow in ecosystem. Point out the 10% energy flow rule.	10
CO3	Q.8	Explain the impact of oil spills on water ecosystem and its bioremediation strategies.	10

CO3	Q.9	Define the term biomining. Discuss the following methods of metal extraction (i) Heap bioleaching (ii) Dump bioleaching.	10
CO4	Q.10	Discuss the following: (a) Explain the impact of nutrient enrichment of water bodies on water ecosystem. (b) Explain the process of biodiesel production, how it is helpful in reducing need of conventional fuels?	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental Biotechnology***/Course code ***BSB 601*** is level **3** for the academic year ***2018-19***.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

ROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2018-19

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
VI SEM	**BSB 620**	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**1**	**2**	**-**	**-**	**2**	**3**	**1**

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL AND INDUSTRIAL BIOTECHNOLOGY LAB
Course Code : BSB 620, Crédits : 01, Session :2018-19 (Even Sem.), Class : B.Sc. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with impact of conventional fules/ pollutions on environment and plants by assessing through lab experiments i.e, Comparative and statistical analysis of the pigment contents, Sugar content, NR activity and alcohol production

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 620.1. Understand and perform Symptomological studies and comparative and statistical analysis of the pigment content due to air pollution.
BSB 620.2. Understand and perform comparative and statistical analysis of the sugar content as an impact of air pollution and NR activity
BSB 620.3. Understand and perform production & downstream processing of alcoholic fermentation.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1 practical based	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination (Practical Exam)	EE	70%
Total			**100%**

F. Syllabus

Module I

Symptomological studies of the impacts of conventional fuel

Comparative and statistical analysis of the pigment content due to air pollution..

Module II

Comparative and statistical analysis of the sugar content as an impact of air pollution

NR activity estimation and its statistical analysis under pollution stress conditions.

Module III

Production & downstream processing of alcoholic fermentation.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Lab Manual for B.Sc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Lab Introduction	Practical	BSB 620.1.	Mid Term-, Quiz & End Sem Exam
2	Symptomological studies of the impacts of conventional fuel Symptomological studies of the impacts of conventional fuel	Practical		Mid Term-1, Quiz & End Sem Exam
3	Symptomological studies of the impacts of conventional fuel	Practical		Mid Term-1, Quiz & End Sem Exam
4	Symptomological studies of the impacts of conventional fuel	Practical		Mid Term-1, Quiz & End Sem Exam

5	Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution. Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution.	Practical		Mid Term-1, Quiz & End Sem Exam
6	Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution.	Practical	BSB 620.2.	Mid Term-1, Quiz & End Sem Exam
7	Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution.	Practical		Mid Term-1, Quiz & End Sem Exam
8	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
9	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
10	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
11	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
12	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam
13	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam
14	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam
15	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam

16	Production & downstream processing of alcoholic fermentation.	Practical	BSB 620.3.	Mid Term-1, Quiz & End Sem Exam
17	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
18	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
19	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
20	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
21	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, & End Sem Exam
22	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
23	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
24	Production & downstream processing of alcoholic fermentation.	Practical	B	Quiz & End Sem Exam
		Practical		

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

BSB 620.1.	Understand and perform Symptomological studies and comparative and statistical analysis of the pigment content due to air pollution.	3	3	3	2	3	-	-	**1**	1	2	-	-	2	3	-
BSB 620.2.	Understand and perform comparative and statistical analysis of the sugar content as an impact of air pollution and NR activity	3	3	3	2	3	-	-	1	1	2	-	-	2	3	-
BSB 620.3.	Understand and perform production & downstream processing of alcoholic fermentation.	3	3	3	2	3	-	-	-	1	2	-	-	2	3	1

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental and Industrial Biotechnology Lab***/Course code ***BSB 620*** is level **3** for the academic year ***2018-19***.

Amity Institute of Biotechnology
Course Handout
Course : Cell Biology
Course Code : BSB101, Credits : 03, Session : 2018-19(Odd Sem.), Class : B.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To acquaint the students to understand the basic concept of cell biology and cell as a unit of living system, its various organelles, their structure, function and metabolic processes. Further, to help students to understand the concept of cellular evolution. Enable students to strengthen the cellular structure of cell organelle and their function.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB101.1. To study cell as a basic unit of life. Cell Theory. Understanding cellular organisation of Plant and animal cells. Their tissue, organ and organisational structure.

BSB101.2. To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, ribosomes, cytoskeletal, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.

BSB101.3. Students will learn about Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome and eu and hetero-chromatin.

BSB101.4. To develop deeper knowledge about Cell cycle, interphase, mitosis and meiosis.

BSB101.5. Knowledge of cell locomotion, cell senescence and apoptosis.

BSB101.6. Understanding of mechanism of cell differentiation and difference between normal and cancer cell.

C. **Programme Outcomes:**

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate

living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO 2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and

their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Cell as a basic unit of living systems: The cell theory, precellular evolution; broad classification of cell types: archaebacteria, PPLOs, bacteria, eukaryotic microbes, plant and animal cells; cell, tissue, organ and organisms, different levels of organization.

Module II: Ultrastructure of the cell membrane and cell organelles**:** Ultrastructure of cell membrane and function, Structure of cell organelles; golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes; cytoskeletal structures (actin, microtubules.), mitochondria, chloroplast, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus).

Module III: Chromosomes**:** Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome organisations; eu-and heterochromatin.

Module IV: Cell division and cell cycle**:** Cell cycle, interphase, mitosis and meiosis.

Module V: Cell interaction: Cell locomotion (amoeboid, flagellar and ciliar); cell senescence and death (apoptosis).

Module VI: Cell differentiation: Mechanism of cell differention (e.g., RBC); difference between normal and cancer cells.

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.
- Cell and Molecular Biology –Sheelar & Bianchi, John Wiley
- Essential Cell Biology : An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company
- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J. Danell, W.H. Preeman and Company.
- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell Biology, Singh & Tomar
- The world of the cell Becker, Klinshmith & Harden, Pearson

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Cell Theory	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
2	Precellular Evolution	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
3	Broad Classification of Cell Types	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
4	Eukaryotic Microbes	Lecture	BSB101.1	Mid Term, Quiz & End Sem

				Exam
5	Plant and animal cells, tissues and organs	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
6	Different levels of organization	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
7	Ultrastructure of cell membrane and function	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
8	Structure of cell organelles	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
9	Golgi bodies, Endoplasmic Reticulum (Smooth and Rough), Ribosomes	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
10	Cytokeletal Structures (Actin and Microtubules)	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
11	Mitochondria, Chloroplast	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
12	Lysosomes and Peroxisomes	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
13	Nucleus Structure	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
14	Nuclear Membrane, Nucleoplasm, Nucleolus	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
15	Structural organisation of chromosomes	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
16	Chromatids	Lecture	BSB101.3	Mid Term, Quiz & End Sem

				Exam
17	Centromere and Telomere	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
18	Streptomycin and Tatracycline	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
19	Chromatin and Nucleosome Organization	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
20	Eu and Hetero-Chromatin	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
21	Cell Cycle	Lecture	BSB101.4	Quiz & End Sem Exam
22	Interphase	Lecture	BSB101.4	Quiz & End Sem Exam
23	Mitosis	Lecture	BSB101.4	Quiz & End Sem Exam
24	Meiosis	Lecture	BSB101.4	Quiz & End Sem Exam
25	Cell Locomotion	Lecture	BSB101.5	Quiz & End Sem Exam
26	Amoeboid, Flagellar and Cilliar	Lecture	BSB101.5	Quiz & End Sem Exam
27	Cell Senescence	Lecture	BSB101.5	Quiz & End Sem Exam
28	Cell Death	Lecture	BSB101.5	Quiz & End Sem Exam
29	Apoptosis	Lecture	BSB101.5	Quiz & End Sem Exam
30	Cell Division	Lecture	BSB101.5	Quiz & End Sem Exam
31	Mechanisms of Cell	Lecture	BSB101.6	Quiz &

	Differentiation			End Sem Exam
32	RBCs	Lecture	BSB101.6	Quiz & End Sem Exam
33	Cancer	Lecture	BSB101.6	Quiz & End Sem Exam
34	Carcinogens	Lecture	BSB101.6	Quiz & End Sem Exam
35	p53 Gene and its role in cancer development	Lecture	BSB101.6	Quiz & End Sem Exam
36	Difference between normal and cancer cell	Lecture	BSB101.6	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB101.1	To study cell as a basic unit of life. Cell Theory. Understanding cellular organization of Plant and animal cells. Their tissue, organ and organizational structure.	3	2	2	2	2	2	2	2	2	2	3	2	3

BSB101.2	To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, robosomes, cytoskeletal, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.	3	2	2	2	2	2	2	2	3	2	3	3	2
BSB101.3	Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome and eu and hetero-chromatin.	3	2	2	3	2	2	2	2	3	2	3	3	2
BSB101.4	To develop deeper knowledge about Cell cycle, interphase, mitosis and meiosis.	3	3	2	3	2	2	2	1	3	2	3	2	2
BSB101.5	Knowledge of cell locomotion, cell senescence and apoptosis.	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB101.6	Understanding of mechanism of cell differentiation and difference between normal and cancer cell.	3	3	2	2	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

Amity Institute of Biotechnology MID-SEMESTER 2018-19
Class: BSB101 (Biotech) I Semester

Subject Name: BSB 101 Cell Biology	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzin g	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to
CO1: To understand cell as a basic unit of life. Cell Theory. Understanding cellular organization of Plant and animal cells, their tissue, organ and organizational structure.
CO2: To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, ribosome's, cytoskeleton, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the Cell Theory.	3
CO1	Q.2a	What are different cytoskeletal structures?	3
	Q.2b	How is mode of functioning of Peroxysomes and lysosomes are different from each other ?	3
CO1	Q.3	How Nucleosome organization affects eu and heterochromatin region of DNA ?	6
CO2	Q.4	Explain the different stages of cellular reductional division i.e. Meiosis.	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **CELL BIOLOGY/BSB 101** is **level 3** for the academic year 2018-19.

Manish Kr

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY ISTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

PROGRAMME SPECIFIC OUTCOMES

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	BTB 301	3	3	3	1	-	-	1	2	2	1	3	1	-	1

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : CELL BIOLOGY
Course Code : BTB 301, Crédits : 03, Session :2018-19 (Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Cell biology plays a central role to connect the different fields of biotechnology which is highly interdisciplinary. It incorporates elements of biology, maths, physics and chemistry with combination of computers and electronics. The object of the present course is to understand the structure and function of the cellular and sub cellular components of cells and tissues with the help of recent techniques.

B. Course Outcomes: After successful completion of the course student will be able to:

BTB 301.1. Understand and explain the cell theory origin of life, and evolution.
BTB 301.2. Understand the cell cycle, regulation and checkpoints' in the cell-cycle.
BTB 301.3. Understand structure of cell membranes, transport of solutes across cell membranes.
BTB 301.4. Learn structure and function of the cell cytoskeleton, cilia and flagella.
BTB 301.5. Understand mechanism of signaling and receptors involved in signaling process.
BTB 301.6. Understand mechanism of cancer and cancer mechanism. .
BTB 301.7. Understand mechanism of apoptosis process.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

The cell theory, pre cellular evolution, prokaryotic and eukaryotic cells.

Module II

Cell cycle - molecular events, cell division, mitosis and meiosis.

Module III

Cellular organelles - structure and function of cell wall, plasma membrane nucleus, Mitochondria, Chloroplast, Nucleus, lysosomes, peroxisomes, golgi bodies, and transport across membranes.

Module IV

Cell locomotion- cytoskeleton, structure and function of cilia and flagella.

Module V

Cellular signaling –general mechanism of signaling and structures of the various types of receptors.

Module VI

Types of cancer, etiology of cancer, metastasis, cytological role of p53 and p21 genes in cancer development.

Module VII

Apoptosis.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.

References:

- Cell in Development and Inheritance, E.B. Wilson, Macmilian
- Developmental Biology, S.F. Gilbert, Sinauer Associates Inc.
- Essential Cell Biology : An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company
- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J. Danell, W.H. Preeman and Company.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	The cell theory,	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
2	Pre cellular evolution,	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
3	Prokaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
4	Prokaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
5	Eukaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
6	Eukaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
7	Cell cycle - molecular events	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
8	Cell division	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
9	Mitosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
10	Mitosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
11	Meiosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
12	Meiosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
13	Cellular organelles - structure and function of cell wall,	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
14	Plasma Membrane	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
15	Nucleus	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
16	Mitochondria	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
17	Chloroplast	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
18	Lysosome	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
19	Peroxisomes	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
20	Golgi Bodies	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
21	Transportation	Lecture	BTB 301.3	Mid Term-2, Quiz & End Sem Exam
22	Transportation	Lecture	BTB 301.3	Mid Term-2, Quiz & End Sem Exam
23	Cell locomotion-cytoskeleton	Lecture	BTB 301.4	Mid Term-2, Quiz & End Sem Exam

24	Cell locomotion-cytoskeleton	Lecture	BTB 301.4	Quiz & End Sem Exam
25	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
26	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
27	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
28	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
29	Cellular signaling –general mechanism of signaling	Lecture	BTB 301.5	Quiz & End Sem Exam
30	Structures of the various types of receptors.	Lecture	BTB 301.5	Quiz & End Sem Exam
31	Structures of the various types of receptors..	Lecture	BTB 301.5	Quiz & End Sem Exam
32	Types of cancer, etiology of cancer, metastasis	Lecture	BTB 301.6	Quiz & End Sem Exam
33	Cytological role of p53 and p21 genes in cancer development.	Lecture	BTB 301.6	Quiz & End Sem Exam
34	Apoptosis	Lecture	BTB 301.7	Quiz & End Sem Exam
35	Apoptosis	Lecture	BTB 301.7	Quiz & End Sem Exam
36	Apoptosis	Lecture	BTB 301.7	Quiz & End Sem Exam

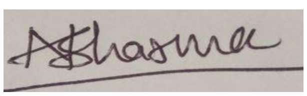
J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 301.1	Understand and explain the cell theory origin of life, and evolution.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.2	Understand the cell cycle, regulation and checkpoints’ in the cell-cycle.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.3	Understand structure of cell membranes, transport of solutes across cell membranes	3	3	3	1	-	-	1	2	2	1	3	1	-	1

BTB 301.4	Learn structure and function of the cell cytoskeleton, cilia and flagella.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.5	Understand mechanism of signaling and receptors involved in signaling process.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.6	Understand mechanism of cancer and cancer mechanism	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.7	Understand mechanism of apoptosis process.														

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Cell Biology*** Course code ***BTB 301*** is level **3** for the academic year 2018-19.



AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Microbiology
Course Code : BTB303, Credits : 04, Session : 2018-19(Odd Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Manish Kumar

A. Introduction: This fundamental paper discusses the importance of microorganisms. The course throws light on types of microorganisms in and around humans. At the end of the course, the student has understanding on the metabolism and mechanism of microbial life. Students will gain knowledge about the different cell organelles of microorganisms and their detailed functions. Students will also study the growth and control of microbes as well as different bacteriological techniques involved in microbiology. Students will learn about the biomolecules by studying their structures and types.

B. Course Outcomes: At the end of the course, students will be able to:

BTB303.1. Students will learn about the historical perspective of microbial world, spontaneous generation, role of microbes, pure culture, microbial nutrition, culture media, and sterilization.

BTB303.2. Students will gain knowledge of prokaryotic cell, structural and functional anatomy of cell and organelles. Growth and growth curve, culture types – batch and continuous, culture collection and maintenance of cultures.

BTB303.3. Students will gain knowledge about the Systematics and taxonomy of bacteria, ribotyping, nomenclature and Bergey's manual.

BTB303.4. Students will know about the Metabolic Diversity among microorganisms, microbial photosynthesis, photosynthetic pigments, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions.

BTB303.5. Students will develop deeper understanding of Archae, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles. Viruses –

Bacterial and Animal, their structure, reproduction. Viroids and Prions. Algae and Fungi – their reproduction and classification.

BTB303.6. Students will learn about the Host-parasite relationship, micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections, types of toxins (Exo, endo, entro) and their mechanism of action. Microbial pathogenesis and sexually transmitted disease.

BTB303.7. Students will have knowledge of Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics.

C. Programme Outcomes:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioral attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**

Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. **Syllabus**

Module I: Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization.

Module II: Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, Fed batch culture, continuous culture, culture collection and maintenance of cultures.

Module III: Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV: Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-ironnitrite- oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophilesViruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI: Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII: Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. **Examination Scheme:**

Components	A	CT	S/V/Q/HA	EE

Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott
The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.
The Microbial World, Roger Y. Stanier, Prentice Hall
Microbiology, Tortora, Funke and Chase, Benzamin& Cummings
Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
Industrial Microbiology, Casida, New Age International
Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC.Brown Publisher.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Discovery of the microbial world	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
2	Controversy over spontaneous generation	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
3	Role of microorganisms in transformation of organic matter and in the causation of diseases	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
4	Development of pure culture methods	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
5	Methods in Microbiology	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
6	Principles of microbial nutrition, Culture media	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
7	Theory and practice of sterilization	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
8	Prokaryotic structure and function	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
9	Functional anatomy of bacteria: cell envelope, cell	Lecture	BTB303.2	Mid Term,

	wall, cytoplasmic membrane, capsule			Quiz & End Sem Exam
10	Functional anatomy of bacteria: surface appendages, cytoplasm and cytoplasmic Inclusions	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
11	Growth - The definition of growth, mathematical expression of growth, growth curve	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
12	Measurement of growth, Synchronous growth	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
13	Fed batch culture, continuous culture	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
14	Culture collection and maintenance of cultures	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
15	Systematics and taxonomy	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
16	New approaches to bacterial taxonomy	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
17	Classification including ribotyping	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
18	Ribosomal RNA sequencing	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
19	Characteristics of primary domains	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
20	Taxonomy, nomenclature	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
21	Bergey's manual	Lecture	BTB303.3	Quiz & End Sem Exam
22	Metabolic Diversity among microorganisms	Lecture	BTB303.4	Quiz & End Sem Exam
23	Photosynthesis in microorganisms	Lecture	BTB303.4	Quiz & End Sem Exam
24	Role of bacteriochlorophylls, carotenoids and phycobilins	Lecture	BTB303.4	Quiz & End Sem Exam
25	Chemolithotrophy, hydrogen-iron-nitrite-oxidizing bacteria	Lecture	BTB303.4	Quiz & End Sem Exam
26	Nitrate and Sulphate reduction, methanogenesis and acetogenesis	Lecture	BTB303.4	Quiz & End Sem Exam

27	Fermentations, nitrogen fixation	Lecture	BTB303.4	Quiz & End Sem Exam
28	Plant microbe interactions (mycorrhizae)	Lecture	BTB303.4	Quiz & End Sem Exam
29	Archae as earliest life forms	Lecture	BTB303.5	Quiz & End Sem Exam
30	Thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BTB303.5	Quiz & End Sem Exam
31	Viruses: Bacterial, animal	Lecture	BTB303.5	Quiz & End Sem Exam
32	Structure of viruses	Lecture	BTB303.5	Quiz & End Sem Exam
33	Reproduction and life cycle of RNA and DNA viruses	Lecture	BTB303.5	Quiz & End Sem Exam
34	Viroids and prions.	Lecture	BTB303.5	Quiz & End Sem Exam
35	Algae and Fungi: Classification and Reproduction	Lecture	BTB303.5	Quiz & End Sem Exam
36	Host-parasite relationship	Lecture	BTB303.6	Quiz & End Sem Exam
37	Normal micro flora of skin, oral cavity, gastrointestinal tract	Lecture	BTB303.6	Quiz & End Sem Exam
38	Respiratory infections; entry of pathogens into the host	Lecture	BTB303.6	Quiz & End Sem Exam
39	Types of toxins (Exo, endo, entro) and their mode of actions	Lecture	BTB303.6	Quiz & End Sem Exam
40	Microbial pathogenesis - Disease reservoirs	Lecture	BTB303.6	Quiz & End Sem Exam
41	Epidemiological terminologies; Infectious disease transmission	Lecture	BTB303.6	Quiz & End Sem Exam
42	Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi	Lecture	BTB303.6	Quiz & End Sem Exam
43	Chemotherapy/antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam
44	Antimicrobial agents, sulfa drugs	Lecture	BTB303.7	Quiz & End Sem Exam
45	Antibiotics - Penicillin and Cephalosporins	Lecture	BTB303.7	Quiz & End Sem Exam
46	Broad spectrum antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam

47	Antifungal antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam
48	Mode of action of antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BTB303.1	historical perspective of microbial world, spontaneous generation, role of microbes, pure culture, microbial nutrition, culture media, and sterilization	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.2	prokaryotic cell, structural and functional anatomy of cell and organelles. Growth and growth curve, culture types – batch and continuous, culture collection and maintenance of cultures	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.3	Systematics and taxonomy of bacteria, ribotyping, nomenclature and Bergey's manual	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

BTB303.4	Metabolic Diversity among microorganisms, microbial photosynthesis, photosynthetic pigments, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.5	Archaea, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles. Viruses – Bacterial and Animal, their structure, reproduction. Viroids and Prions. Algae and Fungi – their reproduction and classification	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.6	Host-parasite relationship, micro flora of skin, oral cavity, gastrointestinal tract,	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

	Respiratory infections, types of toxins (Exo, endo, entro) and their mechanism of action. Microbial pathogenesis and Sexually transmitted disease															
BTB303.7	Chemotherapy/ antibiotics - Antimicrobial agents, sulfa drugs, penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
I MID-SEMESTER (SEM –III) 2018-19</td></tr>
<tr><td colspan="7">Class: B.Tech. Biotechnology III Semester</td></tr>
<tr><td colspan="2">Subject Name:
BTB 303 MICROBIOLOGY</td><td colspan="3">Time: 1.5 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4</td><td>Q.2,3</td><td>Q.4</td><td>Q.2,5,6</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to
CO1: Enumerate bacterial count their isolation and development of pure culture.
CO2: Apply generation time calculation for different microbial entities.</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief about microbial evolution.	3
CO1	Q.2a	What do you understand by isolation of culture?	3
	Q.2b	How are prokaryotic microbes different from eukaryotic microbes?	3
CO1	Q.3	Give an account of DNA sequencing.	6
CO2	Q.4	Explain the significance of bacterial toxins.	3
CO2	Q.5a	What are the factors favoring enteric bacteria?	3
	Q.5b	Discuss the different factors affecting the growth of bacteria.	3
CO2	Q 6	Differentiate between monoauxic and diauxic bacterial growth curve.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **MICROBIOLOGY/BTB 303** is **level 3** for the academic year 2018-19.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	BTB 320	3	3	3	1	-	-	1	2	2	1	3	1	-	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : CELL BIOLOGY LAB
Course Code : BTB 320, Crédits : 01, Session :2018-19(Odd Sem.), Class : B.Tech. 2^{nd} Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Cell biology plays a central role to connect the different fields of biotechnology which is highly interdisciplinary. It incorporates elements of biology, maths, physics and chemistry with combination of computers and electronics. The object of the present course is to understand the structure and function of the cellular and sub cellular components of cells and tissues with the help of recent techniques.

B. Course Outcomes: After successful completion of the course student will be able to:

BTB 320.1. Understand and explain the different types of microscopy
BTB 320.2 Understand the about the plant cell and cell organelles.
BTB 320.3. Understand the about the cell cycle, regulation and checkpoints' in the cell-cycle.
BTB 320.4. Understand mechanism of cancer and cancer mechanism.
BTB 320.5. Understand mechanism of apoptosis process.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Module I
Microscopy: Light microscopy, Bright field, Phase contrast & Gram's staining.
Module II
Study of chromoplasts, chloroplast in plant cell.
Module III: Cell Division
Mitosis and Meiosis
Module IV
Study of permanent slides of types of cancer
Module V
Study of apoptosis

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.

References:
- Cell in Development and Inheritance, E.B. Wilson, Macmilian
- Developmental Biology, S.F. Gilbert, Sinauer Associates Inc.
- Essential Cell Biology : An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company
- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J. Danell, W.H. Preeman and Company.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Bright Field Microscopy	Practical	BTB 320.1	Mid Term-1, Quiz & End Sem Exam
2	Phase Contrast Microscopy	Practical	BTB 320.1	Mid Term-1, Quiz & End Sem Exam
3	Gram's Staining	Practical	BTB 320.1	Mid Term-1, Quiz & End Sem Exam
4	Study of chromoplasts, in plant cell.	Practical	BTB 320.2	Mid Term-1, Quiz & End Sem Exam
5	Study of chloroplast in plant cell.	Practical	BTB 320.2	Mid Term-1, Quiz & End Sem Exam
6	Mitosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
7	Mitosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
8	Mitosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
9	Meiosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
10	Meiosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
11	Study of permanent slides of types of cancer	Practical	BTB 320.4	Mid Term-1, Quiz & End Sem Exam
12	Study of Apoptosis	Practical	BTB 320.5	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
BTB 320.1.	Understand and explain the different types of microscopy	3	3	3	1	-	-	1	2	2	1	3	1	-
BTB 320.2.	Understand the about the plant cell and cell organelles	3	3	3	1	-	-	1	2	2	1	3	1	-
BTB 320.3.	Understand the about the cell cycle,	3	3	3	1	-	-	1	2	2	1	3	1	-

	regulation and checkpoints' in the cell-cycle													
BTB 320.4.	Understand mechanism of cancer and cancer mechanism	3	3	3	1	-	-	1	2	2	1	3	1	-
BTB 320.5.	Understand mechanism of apoptosis process	3	3	3	1	-	-	1	2	2	1	3	1	-

Sample Question Paper

<table>
<tr><td colspan="7">Amity School of Engineering and Technology
Department of Computer Science and Engineering
I MID-SEMESTER (SEM –VII) 2018-19</td></tr>
<tr><td colspan="7">Class: B.Tech.(CSE) VII Semester</td></tr>
<tr><td colspan="2">Subject Name:
CSE 703 CLOUD COMPUTING</td><td colspan="3">Time: 2 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4</td><td>Q.2,3</td><td>Q.4</td><td>Q.2,5,6</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to
CO1: List the broad perceptive of cloud architecture and model.
CO2: Apply different cloud programming models as per need.</td></tr>
</table>

<table>
<tr><th>CO Map</th><th>Question No.</th><th>Question</th><th>Marks</th></tr>
<tr><td>CO1</td><td>Q.1</td><td>Explain in brief the cloud computing concept.</td><td>3</td></tr>
<tr><td rowspan="2">CO1</td><td>Q.2a</td><td>What are the essential characteristics of cloud computing?</td><td>3</td></tr>
<tr><td>Q.2b</td><td>How is cloud computing requirements and cloud servicerequirement services related to each other?</td><td>3</td></tr>
<tr><td>CO1</td><td>Q.3</td><td>Sketch NIST Cloud Computing Reference Architecture and depictits elements</td><td>6</td></tr>
<tr><td>CO2</td><td>Q.4</td><td>Explain the significance of Cloud Reference Model</td><td>3</td></tr>
<tr><td rowspan="2">CO2</td><td>Q.5a</td><td>Elaborate different cloud types with example.</td><td>3</td></tr>
<tr><td>Q.5b</td><td>Write characteristics of private cloud.</td><td>3</td></tr>
<tr><td>CO2</td><td>Q 6</td><td>How virtualization is applied in cloud computing scenario?</td><td>6</td></tr>
</table>

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Cell Biology lab*** Course code ***BTB 320*** is level **3** for the academic year 2018-19.

ASharma

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Microbiology Lab
Course Code : BTB322, Credits : 01, Session : 2018-19(Odd Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To understand the basics of microbiology and different culture techniques. Preparation of culture media – liquid, slant and solid. Growth curve and different types of staining – grams, endospore and capsule staining. Isolation and identification of rhizobium from root nodules

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB322.1. Students will learn about preparation of solid and liquid media.

BTB322.2. Students will do isolation and maintenance of organisms by plating, streaking and serial dilution.

BTB322.3. Students will know about the preparation of slant cultures.

BTB322.4. Students will learn about growth curve measurement of bacterial population by turbidometry.

BTB322.5. Students will know about measurement of bacterial population by dilution method.

BTB322.6. Students will gain knowledge of effect of temperature, pH, carbon and nitrogen sources on growth of bacteria.

BTB322.7. Students will do microscopic examination of bacteria by gram staining.

BTB322.8. Students will learn about Endospore staining.

BTB322.9. Students will be acquainted with Capsule Staining.

BTB322.10. Students will experimentally perform isolation and identification of Rhizobium from root nodules.

C. **Programme Outcomes:**

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of

complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of

technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Internal Examination	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	External Examination	EE	70%

Total			100%

E. **Syllabus**

Module I: Preparation of solid and liquid media.

Module II: Isolation and maintenance of organisms by plating, streaking and serial dilution.

Module III: Preparation of slant cultures.

Module IV: Growth curve measurement of bacterial population by turbidometry.

Module V: Measurement of bacterial population by dilution method.

Module VI: Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria.

Module VII: Microscopic examination of bacteria by gram staining.

Module VIII: Endospore staining.

Module IX: Capsule Staining.

Module X: Isolation and identification of Rhizobium from root nodules.

F. **Examination Scheme:**

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. **Suggested Text/Reference Books:**

General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian

Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott

The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

The Microbial World, Roger Y. Stanier, Prentice Hall

Microbiology, Tortora, Funke and Chase, Benzamin& Cummings

Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.

Industrial Microbiology, Casida, New Age International

Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of

Microbiology, R.M. Atlas, WMC.Brown Publisher.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Preparation of solid and liquid media	Practical	BTB322.1	Internal & External Exam
2	Learning about autoclave, laminar air flow	Practical	BTB322.1	Internal & External Exam
3	Isolation and maintenance of organisms by plating and streaking	Practical	BTB322.1	Internal & External Exam
4	Isolation and maintenance of organisms by serial dilution	Practical	BTB322.1	Internal & External Exam
5	Measurement of bacterial population by dilution	Practical	BTB322.1	Internal & External Exam
6	Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria	Practical	BTB322.1	Internal & External Exam
7	Microscopic examination of bacteria by gram staining	Practical	BTB322.1	Internal & External Exam
8	Endospore staining	Practical	BTB322.2	Internal & External Exam
9	Capsule staining	Practical	BTB322.2	Internal & External Exam
10	Collection of Root Nodules	Practical	BTB322.2	Internal & External Exam
11	Isolation of Rhizobium from root nodules	Practical	BTB322.2	Internal & External Exam
12	Identification of Rhizobium from root nodules	Practical	BTB322.2	Internal & External Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BTB 322.1	Preparation of solid and liquid media	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.2	Isolation and maintenance of organisms by plating, streaking and serial dilution	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.3	Preparation of slant cultures	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.4	Growth curve measurement of bacterial population by turbidometry	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.5	Measurement of bacterial population by dilution method	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.6	Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.7	Microscopic examination of bacteria by gram staining	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.8	Endospore staining	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.9	Capsule Staining	3	2	2	2	3	2	2	2	2	2	3	2	2
BTB 322.10	Isolation and identification of Rhizobium from root nodules	3	2	2	2	2	2	2	2	2	2	3	2	2

Sample Question Paper

Amity Institute of Biotechnology MID-SEMESTER 2018-19		
Class: B.Tech (Biotech) III Semester		
Subject Name: BTB 322 Microbiology Lab	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to
CO1: List the broad perceptive of cloud architecture and model.
CO2: Apply different cloud programming models as per need.

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss the development of pure cultures.	3
CO1	Q.2a	Differentiate between bacteria and fungi.	3
	Q.2b	Write a short note on bacterial DNA marker.	3
CO1	Q.3	Differentiate between genotype and ribotype.	6
CO2	Q.4	Explain about the capsule staining and	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **MICROBIOLOGY LAB/BTB 322** is **level 2** for the academic year 2018-19.

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : GENETICS
Course Code : BTB 402,   Credits : 04, Session : 2018-19.(Even Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Pushpika Udawat

A. **Introduction :** To acquaint the students to understand the basic concept of genetics incorporating the concepts of classical, molecular genetics. Students will learn about Mendelian Laws, Extension of Mendels Law, Multiple allele and isoallele, etc. Mutation, Mutagen, Chromosomal Aberrations, Human Genetic Disorders. Knowledge of methods of sex determination, Chromosomal non-disjunction, Chromosomal theory of inheritance, Sex linked, Sex limited and Sex limited Inheritance, Extra-chromosomal inheritance. Understanding of Population Genetics, Hardy-Weinberg Equilibrium, Gene and Genotype Frequencies.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB402.1. Students will develop an understanding of History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance.

BTB402.2. Understanding the pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation.

BTB402.3. To study the classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage.

BTB402.4. Students will develop a basic understanding of Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders.

BTB402.5. Knowledge of Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance.

BTB402.6. Students will learn about extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA.

BTB402.7. Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies.

C. **Programme Outcomes:**

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyze problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioral attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Brief history, scope and significance of Genetics. Mendelian law of inheritance. Lethality and interaction of gene. Multiple allele and isoallele. Penetrance and Expressivity. Linkage and crossing over. Mapping of genes. interference and coincidence.

Module II: Basic microbial genetics, Conjugation, transformation, transduction and their use in genetic mapping.

Module III: Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over and complementation test, Benzers work on rII locus in T4 Bacteriophage.

Module IV: Mutation; spontaneous and induced, Mutagen;chemical and physical. Chromosomal aberrations; structural and numerical. Economic importance of mutation. Genetic disorders in human; Kleinefelter, Turner, Cri-du-Chat and Down syndrome.

Module V: Sex determination in plant and animal. Non disjunction as a proof of chromosomal theory of inheritance. Sex linked, sex influenced and sex limited inheritance.

Module VI: Extra chromosomal inheritance; cytoplasmic inheritance, Mitochondrial and Chloroplast genetic system.

Module VII: Population genetics; Hardy-Weinberg equilibrium law, Gene and genotype frequencies.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Principles of Genetics, E. J. Gardner, John Wiley & Sons Inc.

Genetics, P.K. Gupta, Rastogi Publication.

Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, Pearson Education.

Genetics, M.W. Strickberger, Prentice Hall College Division.

Genetics, P.J. Russell, Benjamin/Cummings.

Genetics, R. Goodenough, International Thomson Publishing.

Introduction to Genetic Analysis, A.J. F. Griffiths, W.H. Freeman and Company.

Principles of Genetics, D.P. Snustad & M.J. Simmons, John Wiley and Sons Inc.

Molecular Biology of the Gene (Fifth Edition), J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison Wiesley Publishing.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Brief history of Genetics	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
2	Scope and significance of Genetics	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
3	Mendelian law of inheritance	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
4	Lethality and interaction of gene.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
5	Multiple allele and isoallele.	Lecture	BTB402.1	Mid Term, Quiz & End

				Sem Exam
6	Penetrance and Expressivity.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
7	Linkage and crossing over.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
8	Mapping of genes.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
9	Interference and coincidence.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
10	Basic microbial genetics	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
11	Conjugation	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
12	Transformation	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
13	Transduction	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
14	Genetic Mapping	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
15	Uses of Conjugation, Transformation and Transduction in Genetic Mapping	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
16	Significance of Genetic Mapping	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
17	Classical and modern concept of gene	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam
18	Pseudoallelism,	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam
19	Position effect	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam
20	Intragenic crossing over	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam
21	Mapping of genes	Lecture	BTB402.3	Quiz & End Sem Exam

22	Interference	Lecture	BTB402.3	Quiz & End Sem Exam
23	Coincidence	Lecture	BTB402.3	Quiz & End Sem Exam
24	Mutation; spontaneous and induced	Lecture	BTB402.4	Quiz & End Sem Exam
25	Mutagen; chemical and physical	Lecture	BTB402.4	Quiz & End Sem Exam
26	Chromosomal aberrations Structural	Lecture	BTB402.4	Quiz & End Sem Exam
27	Chromosomal aberrations numerical Aberration	Lecture	BTB402.4	Quiz & End Sem Exam
28	Economic importance of mutation	Lecture	BTB402.4	Quiz & End Sem Exam
29	Genetic disorders in human	Lecture	BTB402.4	Quiz & End Sem Exam
30	Kleinfelters, Terners, Cri-Du-Chat and Down Syndrome	Lecture	BTB402.4	Quiz & End Sem Exam
31	Sex determination in plants	Lecture	BTB402.5	Quiz & End Sem Exam
32	Sex determination in animals	Lecture	BTB402.5	Quiz & End Sem Exam
33	Non disjunction of chromosomes	Lecture	BTB402.5	Quiz & End Sem Exam
34	Non disjunction as a proof of chromosomal theory of inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
35	Sex linked inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
36	Sex influenced inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
37	Sex limited inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
38	Extra chromosomal inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
39	Cytoplasmic inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
40	Mitochondrial DNA	Lecture	BTB402.6	Quiz & End Sem Exam
41	Chloroplast genetic system	Lecture	BTB402.6	Quiz & End Sem Exam
42	Significance of Extra chromosomal inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
43	Significance of Cytoplasmic inheritance	Lecture	BTB402.6	Quiz & End Sem Exam

44	Example of Cytoplasmic Inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
45	Population genetics	Lecture	BTB402.7	Quiz & End Sem Exam
46	Hardy-Weinberg equilibrium law	Lecture	BTB402.7	Quiz & End Sem Exam
47	Gene frequencies	Lecture	BTB402.7	Quiz & End Sem Exam
48	Genotype frequencies	Lecture	BTB402.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
BTB402.1	History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.2	Pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.3	To study the classical and modern concept of gene,	3	2	2	2	2	2	2	2	2	2	3	2	2

	pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage													
BTB402.4	Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.5	Knowledge of Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.6	Extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.7	Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies	3	2	2	2	2	2	2	2	2	2	3	2	2

Sample Question Paper

Amity Institute of Biotechnology MID-SEMESTER 2018-19.
Class: B. Tech (Biotech) IV Semester

Subject Name: BTB 402 GENETICS	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to

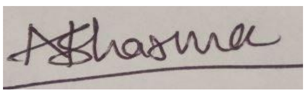
CO1: History and scope of Genetics

CO2: Understanding the pre Mendelian genetic concepts

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the scope and significance of genetics.	3
CO1	Q.2a	What are different steps involved in genetic mapping ?	3
	Q.2b	How is mechanism of conjugation is different from transformation ?	3
CO1	Q.3	How classical concept of gene is different from modern concept of gene ?	6
CO2	Q.4	Explain the significance of extra-chromosomal inheritance and cytoplasmic inheritance.	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Genetics*** Course code ***BTB 402*** is level **3** for the academic year 2018-19.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2018-19

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12		PSO 1	PSO 2	PSO 3	PSO 4
V SEM	BTB 502	3	2	2	3	2	1	2	2	1	2	1	-		3	2	1	-

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ANIMAL BIOTECHNOLOGY
Course Code : BTB 502, Crédits : 03, Session :2018-19 (Odd Sem.), Class : B.Tech. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques in animal biotechnology like in vitro fertilization, animal cell and tissue culture, hormone vaccine and important enzyme production through animal biotechnology.

B. Course Outcomes: At the end of the course, students will be able to:

BTB 502.1. Understand Concepts of animal biotechnology and its commercial applicability methods of sterilization techniques and understanding of organ culture.
BTB 502.2. Learn methods of animal cell culture and maintenance and immobilization cell culture techniques.
BTB 502.3. Understand the technology and concepts of invitro fertilization and embryo transfer, and development of superior live stocks.
BTB 502.4. Become familiar with concept of somatic hybridization and hybridoma technology for vaccine production
BTB 502.5. Understand Animal genetic engineering -vectors, gene transfer methods
BTB 502.6. Understand transgenic technology in animal biotechnology for producing commercially important products.
BTB 502.7. Understand ethical issues in animal biotechnology

C. Programme Outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**

Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Historical perspectives, sterilization methods, organ culture - culture techniques, plasma clot, raft methods, agar gel, grid method, organ engineering.

Module II

Cell culture substrates, cultural media, natural and artificial media, initiation and maintenance of cell cultures, cell culture products, cryopreservation techniques, immobilized cultures

Module III

In vitro fertilization and embryo transfer

Module IV

Somatic cell hybridization, hybridoma technology

Module V

Animal genetic engineering -vectors, gene transfer methods - microinjection, virus mediated and other methods of gene transfer

Module VI

Transgenic animals with new traits, transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutic etc.

odule VII

Bioethical issues related to animal biotechnology,

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss. References:
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford.
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag.
- Cell Culture LabFax, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press.
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Historical perspectives, sterilization methods,	Lecture	BTB 502.1.	Mid Term-1, Quiz & End Sem Exam
2	organ culture - culture techniques, plasma clot, raft methods,	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Agar gel, grid method of Organ culture	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Organ engineering.	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Animal Cell culture substrates for attatchment	Lecture	BTB 502.2.	Mid Term-1, Quiz & End Sem Exam
6	Broad outline of Animal Cell culture Media	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Animal Cell Culture Media: Natural media	Lecture		Mid Term-1, Quiz & End Sem Exam

8	Animal Cell Culture Media: Artificial media	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Advantages and limitations of natural and artificial media.	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Methods of Initiation of Cell culture	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Preversation and maintenance of cell culture.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	cryopreservation techniques,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	immobilized cultures	Lecture		Mid Term-1, Quiz & End Sem Exam
14	In-vitro fertilization technique	Lecture	BTB 502.3.	Mid Term-1, Quiz & End Sem Exam
15	In-vitro fertilization technique	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Embryo transfer	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Embryo transfer .	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Somatic cell hybridization	Lecture	BTB 502.4.	Quiz & End Sem Exam
19	Somatic cell hybridization	Lecture		Quiz & End Sem Exam
20	Hybridoma technology for MAbs production	Lecture		Quiz & End Sem Exam
21	Hybridoma technology for MAbs production	Lecture		Quiz & End Sem Exam
22	Applications of bioreactoras and MAbs	Lecture		Quiz & End Sem Exam
23	Animal genetic engineering	Lecture	BTB 502.5.	Quiz & End Sem

	-vectors, gene transfer methods : Direct			Exam
24	Animal genetic engineering -vectors, gene transfer methods: Indirect	Lecture		Quiz & End Sem Exam
25	Vectors for transgene transfer	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Transgenic animals	Lecture	BTB 502.6.	Quiz & End Sem Exam
27	Methods of transgenic animal production	Lecture		Quiz & End Sem Exam
28	Methods of transgenic animal production	Lecture		Quiz & End Sem Exam
29	Transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutic etc.	Lecture		Quiz & End Sem Exam
30	Transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutic etc.	Lecture		Quiz & End Sem Exam
31	Transgenic animals with new traits	Lecture		Quiz & End Sem Exam
32	Transgenic animals with new traits	Lecture		Quiz & End Sem Exam
33	Bioethical issues related to animal biotechnology,	Lecture	BTB 502.7.	Quiz & End Sem Exam
34	Bioethical issues related to animal biotechnology,	Lecture		Quiz & End Sem Exam
35	Bioethical issues related to animal biotechnology,	Lecture		Quiz & End Sem Exam
36	Test	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
BTB 502.1.	Understand Concepts of animal biotechnology and its commercial applicability methods of sterilization techniques and understanding of organ culture. .	3	2	1	2	1	1	-	-	1	-	-	1	3	1	1
BTB 502.2.	Learn methods of animal cell culture and maintenance and immobilization cell culture techniques	3	2	1	2	1	1	-	-	**1**	-	-	1	3	2	1
BTB 502.3.	Understand the technology and concepts of invitro fertilization and embryo transfer, and development of superior live stocks.	3	2	1	2	1	1	1	-	1	-	-	1	3	2	1
BTB 502.4.	Become familiar with concept of somatic hybridization and hybrodoma technology for vaccine production	3	1	1	-	1	1	-	-	1	-	-	1	3	2	-
BTB 502.5.	Understand Animal genetic engineering -vectors, gene transfer methods	3	-	1	-	1	1	-	-	1	-	-	1	3	2	-

BTB 502.6.	Understand transgenic technology in animal biotechnology for producing commercially important products.	3	-	1	2	1	1	2	-	1	-	-	1	3	2	1
BTB 502.7.	Understand ethical issues in animal biotechnology	3	-	1	-	1	1	3	-	1	-	-	1	3	2	-

<u>Sample Question Paper</u>

Amity Institute Biotechnology 2018-19						
Class: B. Tech. Biotechnology V Semester						
Subject Name: ANIMAL BIOTECHNOLOGY		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4,6	Q.2,5,3	Q.7,8	Q.9	Q. 10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO2	Q.1	Write a short note on primary cell culture including its advantages and limitations.	6
CO5	Q.2	Write a short note on reporter genes used during cloning in animal cells.	6
CO1	Q.3	Briefly discuss moist heat sterilization method including its advantages and limitations.	6
CO2	Q.4	Write a short note on Stirred tanked bioreactor.	6

CO5	Q.5	Explain the selection method of hybridoma cells for vaccine production.	6
CO7	Q.6	Define bioethics? Enlist the initiatives of CSIRO's animal ethics committee.	6
	Q.7	Explain various methods of cell separation from animal tissue, clearly indicating their merits and demerits. How is cell culture maintained in the laboratory?	10
CO1	Q.8	Explain the following- (a) Method of selection of myeloma cells form bone marrow. (b) Recombinant erythropoietin (EPO) and its commercial applications.	10
CO3	Q.9	Discuss the principal and steps involved in Intra-cytoplasmic Sperm Injection (ICSI) with suitable diagramme during IVF for genetically superior livestock development. Enlist the risks associated with IVF.	10
CO2	Q.10	Discuss the following in detail (a) Various selection criteria for grading best embryos for embryo transfer technology (ETT). (b) Natural animal cell culture media.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Animal Biotechnology***/Course code ***BTB 502*** is level **3** for the academic year ***2018-19***.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO1 2	PSO1	PSO2	PSO 3	PSO4
V	BTB 503	3	3	3	1	-	-	1	2	2	3	2	1	3	1	-	1

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : STRUCTURAL BIOLOGY
Course Code : BTB 503, Crédits : 03, Session :2018-19(Odd Sem.), Class : B.Tech 3rd Year
Faculty Name : DR. NEHA SHARMA and DR. PUSHPIKA UDAWAT

A. **Introduction:** The course aims to provide an understanding of the principles and applications of proteins, enzymes and nucleic acids for their role in biochemical pathway as well as interactions among themselves.

B. **Course Outcomes:** After successful completion of the course student will be able to:

BTB503.1. Students will learn about amino acids structure and function, Primary, secondary, tertiary and quaternary structure of protein; Motifs and domains of protein structures; Conformational analysis, Protein folding.

BTB503.2. Students will develop an understanding of Architecture and building blocks of proteins. : Evaluate different mechanism of substrate recognition, its structural basis, reaction mechanism of enzymes and G-protein coupled receptors.

BTB503.3. Students will understand the protein denaturation, refolding and stabilization.

BTB503.4. Students will understand structural parameters of DNA molecule understand about the protein-DNA interaction and its mechanism.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

1. PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering

activities with an understanding of the limitations.

6. PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
7. PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
9. PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves	A	5%

	including medical leaves.		
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Chemistry of amino acids and peptides: Side chain structure and function in protein folding and functionality: Secondary structure of proteins - helices, sheets, loops and turns; Structural and functional proteins. Tertiary structure of proteins, homo and hetero-dimers, trimers and tetramers; forces governing protein-protein interactions; open tertiary structure; Classification of proteins; Structure and function of an antibody; structure of haemoglobin, muscle proteins; Sequence and structural motifs in proteins.

Module II: Protein-ligand interactions: Lock and key versus handshake mechanism of substrate recognition; structural basis of recognition; reaction mechanisms of enzymes, G-Protein coupled receptors.

Module III: Protein solubility, protein stability and stabilization: Salting in and salting out, Parameters affecting; enthalpic and entropic stabilization, mutations increasing stability, .helix capping; Native, partially denatured and denatured proteins; Protein denaturation, Physical and chemical denaturants; Refolding.

Module IV: DNA structure: Covalent structure of DNA, base pairing, hydrogen bonding, DNA melting and annealing, difference between AT and GC pairing, DNA models, The Watson Crick model; Crystal structure of B-DNA, major and minor groves, dyad symmetry, base pair stacking, propellor twist, A and Z- DNA, triple stranded DNA, telomeric sequences and structure, G-quartcts, palindromic and tandem sequences, Base pair flipping and DNA bulges, DNA methylation; Protein-DNA interactions; drug-DNA interactions; Databases of sequences and structure for protein and DNA, public domain softwares for visualizing and modelling biomolecules -Rasmol, Deepview, Whatif.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Biochemistry, R.H. Abeles, P.A. Frey and W.A. Jencks, Jones and Bartlett.
- Essentials of Molecular Biology, D. Freifelder, Jones and Bartlett Publications.
- Genes VII, B. Lewin, Oxford University Press.

References:

- Introduction to Protein Structure, C. Branden and J Tooze, Garland Publishing Company.
- Protein Structure, M. Perutz, Oxford University Press.
- Proteins (Structures and Molecular Properties), T.E. Creighton, W.H. Freeman and Company.
- Database Annotation in Molecular Biology, Arthur M. Lesk.
- From Genes to Clones, E.L. Winnacker.

⮚ Genes & Genomes, M.S. Paul Berg.
⮚ Structure and Machanism in Protein Science, Alan Fersht.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Side chain structure and function in protein folding and functionality	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
2	Secondary structure of proteins - helices, sheets, loops and turns	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
3	Structural and functional proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
4	Tertiary structure of proteins, homo and hetero-dimers, trimers and tetramers	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
5	Forces governing protein-protein interactions	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
6	Open tertiary structure	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
7	Classification of proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
8	Structure and function of an antibody	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
9	Structure of *haemoglobin*	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
10	Muscle proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
11	Protein Sequences	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
12	Structural motifs in proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
13	Lock and key mechanism of substrate recognition	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
14	Handshake mechanism of substrate recognition	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam

15	Structural basis of substrate recognition	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
16	Reaction mechanisms of enzymes	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
17	G-Protein coupled receptors	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
18	Mechanism of G-Protein coupled receptors	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
19	Salting in and salting out,	Lecture	BTB503.3	Quiz & End Sem Exam
20	Parameters affecting; enthalpic and entropic	Lecture	BTB503.3	Quiz & End Sem Exam
21	stabilization, mutations increasing stability,	Lecture	BTB503.3	Quiz & End Sem Exam
22	Helix capping; Native, partially denatured and denatured proteins	Lecture	BTB503.3	Quiz & End Sem Exam
23	Protein denaturation,	Lecture	BTB503.3	Quiz & End Sem Exam
24	Physical and chemical denaturants; Refolding	Lecture	BTB503.3	Quiz & End Sem Exam
25	Covalent structure of DNA, base pairing,	Lecture	BTB503.4	Quiz & End Sem Exam
26	Hydrogen bonding, DNA melting and annealing,	Lecture	BTB503.4	Quiz & End Sem Exam
27	Difference between AT and GC pairing,	Lecture	BTB503.4	Quiz & End Sem Exam
28	DNA models, The Watson Crick model; Crystal structure of B-DNA, major and minor groves, dyad symmetry,	Lecture	BTB503.4	Quiz & End Sem Exam
29	base pair stacking, propellor twist, A and Z- DNA, triple stranded DNA,	Lecture	BTB503.4	Quiz & End Sem Exam
30	telomeric sequences and structure, G-quartcts	Lecture	BTB503.4	Quiz & End Sem Exam
31	Palindromic and tandem sequences,	Lecture	BTB503.4	Quiz & End Sem Exam

32	Base pair flipping and DNA bulges, DNA methylation;	Lecture	BTB503.4	Quiz & End Sem Exam
33	Protein-DNA interactions; drug-DNA interactions;	Lecture	BTB503.4	Quiz & End Sem Exam
34	Databases of sequences and structure for protein and DNA,	Lecture	BTB503.4	Quiz & End Sem Exam
35	Public domain softwares for visualizing and modeling biomolecules -Rasmol, Deepview, Whatif.	Lecture	BTB503.4	Quiz & End Sem Exam
36	Public domain softwares for visualizing and modeling biomolecules -Rasmol, Deepview, Whatif.	Lecture	BTB503.4	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 503.1	Students will learn about amino acids structure and function, Primary, secondary, tertiary and quaternary structure of protein; Motifs and domains of protein structures; Conformational analysis, Protein folding.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 503.2	Students will develop an understanding of Architecture and building blocks of proteins. : Evaluate different mechanism of substrate recognition, its structural	3	3	3	1	-	-	1	2	2	1	3	1	-	1

	basis, reaction mechanism of enzymes and G-protein coupled receptors														
BTB 503.3	Students will understand the protein denaturation, refolding and stabilization	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 503.4	Students will understand structural parameters of DNA molecule understand about the protein-DNA interaction and its mechanism.	3	3	3	1	-	-	1	2	2	1	3	1	-	1

<u>Sample Question Paper</u>

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2018-19</td></tr>
<tr><td colspan="7">Class: B.Tech. Biotechnology
VI Semester</td></tr>
<tr><td colspan="2">Subject Name:
Immunology & Immunotechnology</td><td colspan="2">Time: 3 Hrs</td><td colspan="3">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.7</td><td>Q. 8, 9,</td><td>Q. 10</td></tr>
</table>

Student will be able to:

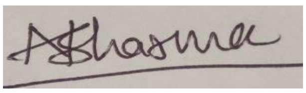
- Students will learn about amino acids structure and function, Primary, secondary, tertiary and quaternary structure of protein; Motifs and domains of protein structures; Conformational analysis, Protein folding.
- Students will develop an understanding of Architecture and building blocks of proteins. : Evaluate different mechanism of substrate recognition, its structural basis, reaction mechanism of enzymes and G-protein coupled receptors.
- Students will understand the protein denaturation, refolding and stabilization.
- Students will understand structural parameters of DNA molecule understand about the protein-DNA interaction and its mechanism.

CO Map	Question No.	Question	Marks
CO1	Q.1	What are the salient features of structure of Watson crick model? Explain with diagram.	6
	Q.2	What is CpG dinucleotides? Explain the role of CpG dinucleotide in methylation.	6

CO2			
	Q.3	Explain Anfinsen experiment and discuss the role of different factors in protein stability.	6
CO4	Q.4	Which DNA double helix do you think would be harder to separate into two strands: DNA composed predominantly of AT base pairs, or of GC base pairs? Why?	6
CO4	Q.5	Discuss about the software which is used in visualization of structure of DNA.	6
CO3	Q.6	Discuss the importance of Chaperonins during protein folding with suitable diagram.	6
	Q.7	What is salting-in and salting-out? Explain the importance of precipitation protein in salting-in process.	10
CO4	Q.8	Explain the different types of interactions are involved in protein-DNA recognition	10
CO3	Q.9	What are the four pairs of DNA bases that form in the double helix? Draw the structure of each base.	10
CO3	Q.10	What is protein danaturation? Explain the role of denaturants such as urea and guanidinium hydrochloride in protein denaturation.	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Structural Biology**/Course code ***BTB 503*** is level **2** for the academic year 2018-19.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2018-19

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12		PSO1	PSO2	PSO3	PSO4
V SEM	BTB 521	3	3	1	2	-	1	2	-	1	1		1		3	2	-	-

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ANIMAL BIOTECHNOLOGY LAB
Course Code : BTB 521, Crédits : 03, Session :2018-19 (Odd Sem.), Class : B.Tech. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with different techniques in animal biotechnology like , Media preparation, cell culture, subculturing and cytotoxicity assay.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB 521.1. Prepare and sterilize animal cell culture media under aseptic conditions.
BTB 521.2. Inoculate specific cells or tissues for callusing in media
BTB 521.3. Maintain cell culture by subculturing.
BTB 521.4. Perform cytotoxicity test

Programme Outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering

activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

1. Preparation, standardization and sterilization of culture media
2. Inoculation of specific tissues for callusing
3. Inoculation and maintenance of cell lines
4. Study of toxicity on cell lines

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

IA			**EE**			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Lab Manual
- Culture of Animal Cells, R.I Freshney, Wiley-Leiss. References:
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford.
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Basic calculations and preparation of solutions and buffers	Practical	BTB 521.1.	Mid Term-1, Quiz & End Sem Exam
2	Basic calculations and preparation of solutions and buffers	Practical		Mid Term-1, Quiz & End Sem Exam
3	Preparation of cell Culture Media (Natural)	Practical		Mid Term-1, Quiz & End Sem Exam
4	Study of composition and Preparation of cell Culture Media (Artificial)	Practical		Mid Term-1, Quiz & End Sem Exam
5	Method of sterilization of culture media.	Practical	BTB 521.2.	Mid Term-1, Quiz & End Sem Exam
6	Separation of cells from tissue/ and inoculation in culture vessel	Practical		Mid Term-1, Quiz & End Sem Exam
7	Separation of cells from tissue/ and inoculation in culture vessel	Practical		Mid Term-1, Quiz & End Sem Exam
8	Cell separation and Inoculation of specific tissues for callusing	Practical		Mid Term-1, Quiz & End Sem Exam
9	Observation of callus development and data recording	Practical		Mid Term-1, Quiz & End Sem Exam
10	preparations of buffers and stains to Study of toxicity on cell lines MTT assay.	Practical		Mid Term-1, Quiz & End Sem Exam
11	Study of cytotoxicity using MTT assay.	Practical		Mid Term-1, Quiz & End Sem Exam
12	Spot identification /slides	Practical		Mid Term-1, Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			PSO	PSO	PSO	PSO

													1	2	3	4
BTB 521.1.	Prepare and sterilize animal cell culture media under aseptic conditions.	3	3	1	-	-	-	-	-	1	-		**3**	**1**	**-**	**-**
BTB 521.2.	Inoculate specific cells or tissues for callusing in media	3	3	1	-	-	1	2	-	1	-		**3**	**1**	**-**	**-**
BTB 521.3.	Maintain cell culture by subculturing.	3	3	1	1	-	1	1	-	1	-		**3**	**1**	**-**	**-**
BTB 521.4.	Perform cytotoxicity test	3	3	1	2	-	1	-	-	1	-		**3**	**1**	**-**	**-**

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Animal Biotechnology***/Course code ***BTB 521*** is level **3** for the academic year ***2018-19***.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
V	BTB 522	3	3	3	1	-	-	1	2	2	1	3	1	-	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : STRUCTURAL BIOLOGY LAB
Course Code : BTB 522, Crédits : 01, Session :2018-19 (Odd Sem.), Class : B.Tech 2ndYear
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe physical properties of protein, analysis of protein structure, protein finger printing, fraction folding and degradation.

B. **Course Outcomes:** After successful completion of the course student will be able to:

BTB 522.1. Experimental Understanding of physical properties of protein, analysis of protein structure, finger printing, protein fractionation.
BTB 522.2. Understand the mechanism of protein folding and degradation through experiments.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Course Contents:

1. Study of physical properties of proteins. **(02 Hours)**
2. Analysis of protein structure.
3. Study of protein finger printing
4. Study of protein fractionation
5. Study of protein folding
6. Study of protein degradation.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Practical based on online available softwares.

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing CO**
1	Study of physical properties of proteins.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
2	Study of physical properties of proteins.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
3	Analysis of protein structure.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
4	Analysis of protein structure.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
5	Study of protein finger printing	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
6	Study of protein finger printing	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
7	Study of protein fractionation	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
8	Study of protein fractionation	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
9	Study of protein folding	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam

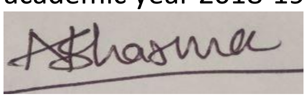
10	Study of protein folding	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam
11	Study of protein degadation.	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam
12	Study of protein degadation.	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 522.1.	Experimental Understanding of physical properties of protein, analysis of protein structure, finger printing, protein fractionation	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 522.2.	Understand the mechanism of protein folding and degradation through experiments	3	3	3	1	-	-	1	2	2	1	3	1	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Structural Biology Lab*** Course code ***BTB 522*** is level **3** for the academic year 2018-19.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
VI	BTB 603	3	3	3	1	-	-	1	2	2	1	3	3	3	1	-	1

AMITY UNIVERSITY

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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : IMMUNOLOGY AND IMMUNOTECHNOLOGY
Course Code : BTB 603, Crédits : 04, Session :2018-19(Even Sem.), Class : B.Tech. 3rd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. Course Outcomes : After successful completion of the course student will be able to:

- **BTB 603.1**. Understand the phylogeny of immune system, types of immunity and immune response.
- **BTB 603.2**. Understand the organization and structure of lymphoid organs and immune cells
- **BTB 603.3**. Understand and explain the concept of antibody and antigen.
- **BTB 603.4**. Understand and explain the concept and types of hypersensitivity and vaccination.
- **BTB 603.5**. Understand the mechanism of autoimmune disorders, transplantation and immune response against tumor.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

1. PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
7. PO7. Environment and sustainability: Understand the impact of the professional engineering

solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
9. PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leavesincluding medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Introduction

Phylogeny of Immune System, Innate and acquired immunity, clonal nature of Immune Response. Organization and structure of lymphoid organs Nature and Biology of antigens and super antigens Antibody structure and function; Types of immunity- innate, acquired, active and passive.

Module II: Major Histocompatibilty

MHC, BCR and TCR, generation of antibody diversity, Complement system

Module III: Cells of the immune system

Hematopoiesis and differentiation, lymphocyte trafficking, B-Lymphocytes, T -Lymphocytes, macrophages, dendritic cells, natural killer, lymphokines and lymphokine activated killer cells, eosinophils, neutrophils and mast cells

Module IV: Regulation of immune response

Antigen processing and presentation, activation of B and T lymphocytes, cytokines and their role in immune regulation, T cell regulation and MHC restriction, immunological tolerance

Module V: Cell mediated toxicity

Mechanism of T cell and NK cell mediated lysis and macrophage mediated cytotoxicity.

Module VI: Hypersensitivity

Module VII: Autoimmunity

Module VIII: Tumor immunology, Immunity to infectious agents

Module IX: Transplantation Immunology

Module X: Synthetic vaccines

Vaccines: General consideration, ideotype network hypothesis, Synthetic vaccines

Module XI: Hnmunological Techniques

Immuno diffusion, immuno-electrophoresis, ELISA, RIA, fluorescence activated cell sorter

Module XII: Hybridoma technology and its applications

Fusion of myeloma cells with lymphocytes

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

Text:

- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company

References:

- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.
- Immunology, Roitt, Mosby – Yearbook Inc.
- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Free

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Phylogeny of Immune System, Innate and acquired immunity,	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
2	Phylogeny of Immune System, Innate and acquired immunity	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
3	Clonal nature of Immune Responses	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
4	Clonal nature of Immune Responses	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
5	Organization and structure of lymphoid organs	Lecture	BTB 603.2	Mid Term-1, Quiz & End Sem Exam
6	Organization and structure of lymphoid organs	Lecture	BTB 603.2	Mid Term-1, Quiz & End Sem Exam
7	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
8	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
9	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
10	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
11	Antibody structure and function; Types of immunity- innate, acquired, active and passive.	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
12	Antibody structure and function; Types of immunity- innate, acquired, active and passive	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
13	Antibody structure and function	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
14	Antibody structure and function	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
15	Types of immunity- innate, acquired, active and passive	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
16	MHC	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
17	BCR	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
18	TCR	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
19	Generation of antibody diversity	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
20	Generation of antibody diversity	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
21	Complement system	Lecture	BTB 603.3	Quiz & End Sem Exam
22	Complement system	Lecture	BTB 603.3	Quiz & End Sem Exam

23	Hematopoiesis and differentiation, lymphocyte trafficking,	Lecture	BTB 603.3	Quiz & End Sem Exam
24	B-Lymphocytes,	Lecture	BTB 603.3	Quiz & End Sem Exam
25	T -Lymphocytes,	Lecture	BTB 603.3	Quiz & End Sem Exam
26	Macrophages, dendritic cells, natural killer	Lecture	BTB 603.3	Quiz & End Sem Exam
27	lymphokines and lymphokine activated killer cells,	Lecture	BTB 603.3	Quiz & End Sem Exam
28	NK cells	Lecture	BTB 603.3	Quiz & End Sem Exam
29	Eosinophils, neutrophils and mast cells	Lecture	BTB 603.3	Quiz & End Sem Exam
30	Antigen processing and presentation,	Lecture	BTB 603.3	Quiz & End Sem Exam
31	activation of B and T lymphocytes,	Lecture	BTB 603.3	Quiz & End Sem Exam
32	cytokines and their role in immune regulation,	Lecture	BTB 603.3	Quiz & End Sem Exam
33	T cell regulation and MHC restriction, immunological tolerance	Lecture	BTB 603.3	Quiz & End Sem Exam
34	Mechanism of T cell and NK cell mediated lysis and macrophage mediated cytotoxicity.	Lecture	BTB 603.3	Quiz & End Sem Exam
35	Mechanism of T cell and NK cell mediated lysis and macrophage mediated cytotoxicity.	Lecture	BTB 603.3	Quiz & End Sem Exam
36	Hypersensitivity	Lecture	BTB 603.4	Quiz & End Sem Exam
37	Hypersensitivity	Lecture	BTB 603.4	Quiz & End Sem Exam
38	Autoimmunity	Lecture	BTB 603.4	Quiz & End Sem Exam
39	Autoimmunity	Lecture	BTB 603.4	Quiz & End Sem Exam
40	Tumor immunology	Lecture	BTB 603.4	Quiz & End Sem Exam
41	Immunity to infectious disease	Lecture	BTB 603.4	Quiz & End Sem Exam
42	Transplantation	Lecture	BTB 603.4	Quiz & End Sem Exam
43	Transplantation	Lecture	BTB 603.4	Quiz & End Sem Exam
44	Vaccines: General consideration, ideotype network hypothesis, Synthetic vaccines	Lecture	BTB 603.4	Quiz & End Sem Exam
45	Immuno diffusion, immuno-electrophoresis,	Lecture	BTB 603.5	Quiz & End Sem Exam
46	ELISA, RIA, fluorescence activated cell sorter	Lecture	BTB 603.5	Quiz & End Sem Exam
47	Hybridoma technology and its applications Fusion of myeloma cells with lymphocytes	Lecture	BTB 603.5	Quiz & End Sem Exam
48	Hybridoma technology and its applications Fusion of myeloma cells with lymphocytes	Lecture	BTB 603.5	Quiz & End Sem Exam

I. **Course Articulation Matrix (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 603.1.	Understand the phylogeny of immune system, types of immunity and immune response.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.2.	Understand the organization and structure of lymphoid organs and immune cells	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.3.	Understand and explain the concept of antibody and antigen.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.4.	Understand and explain the concept and types of hypersensitivity and vaccination.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.5.	Understand the mechanism of autoimmune disorders, transplantation and immune response against tumor.														

Sample Question Paper

Amity Institute Biotechnology 2018-19						
Class: B.Tech. Biotechnology VI Semester						
Subject Name: **Immunology & Immunotechnology**		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

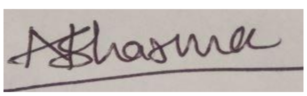
- Understand and explain the phylogeny of immune system, types of immunity, immune response.
- Describe the concept of clonal selection theory, humoral and cell mediated immunity.
- Understand and explain the structure and functions of the organs and cells of the immune system.
- Understand the mechanism of antigen-antibody interaction.
- Describe the structure of antibodies, their types and functions in immunity.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about innate and adaptive immunity. Discuss about the different types of innate immunity with characters.	6
CO2	Q.2	Write a note on different phases of cytotoxic cell mediated targeting killing mechanism.	6
	Q.3	Write a general organization of class I and class II MHC molecules with suitable diagram.	6
CO4	Q.4	Discuss the role of IgG immunoglobulin in immune system.	6
CO4	Q.5	What is antibody diversity? Discuss the role of light chain gene rearrangement in antibody diversity.	6
CO3	Q.6	Draw a well labeled diagram of hybridoma technology with production of monoclonal antibody.	6
	Q.7	Discuss the role of innate and adaptive immunity in tissue grafting. Explain with suitable example.	10
CO4	Q.8	Give a comparison between all type of vaccine with examples and applications.	10
CO3	Q.9	Discuss about features of any two primary lymphoid organs with suitable diagram	10

CO3	Q.10	A. Although all lymphocytes are formed in bone marrow. Explain how these cells get differentiated into B cell and T cell. B Where the CDR regions located on an antibody molecule and what are are their functions? Discuss the ELISA method on the basis of antigen and antibody interaction.	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Immunology and immunotechnology**/Course code ***BTB 603*** is level **2** for the academic year 2018-19.



AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR

AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2018-19

		PROGRAMME ARTICULATION MATRIX														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3
VI SEM	BTB620	3	3	1	2	-	-	-	1	2	1	3	1	3	1	1

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High) If there is no correlation, put "- "

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : Immunology and immunotechnology Lab
Course Code : BTB 622, Crédits : 01, Session: 2018-19(Even Sem.), Class : B.Tech. IIIrd Year
Faculty Name : (Dr.) Neha Sharma

A. **Introduction:** Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. **Course Outcomes :** After successful completion of the course student will be able to:

- **BTB 603.1**. Understand the phylogeny of immune system, types of immunity and immune response.
- **BTB 603.2**. Understand the organization and structure of lymphoid organs and immune cells
- **BTB 603.3**. Understand and explain the concept of antibody and antigen.
- **BTB 603.4**. Understand and explain the concept and types of hypersensitivity and vaccination.
- **BTB 603.5**. Understand the mechanism of autoimmune disorders, transplantation and immune response against tumor.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

1. PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
7. PO7. Environment and sustainability: Understand the impact of the professional engineering

solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
9. PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Course Contents:

1. Purification of immunoglobin G.
2. Study of antigen- antibody pattern (ODD).
3. Study of sandwich ELISA.
4. Study of haemeagglutination.
5. Study of immunoelectrophoresis.
6. Isolation and identification of rosette cells.
7. Antigen capture ELISA

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Manual of Molecular and Clinical Laboratory Immunology, 8th Edition Barbara Detrick (Editor), John L. Schmitz (Editor), Robert G. Hamilton (Editor) ISBN: 978-1-555-81871-5 May 2016 ASM Press
- Immunology Laboratory Manual Published by LAP LAMBERT Academic Publishing (2018) ISBN 10: 6138386175 ISBN 13: 9786138386179

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Purification of Immunoglobulin G	Lecture	**MSB 320.1**	Mid Term-1, Quiz & End Sem Exam
2	Radial Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
3	Double Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
4	Study of sandwich ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
5	Study of DOT ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
6	Study of heamagglutination (Blood group)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
7	Rh factor determination	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
8	Study of heamagglutination (Widal test)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
9	Study of immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
10	Study of rocket immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
11	Isolation and identification of rostte cells	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
12	Revision and discussion	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 320.1	Demonstrate detailed knowledge of purification of immunoglobulin, cells and antigen antibody	3	3	3	1	1	-	-	1	2	1	3	1	3	1

	interaction.														
MSB 320.2	Apply knowledge and incorporate experimental understanding of the agglutination mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 320.3	Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

<u>Sample Question Paper</u>

Amity Institute Biotechnology 2018-19						
Class: B.Tech Biotechnology VI Semester						
Subject Name: Advanced Immunology Lab		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.3 & Q.4	Q.1		Q.2		

Student will be able to:

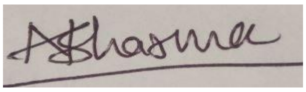
- Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
- Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
- Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
- the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

CO Map	Question No.	Question	Marks
C	Q.1	Perform Dot Elisa for detection of antigen-antibody interaction.	35

O 1			
C O 2	Q.2	Perform hemagglutination (Blood group) test.	15
	Q.3	*Viva-voce*	10
C O 3	Q.4	Record	10

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Immunology and immunotechnology Lab***/Course code ***BTB 622*** is level **3** for the academic year 2018-19.



Sample Question Paper

<table>
<tr><td colspan="7">Amity School of Engineering and Technology
Department of Computer Science and Engineering
I MID-SEMESTER (SEM –VII) 2021-22</td></tr>
<tr><td colspan="7">Class: B.Tech.(CSE) VII Semester</td></tr>
<tr><td colspan="2">Subject Name:
CSE 703 CLOUD COMPUTING</td><td colspan="3">Time: 2 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4</td><td>Q.2,3</td><td>Q.4</td><td>Q.2,5,6</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to
CO1: List the broad perceptive of cloud architecture and model.
CO2: Apply different cloud programming models as per need.</td></tr>
</table>

<table>
<tr><th>CO Map</th><th>Question No.</th><th>Question</th><th>Marks</th></tr>
<tr><td>CO1</td><td>Q.1</td><td>Explain in brief the cloud computing concept.</td><td>3</td></tr>
<tr><td rowspan="2">CO1</td><td>Q.2a</td><td>What are the essential characteristics of cloud computing?</td><td>3</td></tr>
<tr><td>Q.2b</td><td>How is cloud computing requirements and cloud servicerequirement services related to each other?</td><td>3</td></tr>
<tr><td>CO1</td><td>Q.3</td><td>Sketch NIST Cloud Computing Reference Architecture and depictits elements</td><td>6</td></tr>
<tr><td>CO2</td><td>Q.4</td><td>Explain the significance of Cloud Reference Model</td><td>3</td></tr>
<tr><td rowspan="2">CO2</td><td>Q.5a</td><td>Elaborate different cloud types with example.</td><td>3</td></tr>
<tr><td>Q.5b</td><td>Write characteristics of private cloud.</td><td>3</td></tr>
<tr><td>CO2</td><td>Q 6</td><td>How virtualization is applied in cloud computing scenario?</td><td>6</td></tr>
</table>

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2018-19

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX																	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
VII SEM	BTB 701	3	2	2	1	1	1	1	-	1	2	1	-	3	2	-	1

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOPROCESS TECHNOLOGY
Course Code : BTB 701, Crédits : 03, Session :2018-19 (Odd Sem.), Class : B.Tech. 4th Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in bioprocess technology. The objective of the course is to apply the principles of biochemical engineering in large scale cultivation of microorganism for production of important products. The present course will make them competent academically to envisage the different problems.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB 701.1. Understand Concepts of bioprocess technology the advantages of biochemical processes and its conventions.
BTB 701.2. Develop skill of process technology for ethanol, amino acids and biomass production.
BTB 701.3. Gain understanding of production of secondary metabolites and antibiotics.
BTB 701.4. Get knowledge of industrial production of commercially important enzymes.

C. **Programme Outcomes:**

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and

research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Advantage of bioprocess over chemical process. Basic principle in bioprocess technology. Media formulation, Cell culture techniques; Inoculum development and aseptic transfers. Different types of pumps, valves, and line materials, piping conventions etc. used in Biochemical Process

Module II

Process technology for the production of primary metabolites, eg. Biomass, ethanol, acetone-butanol, citric acid, amino acids, polysaccharides and plastics.

Ethanol: production by batch, continuous and cell recycle adopted by various technologies practiced in Indian distilleries using molasses and grains. Computation of fermentation efficiency, distillation efficiency and overall efficiency of ethanol production, recovery, uses, glucose effect etc. Power alcohol – definition, uses, merits and demerits of various technologies for its production.

Amino Acid: Genetic Control of metabolic pathway.

Lysine: Indirect and direct fermentation – mechanism of ph of metabolic block in accumulation of L-lysine by inhibition and repression mechanism.

Biomass: Bakers and distillers yeast production using various raw materials, “bios” factors for growth, Crabtree effect, harvesting, different forms and uses.

What are mushroom, different forms of common mushroom production from agro based raw materials and uses. Biofertilizers, biocompost and biopesticides

Module III

Production of secondary metabolites – penicillin, cephalosporins, streptomycin, tetracycline etc. Metabolites from plant and animal cell culture

Penicillin: Classification, various penicillin as precursor and 'R' – side chain, penicillinase, 6-APA, penicillin production, harvest and recovery, uses of various forms etc.

Streptomycin: chemical structure, production, harvest and recovery, use by-product of streptomycin fermentation etc.

Tetracycline: chemical structure, production, harvest and recovery, use by-product of tetracycline fermentation etc.

Module IV

Microbial production of industrial enzymes – glucose isomerase, penicillin acylase, cellulase, amylase, lipase, protease etc.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Biochemical Engineering- Kinetics, Mass Transport, Reactors and Gene Expression, W F Weith, John Wiley and Sons Inc
- Biochemical Engineering, S Aiba, A E Humphery and N F Millis, University of Tokyo Press
- Bioprocess Engineering Basic Concepts, M.L. Shuler and F. Kargi, Prentice Hall
- Bioprocess Engineering, B.K. Lydersen, K.L. Nelson, B.K. Lyderson and N. D'Elia, John Wiley and Sons Inc.
- Bioprocess Engineering Principles, P Doran, Academic Press
- Biotechnology. A Textbook of Industrial Microbiology, W. Crueger and a. Crueger, Sinauer Associates.
- Principles of Fermentation Technology, P.F. Stanbury and A. Whitaker, Pergamon Press
- Process Engineering in Biotechnolgy, A T Jackson , Prentice Hall

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Advantage of bioprocess over chemical process. Basic principle in bioprocess technology.	Lecture	BTB 701.1.	Mid Term-1, Quiz & End Sem Exam
2	Techniques; Inoculum development and aseptic transfers.	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Different types of pumps, valves, and line materials, piping conventions etc.	Lecture		Mid Term-1, Quiz & End Sem Exam

4	Different types of pumps, valves, and line materials, piping conventions etc.	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Ethanol: production by batch, continuous and cell recycle adopted by various technologies	Lecture	BTB 701.2.	Mid Term-1, Quiz & End Sem Exam
6	Ethanol: production by batch, continuous and cell recycle adopted by various technologies	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Power alcohol – definition, uses, merits and demerits of various technologies for its production.	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Power alcohol – definition, uses, merits and demerits of various technologies for its production.	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Amino Acid: Genetic Control of metabolic pathway.	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Lysine: Indirect and direct fermentation – mechanism of ph of metabolic block in accumulation of L- lysine by inhibition and repression mechanism.	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Lysine: Indirect and direct fermentation – mechanism of ph of metabolic block in accumulation of L- lysine by inhibition and repression mechanism.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Biomass: Bakers and distillers yeast production using various raw materials,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Biomass: Bakers and distillers yeast production using various raw materials,	Lecture		Mid Term-1, Quiz & End Sem Exam
14	What are mushroom, different forms of Mushrooms	Lecture		Mid Term-1, Quiz & End Sem Exam
15	common mushroom production from agro based raw materials and uses	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Biofertilizers, biocompost	Lecture		Mid Term-1, Quiz

				& End Sem Exam
17	Biopesticides	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Production of secondary metabolites – penicillin,	Lecture	BTB 701.3.	Quiz & End Sem Exam
19	Production of secondary metabolites – cephalosporins,	Lecture		Quiz & End Sem Exam
20	Production of secondary metabolites – streptomycin	Lecture		Quiz & End Sem Exam
21	Production of secondary metabolites – tetracyclin	Lecture		Quiz & End Sem Exam
22	Metabolites from plant and animal cell culture	Lecture		Quiz & End Sem Exam
23	Penicillin: Classification, various penicillin as precursor and „R? – side chain,	Lecture		Quiz & End Sem Exam
24	penicillinase, 6-APA, penicillin production,	Lecture		Quiz & End Sem Exam
25	Harvest and recovery, uses of various forms etc	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Streptomycin: chemical structure, production, harvest and recovery, use by-product of streptomycin fermentation etc.	Lecture		Quiz & End Sem Exam
27	Production, harvest and recovery, use by-product of tetracycline fermentation etc.	Lecture		Quiz & End Sem Exam
28	Tetracycline: chemical structure, production, harvest and recovery, use by-product of tetracycline fermentation etc.	Lecture		Quiz & End Sem Exam
29	Tetracycline: chemical structure, production, harvest and recovery, use	Lecture		Quiz & End Sem Exam
30	Tetracycline: chemical structure, production, harvest and recovery, use	Lecture		Quiz & End Sem Exam
31	Microbial production of industrial enzymes –	Lecture	BTB 701.4.	Quiz & End Sem Exam
32	Microbial production of industrial enzymes – glucose isomerase,	Lecture		Quiz & End Sem Exam
33	Microbial production of industrial enzymes –			Quiz & End Sem Exam

	Penicillin acylase,			
34	Microbial production of industrial enzymes – cellulase, amylase, lipase, protease etc.	Lecture		Quiz & End Sem Exam
35	Microbial production of industrial enzymes – cellulase, amylase, lipase, protease etc.	Lecture		Quiz & End Sem Exam
36	Microbial production of industrial enzymes – cellulase, amylase, lipase, protease etc.	Lecture		Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
BTB 701.1.	Understand Concepts of bioprocess technology the advantages of biochemical processes and its conventions.	3	2	-	2	-	1	-	-	1	-	-	3	2	-	-
BTB 701.2.	Develop skill of process technology for ethanol, amino acids and biomass production.	3	2	1	1	-	1	-	-	1	-	-	3	2	-	-
BTB 701.3.	Gain understanding of production of secondary metabolites and antibiotics.	3	2	1	1	-	1	-	-	-	-	-	3	2	-	-

BTB 701.4.	Get knowledge of industrial production of commercially important enzymes.	3	2	1	1	-	1	-	-	1	-	-	3	2	-	1

Sample Question Paper

Amity Institute Biotechnology 2018-19						
Class: B.Tech.Biotechnology VII Semester						
Subject Name: BIOPROCESS TECHNOLOGY		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,2	Q.3,4	Q.,5,6	Q.9,7	Q. 8,10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	Write a short note on crabtree effect.	6
CO2	Q.2	*Discuss* basic principles and applications of bioprocess technology.	6
	Q.3	Differentiate between primary metabolites and secondary metabolites with suitable example	6
CO2	Q.4	Define the term Auxotrophs. Name the bacterial auxotrophs used in L-lysin production.	6
CO3	Q.5	What is penicillin? Explain the mode of action and target site of Penicillin.	6
CO4	Q.6	Write a short note on ion exchange chromatography for product recovery	6
	Q.7	Discuss the process of Industrial production of the following enzymes. (a) Glucose Isomerase. (b) Amylase.	10

CO2	Q.8	Discuss the Different forms Mushrooms production methods using various substrates.	10
CO3	Q.9	Discuss the process of media formulation. Why it is very for fermentation process	10
CO4	Q.10	Discuss the following in details (a) Indirect method of large scale production of L-Lysine amino acid (b) Discuss the industrial production of tetracycline antibiotic using solid state fermentation.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioprocess Technology***/Course code ***BTB 701*** is level **3** for the academic year ***2018-19***.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2018-19

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “

PROGRAMME ARTICULATION MATRIX																	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3	PSO 4
VII SEM	BTB 708	1	2	3	3	2	1	3	1	-	1	1	1	-	3	2	-	1
																-	-	-
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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL BIOTECHNOLOGY
Course Code : BTB 708, Crédits : 03, Session :2018-19 (Odd Sem.), Class : B.Tech. 4th Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in environmental biotechnology. Environment constitutes one of the most important ingredients because of the global problems. Thus, it is imperative to understand the Bioremeditation of different components of environment. The present course will make them competent academically to envisage the different problems.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB 708.1. Understand Concepts of Ecology and ecosystem.
BTB 708.2. Understand environmental components and their delicate interrelationship and pollutions.
BTB 708.3. Learn concepts of waste water treatment using biotechnological interventions.
BTB 708.4. Understand the concept and theory of solid waste disposal methods.
BTB 708.5. Understand microbial role in bioremediation of various xenobiotic.
BTB 708.6. Build up understanding the mechanism of microbial leaching and mining of metals from
BTB 708.7. Understand Wasteland management uses and biorestoration
BTB 708.8. Understand environmental genetics especially release of genetically engineered microbes in environment.
BTB 708.9. Understand Hazardous wastes their source , management and safety.

C. **Programme Outcomes:**

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with

appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology,

biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction

Ecology and ecosystem.

Module II: Environmental pollution

Water, soil and air, noise and thermal pollution, their sources and effects.

Module III: Waste water (sewage and industrial effluents) treatments

Anaerobic and aerobic treatment, conventional and advanced treatment technology, methanogenesis, methanogenic, acetogenic, and fermentative bacteria- technical process and conditions, emerging biotechnological processes in waste - water treatment.

Module IV: Solid waste management

Landfills, composting, earthworm treatment, recycling and processing of organic residues.

Module V: Biodegradation

Biodegradation of xenobiotic compounds, organisms involved in degradation of chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants and microbial treatment of oil pollution

Module VI: Microbial leaching and mining

Microbial leaching and mining: Extraction of metals from ores; Recovery of metals from solutions; Microbes in petroleum extraction; Microbial desulfurization of coal.

Module VII: Wasteland

Wasteland: Uses and management, bioremediation and biorestoration of contaminated lands.

Module VIII:Environmental genetics

Environmental genetics: degradative plasmids, release of genetically engineered microbes in environment.

Module IX: Hazardous wastes

Hazardous wastes: source management and safety.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Environmental Biotechnology by PK Mohapatra
- Comprehensive Biotechnology (Vol. 1-4): M.Y.Young (Eds.), Pergamon Press, Oxford.
- Environmental Microbiology: W.D. Grant & P.E. Long, Blakie, Glassgow and London.
- Microbial Gene Technology: H. Polasa (ED.) South Asian Publishers, New Delhi.
- BiotreatmentSystems, Vol.22, D. L. Wise (Ed.), CRCPress, INC.
- Standard Methods for the Examination of Water and Waste Water (14th Education), 1985. American Public health Association.

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspon ding CO**	**Mode of Assessing CO**
1	Broad outline of Ecology	Lecture	BTB 708.1.	Mid Term-1, Quiz & End Sem Exam
2	Components of Ecology	Lecture		Mid Term-1, Quiz

				& End Sem Exam
3	Components of Ecosystem	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Types of Ecosystem	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Water pollution and its sources and effects	Lecture	BTB 708.2.	Mid Term-1, Quiz & End Sem Exam
6	Soil pollution and its sources and effects	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Air pollution and its sources and effects	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Noise and Thermal Pollution and their sources and effects.	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Waste-water and sewage water treatment- An overview	Lecture	BTB 708.3.	Mid Term-1, Quiz & End Sem Exam
10	Methods of sewage water treatment	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Role of Methanogenic, Acetogenic and fermentative bacteria in waste water treatment.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Emerging biotechnological approaches in waste - water treatment.	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Solid wastes, origin sources and types	Lecture	BTB 708.4.	Mid Term-1, Quiz & End Sem Exam
14	Solid waste management: Composting, earthworm treatment.	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Solid waste management: Landfills and their impact	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Solid waste management :Recycling and processing of organic residues.	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Xenobiotic compounds: An overview	Lecture	BTB 708.5.	Quiz & End Sem Exam
18	Biodegradation of xenobiotic compounds:	Lecture		Quiz & End Sem Exam
19	Biodegradation of xenobiotic compounds:	Lecture		Quiz & End Sem Exam
20	Microbial Biosurfactants	Lecture		Quiz & End Sem Exam
21	Microbial bio degradation of Oil :	Lecture		Quiz & End Sem Exam
22	Microbial treatment of oil pollution	Lecture		Quiz & End Sem Exam
23	Microbial leaching and mining:	Lecture	BTB 708.6.	Quiz & End Sem Exam

	Extraction of metals from ores.			
24	Microbial leaching and mining: Mechanism and methods	Lecture		Quiz & End Sem Exam
25	Microbial leaching and mining: Mechanism and methods	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Microbes in petroleum extraction;	Lecture		Quiz & End Sem Exam
27	Microbes in petroleum extraction;	Lecture		Quiz & End Sem Exam
28	Microbes in petroleum extraction;	Lecture		Quiz & End Sem Exam
29	Microbial desulfurization of coal.	Lecture		Quiz & End Sem Exam
30	Wasteland: Uses and management,	Lecture	BTB 708.7.	Quiz & End Sem Exam
31	Bioremediation and biorestoration of contaminated lands.	Lecture		Quiz & End Sem Exam
32	Bioremediation and biorestoration of contaminated lands.	Lecture		Quiz & End Sem Exam
33	Environmental genetics: Degradative Plasmids	Lecture	BTB 708.8.	Quiz & End Sem Exam
34	Environmental genetics: GE microbes and environment	Lecture		Quiz & End Sem Exam
35	Hazardous wastes: characteristics and types	Lecture	BTB 708.9.	Quiz & End Sem Exam
36	Hazardous wastes: characteristics and types	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
BTB 708.1.	Understand Concepts of Ecology and ecosystem.	3	2	2	3	1	-	-	3	-	-	-	3	2	-	1

BTB 708.2.	Understand environmental components and their delicate interrelationship and pollutions.	3	2	2	3	1	-	-	3	-	-	-	3	2	-	1
BTB 708.3.	Learn concepts of waste water treatment using biotechnological interventions.	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.4.	Understand the concept and theory of solid waste disposal methods	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.5.	Understand microbial role in bioremediation of various xenobiotic.	3	2	2	3	1	1	-	3	-	-	-	3	2	-	1
BTB 708.6.	Build up understanding the mechanism of microbial leaching and mining of metals from ores.	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.7.	Understand Wasteland management uses and biorestoration	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.8.	Understand environmental genetics especially release of genetically engineered microbes in environment	3	2	**2**	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.9.	Understand Hazardous wastes their source ,	3	2	2	1	1	2	-	3	-	-	-	3	2	-	1

	management and safety.															

Sample Question Paper

Amity Institute Biotechnology 2018-19						
Class: B.Tech Biotechnology VII Semester						
Subject Name: ENVIRONMENTAL BIOTECHNOLOGY		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,6	Q.2,4	Q.3,5,7	Q.9,	Q. 8,10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	What is Ecosystem? Briefly point out its vital components.	6
CO2	Q.2	Write a short note on acid rain and its impact on old monuments.	6
	Q.3	Write a short note on vermicomposting. How it is useful in agricultural sustainability?	6
CO4	Q.4	Explain the following terms with suitable example (i) Rhizofilteration (ii) Phytoextraction	6
CO3	Q.5	Write a short note on genetically engineered microbes in bioremediations and their limitations.	6
CO6	Q.6	Give brief description of characteristic features of hazardous wastes.	6
	Q.7	Write explanatory note on main stages of sewage water treatment. How biotehnological interventions offers better solution over conventional approach?	10
CO7	Q.8	microbial enhanced oil recovery (MEOR), briefly explain the microbial products and their le in enhanced petroleum oil extraction. Enlist the key factors affecting MEOR.	10

CO9	Q.9	in-situ bioremediation. Explain the following in context of in-situ bioremediation of land tic Bioagumentation (ii) Biostimulation (iii) Biosparging	10
CO4	Q.10	Explain the following in details a) What is microbial desulfurization of coal? Discuss the methods of coal desulphurization and its beneficial effect on air pollution. b) Discuss the role of microbial enzymes in pesticides and PAHs degradation.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental Biotechnology***/Course code ***BTB 708*** is level **3** for the academic year ***2018-19***.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2018-19

Programme Outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
VII SEM	BTB 720	3	2	3	3	1	-	-	1	1	-		3	3	-	2

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOPROCESS TECHNOLOGY LAB
Course Code : BTB 720, Crédits : 01, Session :2018-19 (Odd Sem.), Class : B.Tech. 4th Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in bioprocess technology. The objective of the course is to provide laboratory exposure and hands on experiments to produce large scale cultivation of microorganism, production of important commercial pharmaceutical products through fermentation like., ethanol, enzymes etc.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB 720.1. Isolate and cultivate of industrially important microorganisms for microbial processes.
BTB 720.2. Perform and standardization of fermentation procedure for ethanol production.
BTB 720.3. Produce single cell protein product as well as enzymes.
BTB 720.4. Perform immobilization of enzymes or cells and Sauer Krant fermentation processes.

C. **Programme Outcomes:**

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and

synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Class test (practical based)	CT	15%
	Mid term-Viva-Voce	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Isolation of industrially important micro organisms for microbial processes.

Module II: Determination of Thermal Death Point and Thermal death time of micro organisms for design of a sterilizer

Module III: Determination of growth curve of a supplied micro organism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.

Module IV: Comparative studies of ethanol production using different substrates.

Module V : Production of single cell protein

Module VI: Production and estimation of alkaline protease

Module VII: Sauer Krant fermentation

Module VIII: Use of alginate for cell immobilization

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Bioprocess Engineering Principles, P Doran, Academic Press
- Biotechnology. A Textbook of Industrial Microbiology, W. Crueger and a. Crueger, Sinauer Associates.
- Principles of Fermentation Technology, P.F. Stanbury and A. Whitaker, Pergamon Press
- Process Engineering in Biotechnolgy, A T Jackson , Prentice Hall

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Isolation of industrially important microorganisms for microbial processes.	Practical	BTB 720.1.	Class test Mid Term Viva/ End Sem Exam
2	Determination of Thermal Death Point and Thermal death time of micro organisms for design of a sterilizer	Practical		Class test Mid Term Viva/ End Sem Exam
3	Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.	Practical		Class test Mid Term Viva/ End Sem Exam
4	Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.	Practical		Class test Mid Term Viva/ End Sem Exam
5	Comparative studies of ethanol production using different substrates.	Practical	BTB 720.2.	Class test Mid Term Viva/ End Sem Exam

6	Comparative studies of ethanol production using different substrates.	Practical		Class test Mid Term Viva/ End Sem Exam
7	Comparative studies of ethanol production using different substrates.	Practical		Class test Mid Term Viva/ End Sem Exam
8	Production of single cell protein	Practical	BTB 720.3.	Class test Mid Term Viva/ End Sem Exam
9	Production and estimation of alkaline protease	Practical		Class test Mid Term Viva/ End Sem Exam
10	Sauer Krant fermentation	Practical	BTB 720.4.	Class test Mid Term Viva/ End Sem Exam
11	Use of alginate for cell immobilization	Practical		Class test Mid Term Viva/ End Sem Exam
12	Use of alginate for cell immobilization	Practical		Class test Mid Term Viva/ End Sem Exam

I. **Course Articulation Matrix (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
BTB 720.1.	Isolate and cultivate of industrially important microorganisms for microbial processes.	3	2	3	3	1	-	-	1	1	-		3	3	-	1
BTB 720.2.	Perform and standardization of fermentation procedure for ethanol production.	3	2	3	3	1	-	-	-	-	-		3	3	-	1

BTB 720.3.	Produce single cell protein product as well as enzymes.	3	2	2	3	1	-	-	-	-	-		3	3	-	1
BTB 720.4.	Perform immobilization of enzymes or cells and Sauer Krant fermentation processes.	3	2	3	2	1	-	-	-	-	-		3	3	-	1

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioprocess Lab***/Course code ***BTB 720*** is level **3** for the academic year ***2018-19***.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY-I
Course Code : BTB-302 Credits: 03, Session :2021-22 (Odd Sem.), Class : B. Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB302.1. Learn about chemical interactions in biological system.

BTB302.2. Develop the understanding between structure and function of carbohydrates & lipids.

BTB302.3. Learn the concept of metabolism and energy involved in metabolic pathways.

BTB302.4. Understand the metabolic pathways and regulations of carbohydrates metabolism.

BTB302.5. Learn about the digestion, transport, anabolism and catabolism of lipids in the body.

C. **Programme Outcomes:**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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diverse teams, and in multidisciplinary settings.

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[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction aims and scope

Chemical foundations of Biology -Properties of water, acids, bases and buffers, covalent bonds, Non-covalent interactions in biological systems.

Module II

Introduction to biomolecules - *Carbohydrates* -Sugars; Polysaccharides

Lipids -classification, structure and function. Lipids and biological membranes, Lipid linked proteins and lipoproteins, Atherosclerosis.

Module III

Metabolism and bioenergetics -First and second law, free energy and chemical equilibrium, Organic reaction mechanisms, Design of metabolism-concept of free energy, ATP-ADP cycle. Cellular energy transactions -role of mitochondria and chloroplast

Module IV

Carbohydrate metabolism-glycolysis pathway and reactions, Glycogen breakdown and synthesis, control of glycogen metabolism, glycogen storage and its diseases, Citric acid cycle -Overview, Metabolic sources of Acetyl Co-A, enzymes and regulation, The amphibolic nature of the Citric acid cycle Electron transport chain and oxidative photophosphorylation -mitochondrion and electron transport, phosphorylation and control of ATP production Gluconeogenesis, The glyoxylate pathway, Pentose phosphate pathway

Module V

Lipid metabolism -Lipid digestion, absorption and transport, fatty acid oxidation, ketone bodies, fatty acid biosynthesis, regulation of fatty acid metabolism. Cholesterol and Arachidonic Acid metabolism, Phospholipids, Sphingolipids and Glycolipids

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Harper's Biochemistry, K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw-Hill/Appleton and Lange.
- Biochemistry, L. Stryer, W.H. Freeman and Company
- Tools of Biochemistry, T.G. Cooper, John Wiley and Sons Inc.

References:

- Cellular Biophysics I & II, Thomas F. Weiss 1995, MIT Press
- Biochemical calculations, I.H. Segal. Publisher, John Wiley and Sons
- Biochemistry, C.K. Mathews, K.E. Van Holde and K.G. Ahern, Benjamin / Cummings.
- Devlin's Textbook of Biochemistry with Clinical correlations, John Wiley and Sons Inc.
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox, Worth Publishing

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction aims and scope	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
2	Chemical Foundations of Biology- Properties of water, acids, bases and buffers	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
3	Chemical Foundations of Biology- Properties of water, acids, bases and buffers	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
4	Covalent and Non-covalent interactions in biological systems	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
5	Introduction to biomolecules- Carbohydrates, Sugars, Polysaccharides	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
6	Introduction to biomolecules- Carbohydrates, Sugars, Polysaccharides	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
7	Lipids- Classification, Structure and Function	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
8	Lipids and biological membranes	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
9	Lipid linked proteins and lipoproteins, Atherosclerosis	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
10	Metabolism and bioenergetics- First and Second law	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
11	Free energy and chemical equilibrium	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
12	Organic reaction mechanisms	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
13	Design of metabolism-concept of free energy, ATP-ADP cycle	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
14	Cellular energy transactions- role of mitochondria and chloroplast	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
15	Carbohydrate pathway- glycolysis pathway and reactions	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
16	Glycogen breakdown and synthesis	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
17	Glycogen breakdown and synthesis	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
18	Control of glycogen metabolism, glycogen storage and its diseases	Lecture	BTB302.4	Quiz & End Sem Exam
19	Citric acid cycle-Overview, Metabolic sources of Acetyl Co-A	Lecture	BTB302.4	Quiz & End Sem Exam
20	Enzymes and regulation	Lecture	BTB302.4	Quiz & End Sem Exam
21	Amphibolic nature of the Citric acid cycle	Lecture	BTB302.4	Quiz & End Sem Exam

22	Electron transport chain	Lecture	BTB302.4	Quiz & End Sem Exam
23	Oxidative phosphorylation	Lecture	BTB302.4	Quiz & End Sem Exam
24	Mitochondrion and electron transport	Lecture	BTB302.4	Quiz & End Sem Exam
25	Phosphorylation and control of ATP production	Lecture	BTB302.4	Quiz & End Sem Exam
26	Gluconeogenesis	Lecture	BTB302.4	Quiz & End Sem Exam
27	Glyoxylate pathway	Lecture	BTB302.4	Quiz & End Sem Exam
28	Pentose phosphate pathway	Lecture	BTB302.4	Quiz & End Sem Exam
29	Lipid metabolism- Lipid digestion	Lecture	BTB302.5	Quiz & End Sem Exam
30	Absorption and transport	Lecture	BTB302.5	Quiz & End Sem Exam
31	Fatty acid oxidation, Ketone bodies	Lecture	BTB302.5	Quiz & End Sem Exam
32	Fatty acid biosynthesis	Lecture	BTB302.5	Quiz & End Sem Exam
33	Regulation of fatty acid metabolism	Lecture	BTB302.5	Quiz & End Sem Exam
34	Cholesterol and Arachidonic acid metabolism	Lecture	BTB302.5	Quiz & End Sem Exam
35	Phospholipids, Sphingolipids and Glycolipids	Lecture	BTB302.5	Quiz & End Sem Exam
36	Phospholipids, Sphingolipids and Glycolipids	Lecture	BTB302.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB302.1.	Learn about chemical interactions in biological system.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.2.	Develop the understanding between structure and function of carbohydrates & lipids.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.3.	Learn the concept of metabolism and energy involved in metabolic pathways.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.4.	Understand the metabolic pathways and regulations of carbohydrates metabolism.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.5.	Learn about the digestion, transport, anabolism and catabolism of lipids in the body.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
I MID-SEMESTER (SEM –III) 2021-22</td></tr>
<tr><td colspan="7">Class: B.Tech. Biotechnology III Semester</td></tr>
<tr><td colspan="2">Subject Name:
BTB 302 BIOCHEMISTRY-I</td><td colspan="3">Time: 1.5 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4</td><td>Q.2,3</td><td>Q.4</td><td>Q.2,5,6</td><td></td><td></td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biopolymers with examples.	3
CO1	Q.2a	What do you understand by proton hopping?	3
	Q.2b	How is monosaccharide different from polysaccharide?	3
CO1	Q.3	Give an account of lipid digestion in body.	6
CO2	Q.4	Explain the significance of lipoproteins in clinics.	3
CO2	Q.5a	What are the factors favoring glycogenolysis.	3
	Q.5b	Discuss the different factors affecting fat oxidation.	3
CO2	Q 6	Glycolysis and Gluconeogenesis will never occur simultaneously. Why?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry-I**/Course code **BTB-302** is level **2** for the academic year 2018-19.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR BIOLOGY
Course Code : BTB-304, Credits: 04, Session :2021-22 (Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB304.1. Learn about the mechanism of replication of DNA in prokaryotes and eukaryotes.

BTB304.2. Learn and compare the mechanism of transcription in prokaryotes and eukaryotes.

BTB304.3. Learn the various post-transcriptional processes in cell.

BTB304.4. Learn about the mechanism of protein synthesis in prokaryotes and eukaryotes.

BTB304.5. Understand about gene expression regulation.

BTB304.6. Understand about various mechanisms of gene silencing.

C. **Programme Outcomes:**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: DNA Replication and repair

Nucleic Acid Structure and Functions, Mechanism of Prokaryotic and Eukaryotic DNA replication, Enzymes and accessory proteins involved in DNA replication, DNA repair Mechanism.

Module II: Transcription
Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements.

Module III: Modifications in RNA
5'-cap formation, transcription termination, 3 '-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA and mRNA stability.

Module IV: Translation
Prokaryotic and Eukaryotic translation, the translation Machinery; Mechanisms of initiation, elongation and termination, regulation of translation, co-and post-translational modifications of proteins.

Module V: Regulation of Gene Expression in prokaryotic and eukaryotic systems
Lac operon, Ara operan, regulation in Eukaryotes, Epigenetics.

Module VI: Antisense and Ribozyme technology
Molecular mechanism of antisense molecules, inhibition of spilicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of Ribozyme; Hammerhead, hairpin and other ribozymes, strategies for designing ribozymes, applications of antisense and ribozyme technologies.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education
- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Biology of the Cell. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing
- Gene VIII, Benjamin Lewin 2005, Oxford University Press

References:

- Molecular Cell Biology, H. Lodish, A.Berk, S. Zipursky, P Matsundaira, D.Baltimore and J.E. Barnell, W.H. Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Nucleic Acid Structure and Functions	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
2	Mechanism of Prokaryotic and Eukaryotic DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
3	Mechanism of Prokaryotic and Eukaryotic DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
4	Enzymes and accessory proteins involved in DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
5	Enzymes and accessory proteins involved in DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
6	DNA repair Mechanism	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
7	DNA repair Mechanism	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
8	Tutorial	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
9	Prokaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
10	Prokaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
11	Eukaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
12	Eukaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
13	RNA polymerase	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
14	General and specific transcription factors	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
15	Regulatory elements	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
16	Tutorial	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
17	5'-cap formation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
18	transcription termination	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
19	3'-end processing and polyadenylation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
20	3'-end processing and polyadenylation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
21	Splicing, Editing	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
22	Nuclear export of mRNA and mRNA stability	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
23	Tutorial	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam

24	Prokaryotic and Eukaryotic translation	Lecture	BTB304.4	Mid Term, Quiz & End Sem Exam
25	Prokaryotic and Eukaryotic translation	Lecture	BTB304.4	Quiz & End Sem Exam
26	the translation Machinery	Lecture	BTB304.4	Quiz & End Sem Exam
27	Mechanisms of initiation	Lecture	BTB304.4	Quiz & End Sem Exam
28	elongation and termination	Lecture	BTB304.4	Quiz & End Sem Exam
29	regulation of translation	Lecture	BTB304.4	Quiz & End Sem Exam
30	co-and post-translational modifications of proteins	Lecture	BTB304.4	Quiz & End Sem Exam
31	Tutorial	Lecture	BTB304.4	Quiz & End Sem Exam
32	Lac operon	Lecture	BTB304.5	Quiz & End Sem Exam
33	Ara operon	Lecture	BTB304.5	Quiz & End Sem Exam
34	regulation in Eukaryotes	Lecture	BTB304.5	Quiz & End Sem Exam
35	Epigenetics	Lecture	BTB304.5	Quiz & End Sem Exam
36	Tutorial	Lecture	BTB304.5	Quiz & End Sem Exam
37	Molecular mechanism of antisense molecules	Lecture	BTB304.6	Quiz & End Sem Exam
38	Molecular mechanism of antisense molecules	Lecture	BTB304.6	Quiz & End Sem Exam
39	inhibition of spilicing, polyadenylation and translation	Lecture	BTB304.6	Quiz & End Sem Exam
40	disruption of RNA structure and capping	Lecture	BTB304.6	Quiz & End Sem Exam
41	Biochemistry of Ribozyme	Lecture	BTB304.6	Quiz & End Sem Exam
42	Hammerhead, hairpin and other ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
43	Hammerhead, hairpin and other ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
44	strategies for designing ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
45	applications of antisense	Lecture	BTB304.6	Quiz & End Sem Exam
46	ribozyme technologies	Lecture	BTB304.6	Quiz & End Sem Exam
47	Applications of ribozyme technologies	Lecture	BTB304.6	Quiz & End Sem Exam
48	Tutorial	Lecture	BTB304.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB304.1.	Learn about the mechanism of replication of DNA in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.2.	Learn and compare the mechanism of transcription in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.3.	Learn the various post-transcriptional processes in cell.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.4.	Learn about the mechanism of protein synthesis in prokaryotes and eukaryotes	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.5.	Understand about gene expression regulation.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.6.	Understand about various mechanisms of gene silencing.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
I MID-SEMESTER (SEM –III) 2021-22</td></tr>
<tr><td colspan="7">Class: B.Tech. Biotechnology III Semester</td></tr>
<tr><td colspan="2">Subject Name:
BTB 304 MOLECULAR BIOLOGY</td><td colspan="3">Time: 1.5 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4</td><td>Q.2,3</td><td>Q.4</td><td>Q.2,5,6</td><td></td><td></td></tr>
<tr><td colspan="7"></td></tr>
</table>

<table>
<tr><th>CO Map</th><th>Question No.</th><th>Question</th><th>Marks</th></tr>
<tr><td>CO1</td><td>Q.1</td><td>Explain in brief the nucleic acids with examples.</td><td>3</td></tr>
<tr><td>CO1</td><td>Q.2</td><td>What do you understand by semi discontinuous replication of DNA?</td><td>6</td></tr>
<tr><td>CO1</td><td>Q.3</td><td>Give an account of RNA synthesis in E. coli.</td><td>6</td></tr>
<tr><td>CO2</td><td>Q.4</td><td>Explain the significance of 5’-capping in RNA.</td><td>3</td></tr>
<tr><td rowspan="2">CO2</td><td>Q.5a</td><td>How does tRNA bring amino acid to ribosome for protein synthesis?</td><td>3</td></tr>
<tr><td>Q.5b</td><td>Discuss the different mechanisms of gene silencing.</td><td>3</td></tr>
<tr><td>CO2</td><td>Q 6</td><td>How does cell ensure the correct incorporation of amino acids in translation?</td><td>6</td></tr>
</table>

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology**/Course code **BTB-304** is level **3** for the academic year 2018-19.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	3	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR BIOLOGY LAB
Course Code : BTB-323, Credits: 01, Session :2021-22 (Odd Sem.), Class : B.Tech. 2^{nd} Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. Course Outcomes: At the end of the course, students will be able to:

BTB323.1. Practical based understanding of preparation of genomic and plasmid DNA.

BTB323.2. Practical based understanding of isolation of RNA.

BTB323.3. Practical based understanding of RFLP analysis.

BTB323.4. Practical based understanding of gel filtration.

BTB323.5. Practical based understanding of Preparation of Competent Cells.

BTB323.6. Practical based understanding of Restriction Digestion and Ligation of DNA.

C. Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

F. Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Preparation of DNA: genomic, Plasmid

Module II

Isolation of RNA

Module III
RFLP analysis
Module IV
Gel filtration
Module V
Preparation of Competent Cells
Module VI
Restriction Digestion and Ligation of DNA

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:

Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Preparation of DNA: genomic, Plasmid	Practical	BTB323.1	Class Test (Practical Based) & End Sem Exam
2	Preparation of DNA: genomic, Plasmid	Practical	BTB323.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of RNA	Practical	BTB323.2	Class Test (Practical Based) & End Sem Exam
4	Isolation of RNA	Practical	BTB323.2	Class Test (Practical Based) & End Sem Exam
5	RFLP analysis	Practical	BTB323.3	Class Test (Practical Based) & End Sem Exam
6	RFLP analysis	Practical	BTB323.3	Class Test (Practical Based) & End Sem Exam
7	Gel filtration	Practical	BTB323.4	Class Test (Practical Based) & End Sem Exam
8	Gel filtration	Practical	BTB323.4	Class Test (Practical Based) & End Sem Exam
9	Preparation of Competent Cells	Practical	BTB323.5	Class Test (Practical Based) & End Sem Exam
10	Preparation of Competent Cells	Practical	BTB323.5	Class Test (Practical Based) & End Sem Exam
11	Restriction Digestion and Ligation of DNA	Practical	BTB323.6	Class Test (Practical Based) & End Sem Exam
12	Restriction Digestion and Ligation of DNA	Practical	BTB323.6	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB323.1.	Practical based understanding of preparation of genomic and plasmid DNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.2.	Practical based understanding of isolation of RNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.3.	Practical based understanding of RFLP analysis.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.4.	Practical based understanding of gel filtration.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.5.	Practical based understanding of Preparation of Competent Cells.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.6.	Practical based understanding of Restriction Digestion and Ligation of DNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology Lab**/Course code **BTB-323** is level **3** for the academic year 2018-19.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY - II
Course Code : BTB-401, Credits : 04, Session :2021-22 (Even Sem.), Class : B. Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB401.1. Understand relationships between structure and functions Amino acids and Proteins and the concept of Enzymes, their mode of action and regulation.

BTB401.2. Understand the structure and properties of Nucleic acids – DNA and RNA.

BTB401.3. Learn and understand the amino acid metabolism.

BTB401.4. Understand the metabolism of purines and pyrimidines in the body.

C. **Programme Outcomes:**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.
PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Proteins -Amino acids and peptides - classification, chemical reactions and physical properties. Introduction to protein structure and function. Cis-trans peptide bond formation. Glycoproteins -structure and function, *Vitamins and Coenzymes*: structure and function of water soluble vitamins.
Enzymes -Introduction to kinetic and catalytic mechanisms of enzymes; Regulation of enzyme activity; Effects of physical parameters on enzyme activity, enzyme inhibitors – types of inhibition.

Module II
Nucleic acids - nitrogenous bases, nucleotides, types, structure and properties of nucleic acids

Module III
Amino acid metabolism -Amino acid deamination, urea cycle, biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine,
Tyrosine. Specialized Products of Amino Acids, Nitrogen fixation

Module IV
Nucleotide Metabolism -structure and metabolism of purines and pyrimidines, biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN; Catabolism of heam and clinical significance of bilirubin.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Harper's Biochemistry, K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw-Hill/Appleton and Lange.
- Biochemistry, L. Stryer, W.H. Freeman and Company
- Tools of Biochemistry, T.G. Cooper, John Wiley and Sons Inc.

References:

- Cellular Biophysics I & II, Thomas F. Weiss 1995, MIT Press
- Biochemical calculations, I.H. Segal. Publisher, John Wiley and Sons
- Biochemistry, C.K. Mathews, K.E. Van Holde and K.G. Ahern, Benjamin / Cummings.
- Devlin's Textbook of Biochemistry with Clinical correlations, John Wiley and Sons Inc.
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox, Worth Publishing

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
2	Proteins - Amino acids and peptides - classification	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
3	Proteins - Amino acids and peptides - classification	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
4	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
5	Chemical reactions and physical properties	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
6	Introduction to protein structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
7	Introduction to protein structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
8	Glycoproteins -structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
9	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
10	Vitamins and Coenzymes: structure and function of water soluble vitamins	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
11	Vitamins and Coenzymes: structure and function of water soluble vitamins	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
12	Enzymes - Introduction to kinetic mechanisms of enzymes	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
13	Catalytic mechanisms of enzymes	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
14	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
15	Regulation of enzyme activity	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
16	Effects of physical parameters on enzyme activity	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
17	Enzyme inhibitors – types of inhibition.	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
18	Enzyme inhibitors – types of inhibition.	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
19	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
20	Nucleic acids - nitrogenous bases	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam
21	Nucleotides, types, structure and properties of nucleic acids	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam
22	Nucleotides, types, structure and properties of nucleic acids	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam

23	Amino acid metabolism - Amino acid deamination	Lecture	BTB401.3	Mid Term, Quiz & End Sem Exam
24	TUTORIAL	Lecture	BTB401.3	Mid Term, Quiz & End Sem Exam
25	Urea cycle	Lecture	BTB401.3	Quiz & End Sem Exam
26	Urea cycle	Lecture	BTB401.3	Quiz & End Sem Exam
27	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
28	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
29	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
30	Tutorial	Lecture	BTB401.3	Quiz & End Sem Exam
31	Specialized Products of Amino Acids	Lecture	BTB401.3	Quiz & End Sem Exam
32	Specialized Products of Amino Acids	Lecture	BTB401.3	Quiz & End Sem Exam
33	Nitrogen fixation	Lecture	BTB401.3	Quiz & End Sem Exam
34	Nitrogen fixation	Lecture	BTB401.3	Quiz & End Sem Exam
35	TUTORIAL	Lecture	BTB401.3	Quiz & End Sem Exam
36	Nucleotide Metabolism -structure of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
37	Nucleotide Metabolism -structure of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
38	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
39	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
40	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
41	Biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN)	Lecture	BTB401.4	Quiz & End Sem Exam
42	Biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN)	Lecture	BTB401.4	Quiz & End Sem Exam
43	Biosynthesis of nucleotide	Lecture	BTB401.4	Quiz & End Sem

	coenzymes (NAD, NADP, FAD, FMN)			Exam
44	TUTORIAL	Lecture	BTB401.4	Quiz & End Sem Exam
45	Catabolism of heam	Lecture	BTB401.4	Quiz & End Sem Exam
46	Catabolism of heam	Lecture	BTB401.4	Quiz & End Sem Exam
47	Clinical significance of bilirubin	Lecture	BTB401.4	Quiz & End Sem Exam
48	Clinical significance of bilirubin	Lecture	BTB401.4	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB401.1.	Understand relationships between structure and functions Amino acids and Proteins and the concept of Enzymes, their mode of action and regulation.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.2.	Understand the structure and properties of Nucleic acids – DNA and RNA.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.3.	Learn and understand the amino acid metabolism.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.4.	Understand the metabolism of purines and pyrimidines in the body.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –IV) 2021-22						
Class: B.Tech. Biotechnology IV Semester						
Subject Name: BTB 401 BIOCHEMISTRY-II		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the amino acids with examples.	3
CO1	Q.2	What do you understand by enzyme kinetics?	6
CO1	Q.3	Give an account of biochemistry of glycoproteins.	6
CO2	Q.4	Explain the significance of peptide bond.	3
CO2	Q.5a	How does inhibitors work against enzymes?	3
	Q.5b	Discuss the importance of SGOT and SGPT in liver and kidney function tests.	3
CO2	Q 6	Discuss the importance of mis regulation in nucleic acid metabolism.	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry-II**/Course code **BTB-401** is level **3** for the academic year 2018-19.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	3	3	3	3	-	1	2	2	2	3	1	2

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY LAB-II
Course Code : BTB-420, Credits: 01, Session :2021-22 (Even Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend understanding of the qualitative and quantitative estimation of proteins and nucleic acids.

B. Course Outcomes: At the end of the course, students will be able to:

BTB420.1. Practical based understanding of qualitative and quantitative tests of protein and amino acids.

BTB420.2. Practical based understanding of qualitative and quantitative tests of DNA and RNA.

C. Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

F. **Component of Evaluation**	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Colour reactions of proteins (Ninhydrin test, Biuret test, Xanthoprotein test).
Estimation of proteins.
Module II
Biochemical estimation of DNA
Biochemical estimation of RNA
Quantitative determination of DNA and RNA by spectrophotometric method using UV range.
Determination of melting temperature of DNA from thermal denaturation characteristics.

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:
Text:

- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Ninhydrin test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Xanthoprotein test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
4	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
5	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
6	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
7	Biochemical estimation of DNA	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
8	Biochemical estimation of RNA	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
9	Quantitative determination of DNA and RNA by spectrophotometric method using UV range	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
10	Quantitative determination of DNA and RNA by spectrophotometric method using UV range	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
11	Determination of melting temperature of DNA from thermal denaturation characteristics	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
12	Determination of melting temperature of DNA from thermal denaturation characteristics	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB420.1.	Practical based understanding of qualitative and quantitative tests of protein and amino acids.	3	3	3	3	-	1	2	-	2	2	**-**	**2**	3	3	1	-
BTB420.2.	Practical based understanding of qualitative and quantitative tests of DNA and RNA.	3	3	3	3	-	1	2	-	2	2	**-**	**2**	3	3	1	-

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry lab-II**/Course code **BTB-420** is level **3** for the academic year 2018-19.

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED GENOMICS & PROTEOMICS
Course Code : MSB 204, Crédits : 04, Session :2018-19(Even Sem.), Class : M.Sc. I[st] Year
Faculty Name : Dr. MANISH KUMAR

A. **Introduction:** The course helps in developing a detailed understanding of eukaryotic genome complexity and organization. Current research on the molecular basis of the control of gene expression in eukaryotic has developed a detailed understanding of techniques of gene diagnostics and DNA profile to acquire the fundamental of genomics and bioinformatics, it is desirable to have in depth study on these lines.

B. **Course Outcomes:** At the end of the course, students will be able to:
MSB204.1 Understand the basic of genomics, Anatomy of genomics and human genome project
MSB204.2 Able to understand gene expression, and mapping
MSB204.3 Learn different DNA markers
MSB204.4 Understand Microarray and their applications in analysis of gene expression
MSB204.5 Develop knowledge of fundamental techniques in proteomics.
MSB204.6 Understand Post translational modification.
MSB204.7 Get detail knowledge and understanding of Protein – protein interaction.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Introduction to Genomics: The human genome project "Anatomy of prokaryotic and eucaryotic genome: repetitive DNA and RNA Contents of genomes.

Module II
Transcriptomics and meta-transcriptomics: Introduction, method and uses. Genetic mapping

Module III
Microsatellite DNA markers, RFLP, DNA sequencing, Phylogeny

Module IV
Micro array: DNA micro array marker, computational methods.

PART-II: PROTEOMICS

Module V
Introduction to proteomics
Fundamental methods used in proteomics. 2-D gel electrophoresis + mass spectroscopy.

Module VI
Post translationalprotein modification

Module VII
Protein – protein interaction some examples

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Genes & Genomes, Maxine Singer and Paul Berg
- Genomes II, T.A. Brown

***References*:**

- A Primer of Genome Science, Greg Gibson and Spencer V. Muse
- Database Annotation in Molecular Biology: Principles and Practice, Arthur M. Lesk
- DNA: Structure and Function, Richard R. Sinden
- Recombinant DNA (Second Edition), James D. Watson and Mark Zoller
- Gene Cloning and DNA Analysis – An introduction (Fourth Edition), T.A. Brown
- www.panimatext.com

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
2	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
3	Human Genome project	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam

4	Human Genome project	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem Exam
5	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem Exam
6	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem Exam
7	repetitive DNA and RNA Contents of genoms	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem Exam
8	repetitive DNA and RNA Contents of genoms	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem Exam
9	Transcriptomics and metatranscriptomics	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
10	Transcriptomics and metatranscriptomics	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
11	Transcriptomics and metatranscriptomics	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
12	Introduction , method and uses.genetic mapping	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
13	Introduction , method and uses.genetic mapping	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
14	Introduction , method and uses.genetic mapping	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
15	Microsatellite DNA markers	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
16	Microsatellite DNA markers	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
17	Microsatellite DNA markers	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
18	RFLP	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
19	RFLP	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
20	DNA sequencing, polyogemy	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
21	DNA sequencing, polyogemy	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem

				Exam
22	DNA sequencing, polyogemyprocedure	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
23	DNA sequencing, polyogemy	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
24	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam
25	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam
26	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam
27	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam
28	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam
29	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam
30	Introduction to proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
31	Introduction to proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
32	Fundamental methods used in proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
33	Fundamental methods used in proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
34	Fundamental methods used in proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
35	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
36	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
37	2-D gel electrophoresis + mass spectroscopy 2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
38	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
39	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
40	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
41	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
42	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
43	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
44	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
45	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam

46	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
47	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
48	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB204.1	Understand the basic of genomics, Anatomy of genomics and human genome project	3	3	1	3	1	1	1	-	2	1	3	1	-	1
MSB204.2	Able to understand gene expression, and mapping	3	3	**2**	3	1	-	-	-	2	1	3	1	-	1
MSB204.3	Learn different DNA markers	3	3	2	3	1	-	-	1	2	1	3	1	1	1
MSB204.4	Understand Microarray and their applications in analysis of gene expression	3	3	1	3	1	-	-	-	2	1	3	1	-	1
MSB204.5	Develop knowledge of fundamental techniques in proteomics.	3	3	1	3	1	-	-	-	2	1	3	1	-	1
MSB204.6	Understand Post translational modification.	3	3	1	3	1	-	-	-	2	1	3	1	1	1
MSB204.7	Get detail knowledge and understanding of Protein – protein interaction.	3	3	1	3	1	-	-	-	2	1	3	1	1	1

Amity Institute of Biotechnology I MID-SEMESTER (SEM –II) 2018-19		
Class: M.Sc Biotechnology II Semester		
Subject Name: MSB 204 Advanced Genomics & Proteomics	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

Student will be able to
CO1: Understand the basics of genomics, Anatomy of genomics and human genome project.
CO2: understand gene expression, and mapping.

CO Map	Question No.	Question	Marks
CO1	Q.1	Differentiate between genomics and proteomics.	3
CO1	Q.2a	Discuss the separation processes in genomics.	3
	Q.2b	Discuss the separation processes in proteomics.	3
CO1	Q.3	Discuss physical mapping and use of restriction enzymes.	6
CO2	Q.4	Discuss linkage mapping with suitable example.	3
CO2	Q.5a	Write a short note on phylogeny.	3
	Q.5b	How genomic study is useful in the identification of genomes?	3
CO2	Q 6	Discuss the role of recombination and recombinants in the linkage mapping.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Genomics & Proteomics/MSB 204** is **level 3** for the academic year 2018-19.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
II	MSB 205	3	3	3	1	1	-	-	1	2	1	3	1	3	1

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **COMPUTATIONAL BIOLOGY**
Course Code : MSB 205, Crédits : 03, Session :2018-19(Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: The objective is to describe how molecular data can be used to construct a phylogenetic tree and characterize the rates and causes of nucleotide substitutions. The aim is also to explain how a gene/protein family arises and the mechanisms, which underlie evolution at the molecular level.

B. Course Outcomes: After successful completion of the course student will be able to:

MSB 205.1 Understand and explain the development of computational biology.

MSB 205.2 Describe the fundamentals of bioinformatics databases and their application.

MSB 205.3 Understand and explain the use of various computational methods for phylogentic studies.

MSB 205.4 Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling. Explain the applications of computational biology in different fields of sciences.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction to Computational Biology. History of Bioinformatics
Module II: Bioinformatics Fundamentals

1. Major information Resources & Databases in Bioinformatics
 a. Information Resources: NCBI, EBI, ExPasy Entrez & SRS System
 b. Primary Sequence & Structure Databases: Genbank, SwissProt/Uniprot, EMBL, PIR, PDB, MMDB, NDB, CSD, KEGG etc.
 c. Derived (Secondry) Databases of Sequences and structure:
  i. Prosite, PRODOM, PRINTS, Pfam, BLOCK, INTERPRO etc.
  ii. SCOP, CATH, DSSP, FSSP, RNAbase,
 d. Genome Databases (at NCBI, EBI, TIGR, SANGER), High-throughput genomics sequence (EST, STS, GSS), ENSEMBL.
2. Sequence File formats: fasta, genbank, embl, Swiss-prot, pdb, nbrf, pir and multiple sequences formats (Aln, Mega, Pileup, phylip etc.)
3. Sequence Similarty Basics: Similarty, Indentity, Homology, Scoring, selectivity/Sensitivity, Gap cost, Linear and Affine Gap Penalty, Basic of scoring system and matrices (PAM, BIOSUM, GONNET etc.)
4. Pairwise Sequences Aligment: Brute Force method, Dot matrix method, Global (Needleman-Wunsch) and Local Alignment (Smith-Waterman) using Dynamic programming.
5. Scoring Matrices: Substitution Matrices, Concept log-odds, PAM & BLOSUM Series, Derivation of PAM & BLOSUM matrices, Distance and Similarity matrices.
6. Similarity Searching Tools: BLAST and FASTA, Theory and Algorithms, variants of BLAST and FASTA, PSI-BLAST and PHI BLAST, Statistical Significance.
7. Sequence Pattern and Profiles: Concepts of motif, pattern and profile, Profile construction and its application in Bioinformatics,

Module III: Computational Methods

Scoring methods of MSA (sum of pair, Multidimensional DP, Progressive, Iterative, Probabilistic)

Phylogenetics prediction mrthods: Basics, molecular clock, Substitution Models of evolution, Tree reconstruction methods (Distance based, character based method, statistical), Bootsstrapping.

Suffix tree and its applications in Bioinformatics

Gene Indentification Methods

Predictive Methods using DNA and Protein sequences.

Statistical Modeling: Log-likelihood, Bayesian network, Markov and hidden markov models.

Clustering Algorithms: K-means, Hierarchical and Mixture of Gaussion.

Module IV: Application and software tools

Software and Programmes for sequence comparison and analysis.

Phylogenetics analysis software.

Molecular Structure drawing tool.

Molecular modeling/Docking.

Application of computational biology/Bioinformatics in Agriculture, Human health, Enviroment, Biotechnology, Molecular Biology, Neurobiology, Drug Designing, Veterinary Science.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

• Computational Modeling of Genetic and Biochemical Networks, J.M. Bower and H. Bolouri, MIT Press

• Computational Molecular Biology: An Algorithmic Approach, P.A. Pevzner, MIT Press

• Computer Methods for Macromolecular Sequence Analysis, R.F. Doolittle, J.N, Abelson, M.I. Simon, Academic press

• Essentials of Genomics and Bioinformatics, C.W. Sensen, John Wiley and Sons Inc.

• Introduction to Bioinformatics, T. Attwood and D. Parry-Smith, Prentice Hall

• Introduction to Computational Biology: Maps, Sequences and Genomes, M. Waterman, Chapman and Hall

• Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit, G. V. Heijne and G.V. Heijne, Academic Press

I. **Lecture Plan**

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Introduction to computational Biology & History of Bioinformatics	Lecture	**MSB 205.1**	Mid Term-1, Quiz & End Sem Exam
2	Major information Resources & Databases in Bioinformatics (a & b)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
3	Major information Resources & Databases in Bioinformatics (c & d)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
4	Sequence File formats & Multiple sequence formats	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
5	Sequence Similarity Basics	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
6	Basic of scoring system and matrices	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
7	Pairwise Sequences Aligment	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
8	Local Alignment	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
9	Scoring Matrices	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
10	Similarity Searching Tools (BLAST)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
11	Similarity Searching Tools (FASTA)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
12	Sequence Pattern and Profiles	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
13	Scoring methods of MSA	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
14	Phylogenetics prediction methods	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
15	Gene Identification Methods Predictive Methods using DNA and Protein sequences.	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
16	Statistical Modeling: Log-likelihood, Bayesian network, Markov	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
17	Hidden markov models	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
18	Clustering Algorithms: K-means, Hierarchical and Mixture of Gaussion	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
19	Software and Programmes for	Lecture	**MSB 205.4**	Mid Term-1, Quiz

	sequence comparison and analysis			& End Sem Exam
20	Phylogenetics analysis software (I)	Lecture	**MSB 205.4**	Mid Term-1, Quiz & End Sem Exam
21	Molecular Structure drawing tool (I)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
22	Molecular Structure drawing tool (II)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
23	Molecular modeling/Docking (I)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
24	Molecular modeling/Docking (II)	Lecture	**MSB 205.4**	Quiz & End Sem Exam
25	Application of computational biology/Bioinformatics in Agriculture	Lecture	**MSB 205.4**	Quiz & End Sem Exam
26	Application of computational biology/Bioinformatics in Human health	Lecture	**MSB 205.4**	Quiz & End Sem Exam
27	Application of computational biology/Bioinformatics in Human health	Lecture	**MSB 205.4**	Quiz & End Sem Exam
28	Application of computational biology/Bioinformatics in Environment	Lecture	**MSB 205.4**	Quiz & End Sem Exam
29	Application of computational biology/Bioinformatics in Environment	Lecture	**MSB 205.4**	Quiz & End Sem Exam
30	Application of computational biology/Bioinformatics in Neurobiology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
31	Application of computational biology/Bioinformatics in Neurobiology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
32	Application of computational biology/Bioinformatics in molecular Biology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
33	Application of computational biology/Bioinformatics in molecular Biology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
34	Application of computational biology/Bioinformatics in Drug Designing	Lecture	**MSB 205.4**	Quiz & End Sem Exam
35	Application of computational biology/Bioinformatics in Drug	Lecture	**MSB 205.4**	Quiz & End Sem Exam

	Designing			
36	Application of computational biology/Bioinformatics in Veterinary Science	Lecture	**MSB 205.4**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 205.1	Understand and explain the development of computational biology	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.2	Describe the fundamentals of bioinformatics databases and their application	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.3	Understand and explain the use of various computational methods for phylogentic studies	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.3	Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling. Explain the applications of computational biology in different fields of sciences	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

Amity Institute Biotechnology 2018-19						
Class: M.Sc. Biotechnology II Semester						
Subject Name: Computational Biology		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

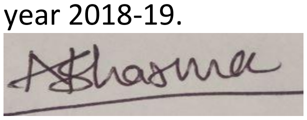
- Understand and explain the development of computational biology.
- Describe the fundamentals of bioinformatics databases and their application.
- Understand and explain the use of various computational methods for phylogentic studies.
- Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling.
- Explain the applications of computational biology in different fields of sciences.

CO Map	Question No.	Question	Marks
CO1	Q.1	Bioinformatics is the integrated field of science" Explain this statement with suitable examples.	6
CO2	Q.2	What is a primary sequence database? Give any five examples of primary databases with features.	6
	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	Compare the Global and Local alignment methods with suitable example of matrix.	6
CO4	Q.5	Give the description of commonly used secondary databases of nucleic acid and protein.	6
CO3	Q.6	Write any five applications of bioinformatics in biological sciences and agriculture.	6
	Q.7	BLAST is a popular program for exploring protein family relationship. Discuss the types and applications of BLAST program.	10
CO4	Q.8	What is Neighbor-joining and UPGMA method? How it is useful in	10

		constructing phylogenetic tree.	
CO3	Q.9	What is sequence alignment? Write the difference between pairwise and multiple sequence alignment.	10
CO3	Q.10	A. Consider the following multiple sequence alignment: A.TCGGTAGGCT B. ACCGTTCCAT C. ACCCAAGGCT D. ATGGTAGGCT How many rooted and un-rooted phylogenies can you construct out of the taxa shown in the alignment? Explain any one method to construct a phylogenetic tree. B. Explain dendogram, cladogram and phylogram. How many different unrooted and rooted trees topologies are possible for 3, 4 and 5 species?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Computational Biology***/Course code ***MSB 205*** is level **3** for the academic year 2018-19.



AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M.Sc.) BT, Academic Year – 2018-19

M.Sc Biotechnology (Four Semesters)

Programme Outcomes:

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
II SEM	**MSB 206**	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**3**	**1**	**-**	**1**

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL BIOTECHNOLOGY
Course Code : MSB 206, Crédits : 03, Session :2018-19 (Odd Sem.), Class : M.Sc.. 1st Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques used in *Environmental* biotechnology. To introduce the students to regenerate clean environment using biotechnology as the key tool and provide them the insight for eco-friendly approach along with the concept of sustainable development.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB 206.1. Understand concept of climate change, pollution and mitigation approaches.
MSB 206.2. Understand concept of energy sustainability, clean fuel technology, Biomass energy and biofuels.
MSB 206.3. Understand concept of Biodegradation, Bioremediation and Phytoremediation. Advances in bioleaching and biomineralization.
MSB 206.4. Understand Advanced waste water treatments.
MSB 206.5. Understand Agriculture Sustainability and Clean agricultural practices, Biosensors and biomarkers, Principles of ecotoxicity
MSB 206.6. Understand the Environmental impact assessment and Environmental audit, Related case studies from India.

C. **Programme Outcomes:**
M.Sc Biotechnology (Four Semesters)

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.
PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%

Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Environmental pollution and its major impacts on human beings, plants, animals and climate, concept of Global warming and climate change, Global Ozone Problem, Eutrophication, Land degradation, Biomagnification.

Module II

Non-renewable and renewable energy resources, concept of clean fuel technology, Biomass energy and biofuels

Module III

Biodegradation, Bioremediation and Phytoremediation of major pollutants (PAH, Pesticides etc), Use of microbial technology for mining of metals (Bioleaching) and Concept of Biomineralisation.

Module IV

Waste water engineering: physicochemical characteristic of water, waste water treatment of municipal wastes and industrial effluents with special focus on use of biological methods, Advanced waste water treatments

Module V

Bioassessment of environmental quality: Biosensors and biomarkers, Principles of ecotoxicity.

Agriculture Sustainability and Clean agricultural practices: Biofertilizers, Biopesticides and vermi composting

Module VI

Environmental impact assessment and Environmental audit, Related case studies from India.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Environmental Science, S.C. Santra
- Environmental Biotechnology, Pradipta Kumar Mohapatra
- Environmental Biotechnology – Concepts and Applications" by Hans-Joachim Jordening and Jesef Winter
- Waste Water Engineering by Metcalf and Eddy. Publisher: Tata McGraw hill
- Environmental Microbiology: Methods and Protocols by Alicia L. Ragout De Spencer, John F.T. Spencer
- Introduction to Environmental Biotechnology by Milton Wainwright
- Principles of Environmental Engineering by Gilbert Masters

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Environmental pollution and its major impacts	Lecture	MSB 206.1.	Mid Term-1, Quiz & End Sem Exam
2	Environmental pollution and its major impacts	Lecture		Mid Term-1, Quiz & End Sem Exam
3	concept of Global warming and climate change,	Lecture		Mid Term-1, Quiz & End Sem Exam
4	concept of Global warming and climate change,	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Global Ozone Problem,	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Eutrophication,	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Land degradation, Biomagnification.	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Non-renewable energy resources,	Lecture	MSB 206.2.	Mid Term-1, Quiz & End Sem Exam
9	Non-renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
12	concept of clean fuel technology,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture	MSB 206.3.	Quiz & End Sem Exam
16	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture		Quiz & End Sem Exam
17	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Microbial technology for mining of metals (Bioleaching)	Lecture		Quiz & End Sem Exam

19	Microbial technology for mining of metals (Bioleaching)	Lecture		Quiz & End Sem Exam
20	Concept of Biomineralisation.	Lecture		Quiz & End Sem Exam
21	Waste water engineering: physicochemical characteristic of water,	Lecture	MSB 206.4.	Quiz & End Sem Exam
22	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
23	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
24	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
25	Advanced waste water treatments	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Bioassessment of environmental quality: Biosensors and biomarkers,	Lecture	MSB 206.5.	Quiz & End Sem Exam
27	Bioassessment of environmental quality: Biosensors and biomarkers,	Lecture		Quiz & End Sem Exam
28	Bioassessment of environmental quality: Principles of ecotoxicity.	Lecture		Quiz & End Sem Exam
29	Agriculture Sustainability and Clean agricultural practices:	Lecture		Quiz & End Sem Exam
30	Biofertilizers,	Lecture		Quiz & End Sem Exam
31	Biopesticides	Lecture		Quiz & End Sem Exam
32	Vermi composting	Lecture		Quiz & End Sem Exam
33	Environmental impact assessment	Lecture	MSB 206.6.	Quiz & End Sem Exam
34	Environmental impact assessment	Lecture		Quiz & End Sem Exam
35	Environmental audit,	Lecture		Quiz & End Sem Exam
36	Environmental audit,	Lecture		Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
MSB 206.1.	Understand concept of climate change, pollution and mitigation approaches.	3	2	2	-	-	1	-	3	1	-	-	3	1	-	1
MSB 206.2.	Understand concept of energy sustainability, clean fuel technology, Biomass energy and biofuels.	3	2	1	-	-	1	-	3	1	-	-	3	1	-	1
MSB 206.3.	Understand concept of Biodegradation, Bioremediation and Phytoremediation. Advances in bioleaching and biomineralization.	3	-	1	1	-	1	-	3	1	-	-	3	1	-	1
MSB 206.4.	Understand Advanced waste water treatments.	3	-	1	1	-	1	-	3	1	-	-	3	1	-	1
MSB 206.5.	Understand Agriculture Sustainability and Clean agricultural practices, Biosensors and biomarkers, Principles of ecotoxicity	3	1	2	1	-	1	-	3	1	-	-	3	1	-	1

	Understand the Environmental impact assessment and Environmental audit, Related case studies from India.															

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2018-19</td></tr>
<tr><td colspan="7">Class: M.Sc.Biotechnology
II Semester</td></tr>
<tr><td colspan="2">Subject Name: ENVIRONMENTAL BIOTECHNOLOGY</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,6</td><td>Q.2, 3, 7</td><td>Q.5,10</td><td>Q. 4, 8,</td><td>Q. 9,</td><td></td></tr>
<tr><td colspan="7">Student will be able to:</td></tr>
</table>

CO Map	Question No.	Questi on	Marks
CO1	Q.1	Briefly explain the following (i) Activated sludge (ii) Biomethanation.	6
CO1	Q.2	Write a short note on different tools of conducting EIA.	6
	Q.3	Define clean fuels and their advantages? How they differ from fossil fuels?	6
CO2	Q.4	Write a short note on the problems associated with prolonged and indiscriminate use of chemical fertilizers and pesticides in present agriculture system.	6
CO5	Q.5	Briefly discuss the role and benefits of biofertilizers in sustainable agriculture system.	6

CO4	Q.6	Write a short note on modes of dispersion of toxic substances in the environment.	6
CO 1	Q.7	What is biodegradation? Discuss role of microbial enzymes especially microbial Dehalogenases and Phosphotriesterase (PTEs) in biodegradation of pesticides in soil.	10
CO3	Q.8	(a) Explain the Solar energy and Wind energy, point out their significance in context of environment and energy (b) Sustainability	10
CO3	Q.9	(c) Explain Explain the following with suitable example. (i) Rhizofilteration (ii) Biomagnification.	10
CO4	Q.10	Discuss the following in detail. (d) What is microbial leaching of metal ores? Explain any two ex-situ methods of microbial leaching from metal ore. How these methods are better eco-friendly options over conventional chemical metal extraction process? (e) Describe secondary treatment of municipal waste water through advanced biofilm based approaches. What impurities and toxic pollutants are usually removed during secondary waste water treatment?	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental Biotechnology*** /Course code ***MSB 206*** is level **3** for the academic year ***2018-19***.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	MSB 301	3	3	3	1	1	-	-	1	2	1	3	2	1	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY
Course Code : MSB 301, Crédits : 03, Session :2018-19 (Odd Sem.), Class : M.Sc. 2^{nd} Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: The aim to teach immunology and immuno technology to the students for their better understanding of immune system, types and mechanism of immunity, immune responses, their tolerance and suppression as well as tools and techniques involved in diagnosis and identification of immune related diseases.

B. Course Outcomes: After successful completion of the course student will be able to:

MSB 301.1. Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.

MSB 301.2. Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.

MSB 301.3. Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.

MSB 301.4. the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Types of immunity - innate, aquired, passive and active physiology of immune response – MI and CMI specificity and memory. Antigen, antibody reactions. Antigens types Hapten, immunoglobuin structure, distribution and function

Module II

Molecular biology of Ig synthesis, Lymphoid tissues – ontogeny and physiology of immuno system - origin and development, differentiation of lymphocytes. Lymphocyte subpopulation of mouse and man. Structure and function of class I and II molecules antigen distribution in population – HLA in human health and diseases. Transplantation immunity – organ transplantation and HLA tissue typing.

Module III

Cell mediated cytotoxicity. Hypersensitivity reactions, cellular interaction in immune response. Antigen recognition. T.B. cell receptors, MHC restriction, Lymphocyte activation clonal proliferation, differentiation. Interleukins and their roles. The complement systems mode of activation, classical and alternate pathway biological functions.

Module IV

Introduction to tumor immunology, autoimmune disorders and immunology of infectious diseases.

Antigen antibody reactions in vitro methods agglutination precipitation, complement fixation, immunofluorescence, immunoelectrophoresis, ELISA, Radio immuno assays, In vitro methods, skin tests and immune complex tissue demonstrations. Applications of these methods in diagnosis of microbial infections, Vaccines

G. **Examination Scheme:**

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. **Suggested Text/Reference Books:**

Text:

- Kuby Immunology, R.A. Goldsby, T.J. Kindt and B.A. Obsorne, Freeman
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company

References:

- Immunology (Sixth Edition), Roitt, Brostoff, Male, Panima Publication
- Fundamentals of Immunology, W. Paul, Lippincot Williams and Wilkins
- Immunology, W.L. Anderson, Frence Creek Publishing (Blackwell)
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.
- Immunology, Poitt, Mosby – Yearbook Inc.
- Perkin Elmer Antibody Manual
- Production of Monoclonal Antibodies – Detailed Protocol, G.K. Lewis, University of Maryland

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I. **Lecture Plan**

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Type of immunity	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
2	Antigen and haptens	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
3	Antibody : function and structure	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
4	Types of antibody and their functions	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
5	Synthesis of Ig molecule	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
6	Light Chain gene rearrangement	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
7	Heavy Chain gene rearrangement	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
8	Antibody Diversity	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
9	Primary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
10	Primary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam

11	Secondary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
12	Secondary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
13	MHC I: Structure, types and function	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
14	MHC II: Structure, types and function	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
15	Transplantation Immunology	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
16	Cell mediated cytotoxicity	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
17	Hypersensitivity : Types and function.	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
18	Hypersensitivity : Types and function.	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
19	Complement system: Types and importance	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
20	Complement system: Types and importance and Regulation	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
21	Lymphocyte activation and clonal proliferation	Lecture	**MSB 301.3**	Mid Term-2, Quiz & End Sem Exam
22	Antigen recognition and T.B. cell receptor	Lecture	**MSB 301.3**	Mid Term-2, Quiz & End Sem Exam
23	Revision of module I and II	Lecture	**MSB 301.3**	Mid Term-2, Quiz & End Sem Exam
24	Introduction of tumor immunology	Lecture	**MSB 301.3**	Quiz & End Sem Exam
25	Tumor immunology	Lecture	**MSB 301.4**	Quiz & End Sem Exam
26	Autoimmune disorder: Organ specific	Lecture	**MSB 301.4**	Quiz & End Sem Exam
27	Autoimmune disorder: systemic	Lecture	**MSB 301.4**	Quiz & End Sem Exam
28	Autoimmunity : mechanism and regulation	Lecture	**MSB 301.4**	Quiz & End Sem Exam
29	Agglutination reaction	Lecture	**MSB 301.4**	Quiz & End Sem Exam
30	Precipitation reaction	Lecture	**MSB 301.4**	Quiz & End Sem Exam
31	Complement fixation	Lecture	**MSB 301.4**	Quiz & End Sem Exam
32	Immunofluorescence and immunoelectrophoresis	Lecture	**MSB 301.4**	Quiz & End Sem Exam
33	ELISA and RIA	Lecture	**MSB 301.4**	Quiz & End Sem Exam
34	Skin test and immune complex tissue demonstration	Lecture	**MSB 301.4**	Quiz & End Sem Exam

35	Application of these methods in diagnosis of microbial infection, Vaccines	Lecture	**MSB 301.4**	Quiz & End Sem Exam
36	Immunofluorescence and immunoelectrophoresis	Lecture	**MSB 301.4**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 301.1	Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.	3	3	3	1	1	-	-	1	2	1	3	2	1	1
MSB 301.2	Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 301.3	Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

MSB 301.4	the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2018-19</td></tr>
<tr><td colspan="7">Class: M.Sc. Biotechnology
IIISemester</td></tr>
<tr><td colspan="2">Subject Name: Computational Biology</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.7</td><td>Q. 8, 9,</td><td>Q. 10</td></tr>
</table>

Student will be able to:

- Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
- Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
- Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
- the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

CO Map	Question No.	Question	Marks
CO1	Q.1	Specific immunity exhibits four characteristic attributes, which are mediated by lymphocytes. List these four attributes and briefly explain how they arise.	6
CO2	Q.2	Draw a schematic diagram of a typical IgG molecule and label each of the following parts: H chains, L chains, inter-chain disulfide bonds, intra-chain disulfide bonds, hinge, Fab, Fc, and all the domains. Indicate which domains are involved in antigen binding.	6

	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	What is antigen? Discuss about the typing procedures for HLA antigens.	6
CO4	Q.5	Describe one advantage and one disadvantage of N-nucleotide addition during the rearrangement of immunoglobulin heavy-chain gene segments.	6
CO3	Q.6	Explain why NK cells from a given host will kill many types of virus-infected cells but do not kill normal cells from that host.	6
	Q.7	Discuss about that the role of cell-Mediated Immunity is Important for Viral Control and Clearance.	10
CO4	Q.8	What is the mechanism of tumor generation and how does normal cells are differentiated from transformed cells?	10
CO3	Q.9	Describe the main stages of leukocyte migration from the blood to a site of inflammation.	10
CO3	Q.10	What are the hallmark features of adaptive immunity? An individual has a mutation severely inhibiting the natural function of the transporter associated with antigen processing (TAP). Which antigen processing pathway would be rendered inefficient? What classes of agents would the individual have a problem attacking and why?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advanced Immunology***/Course code ***MSB 301*** is level **3** for the academic year 2018-19.

ASharma

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M.Sc.) BT, Academic Year – 2018-19

M.Sc Biotechnology (Four Semesters)

Programme Outcomes:

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem

solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "-

ROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
III SEM	MSB 303	3	2	2	2	2	1	1	1	1	3	-	3	1	-	1

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED ANIMAL BIOTECHNOLOGY
Course Code : MSB 303, Crédits : 03, Session :2018-19 (Odd Sem.), Class : M.Sc.. 2nd Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques used in Animal biotechnology. It aims to promote an understanding and knowledge of animal cell culture and function with particular emphasis on in vitro proliferation and differentiation, applications in gene therapy, enzyme therapy, vaccine production, and development of transgenics.

B. Course Outcomes: At the end of the course, students will be able to:

MSB 303.1. Understand conventional and advanced aspects of Animal biotechnology. Learn the cell culture media, cell culture methods and their maintenance
MSB 303.2. Identify therapeutic enzymes, strategies of efficient enzyme replacement therapy methods. .
MSB 303.3. Understand concept of DNA vaccines and other vaccines using animal cell culture.
MSB 303.4. Address the concepts and technology behind Gene therapy**.**
MSB 303.5. Learn molecular mechanism of transgenic animal technology., Gene knockout tech.

C. Programme Outcomes:

M.Sc Biotechnology (Four Semesters)

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.
PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.
PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves	A	5%

	including medical leaves.		
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction of animal cell culture-culture substrate, culture media, maintenance of cell lines. Stem cell Therapy: Methods and applications.

Module II

Enzyme therapy –introduction, therapeutic enzymes- Dnase I, adenosine deaminase, dihydrfolate reductase,streptokinase

Module III

DNA based vaccines, subunit vaccines, peptide vaccines, recombinant DNA vaccines, attenuated vaccines, vector vaccines.

Module IV

Gene therapy - SCID, cystic fibrosis, familial by hypercholestremia, prospects and problem, Biotechnological applications for HIV diagnostics and possible gene therapy for cancer.

Module V

Transgenic animal production and application in production of therapeutic proteins, gene Knock out and mice model for human genetic disorder, baculo virus for expression of foreign gene mapping of human genome

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag
- Cell Culture Lab FAx, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Animal cell culture: An Overview	Lecture	MSB 303.1.	Mid Term-1, Quiz & End Sem Exam
2	ell culture attachment substrates: Types, Advantages and Applications	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Animal Cell culture Media: Natural Media.	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Animal Cell culture Media: Artificial Media.	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Applications, advantages and limitations of media	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Method of Initiation of of Cell culture (primary/secondary etc)	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Method of Initiation of of Cell culture (primary/secondary etc)	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Maintenance of cell lines and subculturing	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Stem cell therapy:Method an applications	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Enzyme replacement therapy: An Overview	Lecture	MSB 303.2.	Mid Term-1, Quiz & End Sem Exam
11	Mechanism and role in SCID disease treatment using ERT Adagen-1	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Mechanism and role in CSID disease treatment using ERT DNAse-1.	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Mechanism and role in cronory blockage disease treatment using ERT Streptokinase	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Mechanism and role of DHFR in ERT.	Lecture		Mid Term-1, Quiz & End Sem Exam
15	DNA vaccines:An Overview.	Lecture	MSB 303.3.	Quiz & End Sem Exam
16	Subunit vaccines and Peptide vaccines	Lecture		Quiz & End Sem Exam
17	DNA based vaccines: Recombinant vaccines.	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Method and production of recombinant vaccines	Lecture		Quiz & End Sem Exam

19	Attenuated vaccines and their limitations	Lecture		Quiz & End Sem Exam
20	Advantages and Applications of DNA vaccines.	Lecture		Quiz & End Sem Exam
21	Gene Therapy - An Overview	Lecture	MSB 303.4.	Quiz & End Sem Exam
22	Methods of Gene Therapy	Lecture		Quiz & End Sem Exam
23	Gene therapy -Mechanism and treatment of SCID disease	Lecture		Quiz & End Sem Exam
24	Gene therapy -Mechanism and treatment of CF disease	Lecture		Quiz & End Sem Exam
25	Gene therapy -Mechanism and treatment of hypercholestremia disease	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Gene therapy-Applications and current advancement	Lecture		Quiz & End Sem Exam
27	Applications for HIV diagnostics and therapy.	Lecture		Quiz & End Sem Exam
28	Introduction of Transgenic Animals	Lecture	MSB 303.5.	Quiz & End Sem Exam
29	transgene transfer methods in animal cells	Lecture		Quiz & End Sem Exam
30	transgene transfer methods in animal cells	Lecture		Quiz & End Sem Exam
31	Transgenic Animals: Application in production of therapeutic proteins	Lecture		Quiz & End Sem Exam
32	Transgenic Animals: Application in production of therapeutic proteins	Lecture		Quiz & End Sem Exam
33	Production of Gene Knock out mice.			Quiz & End Sem Exam
34	Applications of Knockout mice model for human genetic disorder,	Lecture		Quiz & End Sem Exam
35	Baculo virus for expression of foreign gene	Lecture		Quiz & End Sem Exam
36	Mapping of human genome	Lecture		Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME

														SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
MSB 303.1.	Understand conventional and advanced aspects of Animal biotechnology. Learn the cell culture media, cell culture methods and their maintenance	3	2	3	2	-	-	1	-	1	-	-	3	2	-	1
MSB 303.2.	Identify therapeutic enzymes, strategies of efficient enzyme replacement therapy methods.	3	2	3	1	-	-	-	-	1	-	-	3	2	-	1
MSB 303.3.	Understand concept of DNA vaccines and other vaccines using animal cell culture.	3	2	2	2	-	-	-	-	1	-	-	3	2	-	1
MSB 303.4.	Address the concepts and technology behind Gene therapy**.**	3	2	1	2	-	-	-	-	1	-	-	3	2	-	1
MSB 303.5.	Learn molecular mechanism of transgenic animal technology., Gene knockout tech.	3	2	3	2	-	-	1	-	1	-	-	3	2	-	1

Sample Question Paper

Amity Institute Biotechnology 2018-19						
Class: B.Sc.(H) Biotechnology VI Semester						
Subject Name: ADVANCED ANIMAL BIOTECHNOLOGY		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,2,	Q.3,4,6	Q.5,10	Q. 8, 7	Q. 9,	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	What is primary cell culture? How it differs from cell lines?	6
CO1	Q.2	Name the different plant sources for following enzymes (i) Bromelain (ii) Rutin (iii) Papain.	6
	Q.3	Write a short note on subunit vaccines? How it differs from attenuated vaccine?	6
CO2	Q.4	Write a short note on Congenital sucrase-isomaltase deficiency (CSID) and its treatment method.	6
CO5	Q.5	Write a brief note on particle gun method and liposome method for gene delivery.	6
CO4	Q.6	Briefly explain about DNA vaccine	6
CO 1	Q.7	Discuss the following enzymes and their role in cell separation in animal cell culture. (a) Collagenase (b) Trypsin	10
CO3	Q.8	What is Media? Describe the natural cell culture media and its advantage and limitations. Why artificial media is preferred over natural media for proliferation of specific cell culture?	10
CO3	Q.9	What is Gene Augmentation therapy? Explain the symptoms and method of treatment of severe combined immune deficiency syndrome (SCID) in humans using this method with suitable illustrations.	10

CO4 CO5	Q.10	Explain the following in detail. (a) Familial Hypercholesterolemia (FH). It is an inherited disorder that leads to aggressive and premature cardiovascular disease. What are the causes of this disease? Clearly indicate the name of the genes affected (mutated) and their subsequent impact. Explain the strategy to overcome the effect of this disease. Why this disease is unnoticed in children and young people. (b) Explain the Gene directed enzyme prodrug therapy (GDEPT) for the treatment of cancer cells.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advance Animal Biotechnology***/Course code ***MSB 303*** is level **3** for the academic year ***2018-19***.

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY LAB
Course Code : MSB 320, Crédits : 01, Session :2018-19(Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe the immunological questions through experimentation. The aim is also to explain the antigen antibody interaction patterns through various experiments.

B. Course Outcomes: After successful completion of the course student will be able to:

MSB 320.1. Demonstrate detailed knowledge of purification of immunologlobulin, cells and antigen antibody interaction.

MSB 320.2. Apply knowledge and incorporate experimental understanding of the agglutination mechanism.

MSB 320.3. Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized

for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Course Contents:

1. Purification of immunoglobin G.
2. Study of antigen- antibody pattern (ODD).
3. Study of sandwich ELISA.
4. Study of haemeagglutination.
5. Study of immunoelectrophoresis.
6. Isolation and identification of rosette cells.
7. Antigen capture ELISA

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE

Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;
A: Attendance

H. Suggested Text/Reference Books:

- Manual of Molecular and Clinical Laboratory Immunology, 8th Edition Barbara Detrick (Editor), John L. Schmitz (Editor), Robert G. Hamilton (Editor) ISBN: 978-1-555-81871-5 May 2016 ASM Press
- Immunology Laboratory Manual Published by LAP LAMBERT Academic Publishing (2018) ISBN 10: 6138386175 ISBN 13: 9786138386179

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Purification of Immunoglobulin G	Lecture	**MSB 320.1**	Mid Term-1, Quiz & End Sem Exam
2	Radial Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
3	Double Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
4	Study of sandwich ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
5	Study of DOT ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
6	Study of heamagglutination (Blood group)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
7	Rh factor determination	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
8	Study of heamagglutination (Widal test)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
9	Study of immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
10	Study of rocket immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
11	Isolation and identification of rostte cells	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
12	Revision and discussion	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 320.1	Demonstrate detailed knowledge of purification of immunoglobulin, cells and antigen antibody interaction.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 320.2	Apply knowledge and incorporate experimental understanding of the agglutination mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 320.3	Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

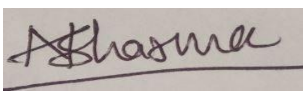
Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2018-19</td></tr>
<tr><td colspan="7">Class: M.Sc. Biotechnology
III Semester</td></tr>
<tr><td colspan="2">Subject Name: Advanced Immunology Lab</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.3 & Q.4</td><td>Q.1</td><td></td><td>Q.2</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to:
• Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
• Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
• Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
• the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Perform Dot Elisa for detection of antigen-antibody interaction.	35
CO2	Q.2	Perform hemagglutination (Blood group) test.	15
	Q.3	*Viva-voce*	10
CO 3	Q.4	Record	10

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advanced Immunology lab***/Course code ***MSB 320*** is level **3** for the academic year 2018-19.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M.Sc.) BT, Academic Year – 2018-19

M.Sc Biotechnology (Four Semesters)

Programme Outcomes:

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
III SEM	MSB 322	3	2	3	3	1	-	-	-	1	-	-	3	2	-	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED ANIMAL BIOTECHNOLOGY & PLANT BIOTECHNOLOGY LAB
Course Code : MSB 322, Crédits : 01, Session :2018-19 (Odd Sem.), Class : M.Sc.. 2nd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques used in Animal biotechnology and plant biotechnology. It aims to promote an understanding and knowledge of animal cell culture and function with particular emphasis on in vitro proliferation and differentiation. In plant biotech aim to quint the students with plant tissue culture techniques.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB 322.1. Learn preparation of the cell culture media, cell culture methods of chicken fibroblast cells
MSB 322.2. Learn the maintenance of cell culture by subculturing.
.
MSB 322.3. Learn the preparation of, stock solutions, Plant tissue culture Media, sterilization etc.
MSB 322.4. Learn the callus development, anther culture embryo culture etc.

C. **Programme Outcomes:**
[M.Sc Biotechnology (Four Semesters)

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

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professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

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PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

D. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

ADVANCED ANIMAL BIOTECHNOLOGY

1. Histological study of important animal tissues.
2. Estimation of enzyme activity from animal tissues.
3. Study of toxicity on invitro model.
4. Culture and maintenance of animal cell lines.
5. Culture of chickenfibroblasts.
6. Invitro expression of proteins in animal cell lines.

PLANT BIOTECHNOLOGY

1. Tissue culture lab and organization.Sterilisation of glasswares, tools and equipments.
2. Preparation of stocks and media.Surface sterilization of various explants
3. ORGAN CULTURE
4. Callus culture
5. Anther culture
6. Embryo culture, Protoplast isolation and culture

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

IA	EE

Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag
- Cell Culture Lab FAx, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Histological study of important animal tissues.		MSB 322.1.	Mid Term-1, Quiz & End Sem Exam
2	Estimation of enzyme activity from animal tissues.			Mid Term-1, Quiz & End Sem Exam
3	Study of toxicity on invitro model.			Mid Term-1, Quiz & End Sem Exam
4	Culture and maintenance of animal cell lines.			Mid Term-1, Quiz & End Sem Exam
5	Culture of chickenfibroblasts.			Mid Term-1, Quiz & End Sem Exam
6	Invitro expression of proteins in animal cell lines.			Mid Term-1, Quiz & End Sem Exam
7	**PLANT BIOTECHNOLOGY** Tissue culture lab and organization.Sterilisation of glasswares, tools and equipments.			Mid Term-1, Quiz & End Sem Exam
8	Preparation of stocks and media.Surface sterilization of various explants			Mid Term-1, Quiz & End Sem Exam
9	ORGAN CULTURE			Mid Term-1, Quiz & End Sem Exam
10	Callus culture		MSB	Mid Term-1, Quiz

			322.2.	& End Sem Exam
11	Anther culture			Mid Term-1, Quiz & End Sem Exam
12	Embryo culture, Protoplast isolation and culture			Mid Term-1, Quiz & End Sem Exam

H. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MSB 322.1.	Learn preparation of the cell culture media, cell culture methods of chicken fibroblast cells	3	1	3	3	1	-	-	-	1	-	-	3	2	-	-
MSB 322.2.	Learn the maintenance of cell culture by subculturing. .	3	2	3	3	1	-	-	-	1	-	-	3	2	-	1
MSB 322.3.	Learn the preparation of, stock solutions, Plant tissue culture Media, sterilization etc.	3	1	2	3	1	-	-	-	1	-	-	3	2	-	1
MSB 322.4.	Learn the callus development, anther culture embryo culture etc.	3	**1**	2	3	1	-	-	-	1	-	-	3	2	-	1
MSB 322.5.		3	2	3	3	1	-	-	-	1	-	-	3	2	-	1

Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advance Animal and Plant Biotechnology***/Course code ***MSB 322*** is level **3** for the academic year ***2018-19***.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

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PROGRAM SPECIFIC OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

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Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3: Substantial (High)

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PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MSB101	3	3	2	3	1	3	2	2	2	1

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED BIOCHEMISTRY
Course Code : MSB 101, Credits: 04, Session :2021-22 (Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** Objective of this course is to help students navigate the discipline of biochemistry that explains how the collection of inanimate molecules that constitute the living systems interact, to maintain and perpetuate life. This knowledge has its roots in medicine, nutrition, agriculture, fermentation and natural products chemistry. It also aims to provide an understanding of the principles and application of primary and secondary metabolites.

B. **Course Outcomes:** At the end of the course, students will be able to:
MSB101.1. Understand the basics of structures of biopolymers.
MSB101.2. Learn carbohydrate metabolism in detail by analyzing all the pathways.
MSB101.3. Learn the various aspects of lipid metabolism and their regulation.
MSB101.4. Understand the metabolism of Nitrogen and excretion of urea from body.
MSB101.5. Learn Nucleotide metabolism and clinical disorders of purine metabolism.
MSB101.6. Develop advanced knowledge of action of major hormones.
MSB101.7. Understand the principles and application of primary and secondary metabolites.

C. **Programme Outcomes:**

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E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Basics of structures of biopolymers; Carbohydrates, Lipids, Proteins and Nucleic Acids.

Module II

Carbohydrates Metabolsm – I

Anaerobic processes in generating metabolic energy

Glycolysis, fates of pyruvate: Lactate and ethanol metabolism, regulation of glycolysis, glycogen mobilization, regulation of glycogen breakdown.

Oxidative processes: Pyruvate oxidation, coenzymes involved in pyruvate oxidation and citric acid cycle, action of PDH, Complex, Krebs Cycle, Regulation of PDH and Krebs Cycle, anaplerotic sequences, glyoxylate cycle, PPP, Human genetic disorder involving PPP enzymes.

ETC and OP: Electron carriers in respiratory chain, OP, enzyme system for ATP synthesis, chemiosmotic coupling.

Carbohydrate Metabolism – II

Gluconeogenesis. Ethanol consumption and gluconeogenesis, reciprocal regulation of glycolysis and gluconeogenesis, glycogen metabolism in humans, photosynthesis.

Module III: Lipid Metabolism

Utilization and transport of fat and cholesterol, lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain, control of fatty acid oxidation, biosynthesis of fatty acids, fatty acid desaturation, control of fatty acid synthesis, variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.

Module IV: Nitrogen Metabolism
Utilization of ammonia – GDH, GS, transamination, Biosynthetic of amino acids, amino acids degradation, detoxification and excretion of ammonia, urea cycle, transport of ammonia to liver, porphyrin and hememetabolism – The succinate-glycine pathway, Biological Nitrogen fixation.
Module V: Nucleotide Metabolism
De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides, purine degradation and clinical disorders of purine metabolism (Gout, lesch – nyhan syndrome, immuno deficiency), pyrimidine breakdown, reduction of ribonucleotides to deoxyibonucleotides, thymidylate synthetase – a target enzyme for chemotheraphy.
Module VI: Integration of cellular metabolism and hormonal regulation
Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation.
Module VII: Secondary Plant Metabolism
Importance of secondary metabolites, terpenes, classification, mevalonic acid pathway, phenolic compounds, shikimic acid pathway, alkaloids.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox. , Worth Publishing

References:
- Harper’s Biochemistry K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw Hill/ Appleton and Lange.
- Biochemistry (Fifth Edition), Lubert Stryer

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Basics of structures of Carbohydrates	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
2	Basics of structures of Carbohydrates	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
3	Basics of structures of Lipids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
4	Basics of structures of Lipids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
5	Basics of structures of Proteins	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
6	Basics of structures of Proteins	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
7	Basics of structures of Nucleic Acids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
8	Basics of structures of Nucleic Acids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
9	Anaerobic processes in generating metabolic energy	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
10	Glycolysis, fates of pyruvate: Lactate and ethanol metabolism	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
11	Glycolysis, fates of pyruvate: Lactate and ethanol metabolism	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
12	regulation of glycolysis, glycogen mobilization	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
13	glycogen breakdown	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
14	Oxidative processes: Pyruvate oxidation, coenzymes involved in pyruvate oxidation	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
15	citric acid cycle, action of PDH, Complex	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
16	Krebs Cycle, Regulation of PDH and Krebs Cycle, anaplerotic sequences	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
17	glyoxylate cycle, PPP, Human genetic disorder involving PPP enzymes.	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
18	ETC and OP: Electron carriers in respiratory chain, OP.	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
19	enzyme system for ATP synthesis, chemiosmotic coupling	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
20	Gluconeogenesis. Ethanol consumption and gluconeogenesis	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
21	reciprocal regulation of glycolysis and gluconeogenesis, glycogen metabolism in humans	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
22	Photosynthesis	Lecture	MSB101.2	Mid Term, Quiz

				& End Sem Exam
23	Utilization and transport of fat and cholesterol	Lecture	MSB101.3	Mid Term, Quiz & End Sem Exam
24	lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain	Lecture	MSB101.3	Mid Term, Quiz & End Sem Exam
25	lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain	Lecture	MSB101.3	Quiz & End Sem Exam
26	control of fatty acid oxidation	Lecture	MSB101.3	Quiz & End Sem Exam
27	biosynthesis of fatty acids, fatty acid desaturation	Lecture	MSB101.3	Quiz & End Sem Exam
28	control of fatty acid synthesis	Lecture	MSB1013	Quiz & End Sem Exam
29	variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.	Lecture	MSB101.3	Quiz & End Sem Exam
30	variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.	Lecture	MSB101.3	Quiz & End Sem Exam
31	Utilization of ammonia, transamination	Lecture	MSB101.4	Quiz & End Sem Exam
32	Biosynthetic of amino acids, amino acids degradation	Lecture	MSB101.4	Quiz & End Sem Exam
33	detoxification and excretion of ammonia	Lecture	MSB101.4	Quiz & End Sem Exam
34	urea cycle, transport of ammonia to liver	Lecture	MSB101.4	Quiz & End Sem Exam
35	porphyrin and hememetabolism	Lecture	MSB101.4	Quiz & End Sem Exam
36	The succinate-glycine pathway, Biological Nitrogen fixation	Lecture	MSB101.4	Quiz & End Sem Exam
37	De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
38	De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
39	purine degradation and clinical disorders of purine metabolism (Gout, lesch – nyhan syndrome, immuno deficiency)	Lecture	MSB101.5	Quiz & End Sem Exam
40	pyrimidine breakdown, reduction of ribonucleotides to deoxyribonucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
41	pyrimidine breakdown, reduction of ribonucleotides to	Lecture	MSB101.5	Quiz & End Sem Exam

	deoxyribonucleotides			
42	thymidylate synthetase – a target enzyme for chemotheraphy	Lecture	MSB101.5	Quiz & End Sem Exam
43	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
44	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
45	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
46	Importance of secondary metabolites-terpenes, classification	Lecture	MSB101.7	Quiz & End Sem Exam
47	mevalonic acid pathway, phenolic compounds	Lecture	MSB101.7	Quiz & End Sem Exam
48	shikimic acid pathway, alkaloids	Lecture	MSB101.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB101.1.	Understand the basics of structures of biopolymers.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.2 .	Learn carbohydrate metabolism in detail by analyzing all the pathways.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1

MSB101.3.	Learn the various aspects of lipid metabolism and their regulation.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.4.	Understand the metabolism of Nitrogen and excretion of urea from body.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.5 .	Learn Nucleotide metabolism and clinical disorders of purine metabolism.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.6 .	Develop advanced knowledge of action of major hormones.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.7 .	Understand the principles and application of primary and secondary metabolites.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –I) 2021-22						
Class: M.Sc. Biotechnology I Semester						
Subject Name: MSB 101 ADVANCED BIOCHEMISTRY		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biomolecules with examples.	3
CO1	Q.2a	What do you understand by phosphorylation?	3
	Q.2b	Discuss secondary metabolites in brief.	3
CO1	Q.3	Give an account of lipid transport in body.	6
CO2	Q.4	Explain the significance of urea cycle in clinics.	3
CO2	Q.5a	What are the factors favoring nucleic acid synthesis?	3
	Q.5b	Discuss the different factors affecting cholesterol synthesis.	3
CO2	Q 6	Phosphofructokinase I is the pace maker of glycolysis. Why?	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Biochemistry**/Course code **MSB-101** is level **3** for the academic year 2018-19.

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Advanced Microbial Technology
Course Code : MSB102, Credits : 03, Session : 2018-19(Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To acquaint the students to understand the basic concept of microbiology and role of various microorganisms in different biotechnological applications, various techniques for their cultivation and control.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB102.1. Study morphology, classification, forms, of bacteria, archaebacteria, mycoplasma and PPLO. Different types of media & their preparations. Isolation of pure cultures, maintenance and preservation. Culture characteristics and Bacterial growth, growth curve, batch and continuous cultures di auxic and synchronous growth enumeration of cells by direct and indirect methods.

MSB102.2. Able to understand the Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals, antiviral etc.

MSB102.3. Know about the Molecular classification of microbes, microbial genetics, prokaryotic gene organization, DNA, replication, transcription and translation. Microbial regulation of gene expression: trp and lac operon. Gene Transfer and Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics and Reproductive cycles of bacteriophage, T4 phage and lambda.

MSB102.4. Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms. Applications of microbiology in effective diagnosis, treatment and prevention of infectious disease.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate the most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need for professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize students to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology,

advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Introduction to Microbiology: Bacteria Morphology and classification. Abnormal forms of bacteria, archaebacteria, mycoplasma and PPLO, cultivation of bacteria nutritional requirements of microorganism, physical requirements, different types of media & their preparations. Isolation of pure cultures, maintenance and preservation of the pure cultures. Culture characteristics Bacterial growth Growth curve, batch and continuous cultures di-auxic and synchronous growth enumeration of cells by direct and indirect methods.

Module II: Control of Microorganisms: Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals, antiviral etc.

Module III: Microbial Genetics: Molecular classification of microbes, The Basics of microbial genetics, prokaryotic gene organization. The basic principles of microbial DNA, replication, transcription and translation. Microbial regulation of gene expression: the trp and lac operon. Gene Transfer Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics Reproductive cycles of bacteriophage, T4 and lambda.

Module IV: Medical Microbiology: Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms (bacteria, fungi, parasites, and viruses), applications of the basic principles of microbiology in effective diagnosis, treatment and prevention of infectious disease.

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill
- General Microbiology, R.Y. Stanier, J.L. Ingraham, M. L. Wheelis and P.R. Painter, Macmillian

- Principles of Microbiology, R.M. Atlas, Wm C. Brown Publisher.
- The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing Benjamin Cummings.
- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin& Cummings.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction to Microbiology	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
2	Discovery of Microbial World	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
3	Spontaneous Generation	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
4	Role of microbes in disease causation	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
5	Development of Pure Culture	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
6	Methods in Microbiology	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
7	Principle of Microbial Nutrition	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
8	Culture Media Types	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
9	Theory of Sterilization	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
10	Practice of Sterilization	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
11	Concept of Sterilization	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
12	Disinfection	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam

13	Methods of Control	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
14	Chemotherapeutics	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
15	Mode of Action of Antibiotics	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
16	Penicillin and Ampicillin	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
17	Sulfonamide and Vanomycin	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
18	Streptomycin and Tatracycline	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
19	Chloramphenicol	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
20	Antifungals and Antivirals	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
21	Basics of Microbial Genetics and Prokaryotic gene organization	Lecture	MSB 102.3	Quiz & End Sem Exam
22	Principles of Microbial DNA	Lecture	MSB 102.3	Quiz & End Sem Exam
23	Replication, Transcription, Translation	Lecture	MSB 102.3	Quiz & End Sem Exam
24	Regulation of Gene Expression: Trp and Lac Operon	Lecture	MSB 102.3	Quiz & End Sem Exam
25	Transformation, Transduction, Conjugation	Lecture	MSB 102.3	Quiz & End Sem Exam
26	Plasmids and Transposons	Lecture	MSB 102.3	Quiz & End Sem Exam
27	Viral Genetics	Lecture	MSB 102.3	Quiz & End Sem Exam
28	Reproductive Cycles of Bacteriophage, T4 and Lambda	Lecture	MSB 102.3	Quiz & End Sem Exam
29	Normal Microflora of Host	Lecture	MSB 102.4	Quiz & End Sem Exam

30	Host Parasite Interactions	Lecture	MSB 102.4	Quiz & End Sem Exam
31	Mechanisms of Pathogenesis	Lecture	MSB 102.4	Quiz & End Sem Exam
32	Clinical manifestations associated to medically important pathogens	Lecture	MSB 102.4	Quiz & End Sem Exam
33	Applications of Microbiology	Lecture	MSB 102.4	Quiz & End Sem Exam
34	Diagnosis of Diseases	Lecture	MSB 102.4	Quiz & End Sem Exam
35	Treatment of different microbial diseases	Lecture	MSB 102.4	Quiz & End Sem Exam
36	Prevention of different microbial diseases	Lecture	MSB 102.4	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 102.1	Study morphology, classification, forms of bacteria, archaebacteria, mycoplasma and PPLO. Different types of media & their preparations. Isolation of pure cultures, maintenance and preservation. Culture characteristics and Bacterial growth, growth curve, batch and continuous cultures di auxic and synchronous growth Eneumeration of	3	2	2	2	2	2	2	2	2	1	3	2	2	2

	cells by direct and indirect methods.														
MSB 102.2	Able to understand the Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals antiviral	3	2	2	2	2	2	2	2	2	1	3	2	2	2
MSB 102.3	Know about the Molecular classification of microbes, microbial genetics, prokaryotic gene organization, DNA, replication, transcription and translation. Microbial regulation of gene expression: trp and lac operon. Gene Transfer and Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics and Reproductive cycles of bacteriophage, T4 phage and lambda.	3	2	2	2	2	2	2	2	2	1	3	2	2	2
MSB 102.4	Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms (bacteria, fungi, parasites, and viruses),	3	2	2	2	2	2	2	2	2	1	3	2	2	2

	applications of the basic principles of microbiology in effective diagnosis, treatment and prevention of infectious disease.													

Sample Question Paper

<table>
<tr><td colspan="8" align="center">Amity Institute of Biotechnology
MID-SEMESTER 2018-19</td></tr>
<tr><td colspan="8" align="center">Class: M.Sc. (Biotech) I Semester</td></tr>
<tr><td colspan="2">Subject Name:
MSB 102
Advanced Microbial Technology</td><td colspan="3">Time: 2 Hrs</td><td colspan="3">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td colspan="2">Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q. 1,4</td><td colspan="2">Q. 2,3</td><td>Q. 4</td><td>Q. 2,5,6</td><td></td><td></td></tr>
<tr><td colspan="8">Student will be able to
CO1: List the broad perspective of microbiology and microbial technology.
CO2: Apply the knowledge to different types of microbes
(Bacteria, Virus, Algae, Fungus and Protozoa).</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the microbial nutritional requirement.	3
CO1	Q.2a	What are different sterilization techniques?	3
	Q.2b	How the mode of action of Penicillin and chloramphenicol are different from each other?	3
CO1	Q.3	How Lactose Operon works in presence and absence of Lactose as a positive or negative regulation?	6
CO2	Q.4	Explain the application of microbiology in effective diagnosis, treatment and prevention of infectious diseases.	3

Attainments		Rubric
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Microbial Technology/MSB 102** is **level 3** for the academic year 2018-19

Manish Kr

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MSB120	3	3	3	3	-	1	2	-	2	2

AMITY UNIVERSITY
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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY LAB
Course Code : MSB 120, Credits: 02, Session :2021-22 (Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend advanced understanding of the qualitative and quantitative estimation of proteins and nucleic acids.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB120.1. Understand the practical based learning of estimation of proteins.

MSB120.2. Understand the practical based learning of enzyme activity.

MSB120.3. Understand the practical based learning of estimation of DNA & RNA.

MSB120.4. Understand the practical based learning of estimation of carbohydrate.

MSB120.5. Understand the practical based learning of estimation of lipid.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Proteins
Identification of protein by Biuret test.
Quantization of protein by Bradford method
Separation of proteins by SDS-PAGE
Module II: Enzyme
Enzyme activity study of serum alkaline phosphates.
Module III: Nucleic Acid
Biochemical estimation of DNA
Biochemical estimation of RNA
Separation of DNA on Agarose gel.
Module IV: Carbohydrate
Biochemical estimation of blood sugar
Module V: Lipids
Blood Cholesterol estimation.

G. Examination Scheme:

IA	**EE**

Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
4	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
5	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
6	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
7	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
8	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
9	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
10	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
11	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
12	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
13	Biochemical estimation of DNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
14	Biochemical estimation of DNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
15	Biochemical estimation of RNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
16	Biochemical estimation of RNA	Practical	MSB120.3	Class Test

				(Practical Based) & End Sem Exam
17	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
18	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
19	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
20	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
21	Biochemical estimation of blood sugar	Practical	MSB120.4	Class Test (Practical Based) & End Sem Exam
22	Biochemical estimation of blood sugar	Practical	MSB120.4	Class Test (Practical Based) & End Sem Exam
23	Blood Cholesterol estimation	Practical	MSB120.5	Class Test (Practical Based) & End Sem Exam
24	Blood Cholesterol estimation	Practical	MSB120.5	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB120.1.	Understand the practical based learning of estimation of proteins.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.2.	Understand the practical based learning of enzyme activity.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.3.	Understand the practical based learning of estimation of DNA & RNA.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.4.	Understand the practical based learning of estimation of carbohydrate.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.5.	Understand the practical based learning of estimation of lipid.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Biochemistry Lab**/Course code **MSB-120** is level **3** for the academic year 2018-19.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

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PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MSB201	3	3	2	3	1	3	2	2	2	1

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED MOLECULAR BIOLOGY
Course Code : MSB 201, Credits: 04, Session :2021-22 (Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The objective of the course is to provide a clear understanding of DNA (genetic material) so that they can manipulate it and understand basic tools and techniques involved in its manipulation. Strong foundation in molecular biology enables the students to familiarize themselves with Genetic engineering technology.

B. **Course Outcomes:** At the end of the course, students will be able to:
MSB201.1. Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes.
MSB201.2. Learn the advanced mechanism of transcription in prokaryotes and eukaryotes.
MSB201.3. Develop understanding of various post-transcriptional processes in cell.
MSB201.4. Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes.
MSB201.5. Understand about the advances of gene expression regulation.
MSB201.6. Develop advanced knowledge of various mechanisms of gene silencing.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: DNA replication and repair

DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork; termination of replication DNA repair, photo reaction, base excision repair, nucleotide excision repair, transcription coupled repair, mismatch repair , error pone repair recombinational repair.

Module II: Transcription of DNA

Transcription in prokaryotes and eukaryotes, RNA polymerase – Composition and function; transcription mechanism; transcription factor and their role, inhibition of RNA synthesis.

Module III: Processing of RNA

Procession of ribosomal and transfer RNA"s processing of mRNA-5'cap formation; 3' polyadenylation ; RNA splicing , RNA editing , RNA degradation.

Module IV: Translation

Translation mechanism in prokaryotes and eukaryotes; ribosomes, initiation of translation, elongation, termination, amino acid activation; translational recoding inhibitors, post translation modification of protein.

Module V: Regulation of gene expression

Regulation in prokaryotes – repressors and negative control, positive control, role of c AMP, Ampreceptor protein, lac, tryp, His and ara operons, Regulation in Eukaryotes=promoters and enhancers, transcriptional regulatory protein, transcriptional activators, eukaryotic repressor.

Module VI: Gene Silencing

RNAi (SiRNA and MiRNA) molecular mechanism and current application in gene silencing, Antisense RNA technology, Biochemistry of ribozyme, Hammer head, hairpin ribozymes. Application of antisense and ribozymes in genetic engineering.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education

References:

- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Biology of the Cell by Alberts Bruce, Bray Demos, and Watson James D.
- Gene VIII, Benjamin Lewin 2005, Oxford University Press
- Molecular Cell Biology, H. Lodish, A. Berk, S. Zipursky, P Matsundaira, D. Baltimore and J.E. Barnell, W.H. Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing.

Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley and Sons Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
2	DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
3	termination of replication DNA repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
4	photo reaction	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
5	base excision repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
6	nucleotide excision repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
7	transcription coupled repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
8	mismatch repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
9	error pone repair, recombinational repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
10	Transcription in prokaryotes and eukaryotes	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
11	Transcription in prokaryotes and eukaryotes	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
12	RNA polymerase – Composition and function	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
13	transcription mechanism	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
14	transcription mechanism	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
15	transcription factor and their role	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
16	inhibition of RNA synthesis	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
17	Procession of ribosomal and transfer RNA	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
18	Procession of ribosomal and transfer RNA	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
19	processing of mRNA-5’cap formation	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
20	3’ polyadenylation	Lecture	MSB201.3	Mid Term, Quiz

				& End Sem Exam
21	RNA splicing	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
22	RNA editing	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
23	RNA degradation	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
24	Translation mechanism in prokaryotes and eukaryotes	Lecture	MSB201.4	Mid Term, Quiz & End Sem Exam
25	Translation mechanism in prokaryotes and eukaryotes	Lecture	MSB201.4	Quiz & End Sem Exam
26	ribosomes, initiation of translation	Lecture	MSB201.4	Quiz & End Sem Exam
27	Elongation	Lecture	MSB201.4	Quiz & End Sem Exam
28	termination	Lecture	MSB2014	Quiz & End Sem Exam
29	amino acid activation	Lecture	MSB201.4	Quiz & End Sem Exam
30	inhibitors, post translation modification of protein	Lecture	MSB201.4	Quiz & End Sem Exam
31	Regulation in prokaryotes	Lecture	MSB201.5	Quiz & End Sem Exam
32	repressors and negative control	Lecture	MSB201.5	Quiz & End Sem Exam
33	positive control, role of cAMP	Lecture	MSB201.5	Quiz & End Sem Exam
34	Ampreceptor protein	Lecture	MSB201.5	Quiz & End Sem Exam
35	Lac operon	Lecture	MSB201.5	Quiz & End Sem Exam
36	Tryp operon	Lecture	MSB201.5	Quiz & End Sem Exam
37	His operon	Lecture	MSB201.5	Quiz & End Sem Exam
38	His operon	Lecture	MSB201.5	Quiz & End Sem Exam
39	Regulation in Eukaryotes=promoters and enhancers	Lecture	MSB201.5	Quiz & End Sem Exam
40	transcriptional regulatory protein	Lecture	MSB201.5	Quiz & End Sem Exam
41	transcriptional activators, eukaryotic repressor	Lecture	MSB201.5	Quiz & End Sem Exam
42	RNAi (SiRNA and MiRNA)	Lecture	MSB201.6	Quiz & End Sem

				Exam
43	RNAi (SiRNA and MiRNA)	Lecture	MSB201.6	Quiz & End Sem Exam
44	molecular mechanism and current application in gene silencing	Lecture	MSB201.6	Quiz & End Sem Exam
45	Antisense RNA technology, Biochemistry of ribozyme	Lecture	MSB201.6	Quiz & End Sem Exam
46	Hammer head and hairpin ribozymes	Lecture	MSB201.6	Quiz & End Sem Exam
47	Application of antisense and ribozymes in genetic engineering	Lecture	MSB201.6	Quiz & End Sem Exam
48	Application of antisense and ribozymes in genetic engineering	Lecture	MSB201.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB201.1.	Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.2.	Learn the advanced mechanism of transcription in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.3.	Develop understanding of various post-transcriptional processes in cell.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.4.	Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.5.	Understand about the advances of gene expression regulation.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.6 .	Develop advanced knowledge of various mechanisms of gene silencing.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –II) 2021-22		
Class: M.Sc. Biotechnology II Semester		
Subject Name: MSB 101 ADVANCED MOLECULAR BIOLOGY	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the types of nucleic acids with examples.	3
CO1	Q.2	What do you understand by semi conservative mode of DNA replication?	6
CO1	Q.3	Give an account of transcription termination in *E. coli*.	6
CO2	Q.4	Explain the significance of poly A tail in RNA.	3
CO2	Q.5a	tRNA acts as an adapter molecule in translation. Discuss.	3
	Q.5b	Discuss the different mechanisms of antisense technology.	3
CO2	Q 6	How does post-translation modification ensure the functionality of a protein? Discuss.	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Molecular Biology** /Course code **MSB-201** is level **3** for the academic year 2018-19.

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MSB220	3	3	2	3	1	3	2	2	2	3

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED MOLECULAR BIOLOGY LAB
Course Code : MSB 220, Credits: 02, Session :2021-22 (Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend the advanced understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. Course Outcomes: At the end of the course, students will be able to:

MSB220.1. Understand the practical based learning of isolation of nucleic acids and DNA protein interaction.

MSB220.2. Understand the practical based learning in-vitro transcription, translation and repair mechanism.

MSB220.3. Understand the practical based learning of PCR and Gradient PCR.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

1. Isolation of genomic DNA from prokaryotic and Eukaryotes.
2. Isolation of plasmid.
3. Study of DNA protein interaction.
4. Study of in vitro transcription.
5. Study of DNA methylation.
6. Study of DNA repair mechanism.
7. Invitro study of translation
8. Isolation of RNA
9. PCR and Gradient PCR

G. Examination Scheme:

IA			**EE**			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:

Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of genomic DNA from prokaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
2	Isolation of genomic DNA from prokaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of genomic DNA from eukaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
4	Isolation of genomic DNA from eukaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
5	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
6	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
7	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
8	Study of DNA protein interaction	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
9	Study of DNA protein interaction	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
10	Study of in vitro transcription	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
11	Study of in vitro transcription	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
12	Study of DNA methylation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
13	Study of DNA methylation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
14	Study of DNA repair mechanism	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
15	Study of DNA repair mechanism	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
16	Invitro study of translation	Practical	MSB220.2	Class Test

				(Practical Based) & End Sem Exam
17	Invitro study of translation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
18	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
19	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
20	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
21	PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
22	PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
23	Gradient PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
24	Gradient PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB220.1.	Understand the practical based learning of isolation of nucleic acids and DNA protein interaction.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB220.2.	Understand the practical based learning in-vitro transcription, translation and repair mechanism.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB220.3.	Understand the practical based learning of PCR and Gradient PCR.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology Lab**/Course code **MSB-220** is level **3** for the academic year 2018-19.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

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PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
III SEM	MSB302	3	3	2	3	1	3	2	2	2	1

AMITY UNIVERSITY

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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENZYME TECHNOLOGY
Course Code : MSB 302, Credits: 03, Session :2021-22 (Odd Sem.), Class : M.Sc. 2^{nd} Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The course aims to provide an understanding of the principles and application of proteins, secondary metabolites and enzyme biochemistry in therapeutic applications and clinical diagnosis. The theoretical understanding of biochemical systems would certainly help to interpret the results of laboratory experiments.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB302.1. Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action.

MSB302.2. Understand about various modes of inhibition of enzyme actions with examples.

MSB302.3. Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc.

MSB302.4. Learn enzyme reactors and various parameters for bio-process design.

MSB302.5. Learn about the concepts of bio-process design.

MSB302.6. Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Enzymes

Introduction and scope, Nomenclature, Mechanism of Catalysis, enzyme catalysis in organic media, Industrial applications.

Module II: Enzyme Kinetics

Single substrate steady state kinetics; King-Altman's method; Inhibitors and activators; Multi-substrate systems; Effect of pH and temperature; Allosteric enzymes. Thermodynamic explanation for transition complex formation, limitations of Michaelis – Menten equation, LB plot method to study enzyme kinetics, effect of pH
And temperature on kinetics,allosteric enzyme kinetics,models as WMC, KNF with examples of ACTase and Hb.

Module III: Immobilization of Enzymes

Advantages, Carriers, adsorption, covalent coupling, cross-linking and entrapment methods, Micro-environmental effects

Module IV: Enzyme Reactors

Reactors for batch/continuous enzymatic processing, Choice ot reactor type: idealized enzyme reactor systems; Mass Transfer in Enzyme Reactors: Steady state analysis of mass transfer and biochemical reaction in enzyme reactors.

Module V: Bio-process Design

Physical parameters, reactor operational stability; Immobilized cells.

Module VI: Challenges and future trends

Catalytic antibodies and Non-protein biomolecules as catalysts, Biocatalysts from Extreme Thermoph!lic and Hyperthermophilic Archaea and Bacteria.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Enzyme Technology, M.F. Chaplin and C. Bucke, Cambridge University Press.

References:

- Biotechnological Innovations in Chemical Synthesis, R.C.B. Currell, V.D. Mieras, Biotol Partners Staff, Butterworth Heinemann.
- Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis, R.A. Copeland, John Wiley and Sons Inc.
- Enzymes Biochemistry, Biotechnology, Clinical Chemistry, Trevor Palner
- Enzyme Kinetics: Behaviour and Analysis of Rapid Equilibrium and Steady State Enzyme Systems, I.H. Segel, Wiley-Interscience
- Industrial Enzymes & their applications, H. Uhlig, John Wiley and Sons Inc

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction and scope	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
2	Nomenclature	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
3	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
4	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
5	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
6	enzyme catalysis in organic media	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
7	Industrial applications	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
8	Single substrate steady state kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
9	Single substrate steady state kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
10	King-Altman's method	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
11	Inhibitors and activators	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
12	Multi-substrate systems	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
13	Effect of pH and temperature	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
14	Allosteric enzymes	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam

15	Thermodynamic explanation for transition complex formation	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
16	limitations of Michaelis – Menten equation	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
17	LB plot method to study enzyme kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
18	effect of pH and temperature on kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
19	allosteric enzyme kinetics	Lecture	MSB302.2	Quiz & End Sem Exam
20	models as WMC, KNF with examples of ACTase and Hb	Lecture	MSB302.2	Quiz & End Sem Exam
21	models as WMC, KNF with examples of ACTase and Hb	Lecture	MSB302.2	Quiz & End Sem Exam
22	Advantages, Carriers, adsorption	Lecture	MSB302.3	Quiz & End Sem Exam
23	covalent coupling, cross-linking and entrapment methods	Lecture	MSB302.3	Quiz & End Sem Exam
24	covalent coupling, cross-linking and entrapment methods	Lecture	MSB302.3	Quiz & End Sem Exam
25	Micro-environmental effects	Lecture	MSB302.3	Quiz & End Sem Exam
26	Reactors for batch/continuous enzymatic processing	Lecture	MSB302.4	Quiz & End Sem Exam
27	Choice of reactor type: idealized enzyme reactor systems	Lecture	MSB302.4	Quiz & End Sem Exam
28	Mass Transfer in Enzyme Reactors	Lecture	MSB302.4	Quiz & End Sem Exam
29	Steady state analysis of mass transfer	Lecture	MSB302.4	Quiz & End Sem Exam
30	biochemical reaction in enzyme reactors	Lecture	MSB302.4	Quiz & End Sem Exam
31	Physical parameters	Lecture	MSB302.5	Quiz & End Sem Exam
32	reactor operational stability	Lecture	MSB302.5	Quiz & End Sem Exam
33	Immobilized cells	Lecture	MSB302.5	Quiz & End Sem Exam
34	Catalytic antibodies and Non-protein biomolecules as catalysts	Lecture	MSB302.6	Quiz & End Sem Exam
35	Biocatalysts from Extreme Thermophilic bacteria	Lecture	MSB302.6	Quiz & End Sem Exam
36	Hyperthermophilic Archaea and Bacteria	Lecture	MSB302.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB302.1.	Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.2.	Understand about various modes of inhibition of enzyme actions with examples.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.3.	Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.4.	Learn enzyme reactors and various parameters for bio-process design.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.5.	Learn about the concepts of bio-process design.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.6.	Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2021-22						
Class: M.Sc. Biotechnology III Semester						
Subject Name: MSB 302 ENZYME TECHNOLOGY		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss in brief about the nomenclature of Enzymes.	3
CO1	Q.2	Explain the Lineweaver Burk plot & its significance.	6
CO1	Q.3	Give a brief account on enzyme kinetics.	6
CO2	Q.4	Briefly discuss the properties of an inhibitor.	3
CO2	Q.5a	Discuss the acid-base catalysis in brief.	3
	Q.5b	What is reversible inhibition? Discuss in brief.	3
CO2	Q 6	Discuss the Michaelis-Menten equation. Derive the double reciprocal plot with this equation.	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Enzyme Technology**/Course code **MSB-302** is level **3** for the academic year 2018-19.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2018-19

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
III SEM	MSB321	3	3	2	3	1	3	2	2	2	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENZYME TECHNOLOGY LAB
Course Code : MSB 321, Credits: 01, Session :2021-22 (Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend advanced understanding of isolation, recovery, and immobilization of enzymes.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB321.1. Understand the practical based learning of Isolation of industrially important microorganisms and growth curve.

MSB321.2. Understand the practical based learning ethanol production, production of antibiotics and fermentation.

MSB321.3. Understand the practical based learning of downstream processing.

MSB321.4. Understand the practical based learning of enzyme assay, enzyme purification and kinetics.

MSB321.5. Understand the practical based learning of enzyme production and immobilization.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Isolation of industrially important microorganisms for microbial processes.

Determination of Thermal Death Point and Thermal death time of microorganisms for design of a sterilizer

Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.

Module II

Comparative studied of ethanol production using different substrates.

Microbial production of antibiotics (Penicillin)

Production and estimation of alkaline protease

Sauer Krant fermentation

Module III: Downstream processing

Conventional filtration

Protein precipitation and recovery

Aqueous two-phase separation

Ion exchange chromatography

Gel filtration

Membrane based filtration i.e. Micro filtration and cross filtration in cross flow Modules.

Module IV

Isolation of Enzymes from plant and microbial sources.

Enzyme assay; activity and specific activity – determination of amylase, nitrate reductase, cellulose, protease.

Purification of Enzyme by ammonium sulphate fractionation.
Enzyme Kinetics: Effect of varying substrate concentration on enzyme activity
Effect of Temperature and pH on enzyme activity.
Module V
Production of enzyme on industrial scale using solid and state fermentation
Enzyme immobilization

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of industrially important microorganisms for microbial processes.	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
2	Determination of Thermal Death Point and Thermal death time of microorganisms for design of a sterilizer	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
3	Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
4	Comparative studied of ethanol production using different substrates. Microbial production of antibiotics (Penicillin)	Practical	MSB321.2	Class Test (Practical Based) & End Sem Exam
5	Production and estimation of alkaline protease Sauer Krant fermentation	Practical	MSB321.2	Class Test (Practical Based) & End Sem Exam
6	Conventional filtration Protein precipitation and recovery	Practical	MSB321.3	Class Test (Practical Based) & End Sem Exam
7	Aqueous two-phase separation	Practical	MSB321.3	Class Test

	Ion exchange chromatography Gel filtration			(Practical Based) & End Sem Exam
8	Membrane based filtration i.e. Micro filtration and cross filtration in cross flow Modules.	Practical	MSB321.3	Class Test (Practical Based) & End Sem Exam
9	Isolation of Enzymes from plant and microbial sources. Enzyme assay; activity and specific activity – determination of amylase, nitrate reductase, cellulose, protease.	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
10	Purification of Enzyme by ammonium sulphate fractionation. Enzyme Kinetics: Effect of varying substrate concentration on enzyme activity	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
11	Effect of Temperature and pH on enzyme activity	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
12	Production of enzyme on industrial scale using solid and state fermentation Enzyme immobilization	Practical	MSB321.5	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB321.1.	Understand the practical based learning of Isolation of industrially important microorganisms and growth curve.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.2.	Understand the practical based learning ethanol production, production of antibiotics and fermentation.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.3.	Understand the practical based learning of downstream processing.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.4.	Understand the practical based learning of enzyme assay, enzyme purification and kinetics.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.5.	Understand the practical based learning of enzyme production and immobilization.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Enzyme Technology Lab**/Course code **MSB-321** is level **3** for the academic year 2018-19.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
I	MTB 123	3	3	3	1	1	-	-	1	2	1	3	2	1	1

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOINFORMATICS LAB
Course Code : MTB 123, Crédits : 01, Session :2018-19(Odd Sem.), Class : M.Tech 1st Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to demonstrate the techniques and software's used for sequence analysis, alignment, structure prediction of the proteins and other compounds, docking and finding the phylogenetic relationships.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MTB 123.1. Understand about Retrieving of nucleotide and protein sequence through NCBI database.

MTB 123.2. Understand the nucleotide and protein sequence alignment methods through different types of algorithm and able to make phylogenetic tree.

MTB 123.3. Experimental understanding of different structure of protein.

MTB 123.4. Experimental prediction of the databases related to Phylogenetic.

MTB 123.5. Describe the molecular docking and visualization of structure.

MTB 123.6. Experimental demonstration of finding of transcription regulatory signals.

c. Programme Outcomes:

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.
PO8: Ability to communicate effectively and develop scientific writing.
PO9. Inculcation of ability to think independently for problem solving.
PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.
PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**
Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a	A	5%

	student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.		
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Basics of sequence analysis Retrieving a sequence-nucleic acid/Protein
Module II
Local and Global Alignment- concepts Pair wise sequence alignment, multiple sequence alignment
Dynamic Programming – Smith Watermann Algorithm Needleman Wunsch Algorithm
Module III
Motif and pattern searching, Structure prediction, Protein structure classification resources, Structure superposition tools, Energy minimization and simulated annealing
Module IV
Phylogenetic prediction and analysis
Module V
Docking small molecules/peptides in active site of protein. Use of automated docking procedures. Free energy calculation.
Module VI
Finding transcription regulatory signals

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Essentials of Genomics and Bioinformaticsby C.W. Sensen, John Wiley and Sons
- Bioinformatics: Sequence and Genome Analysis by D.W. Mount, Cold Spring Harbor Laboratory Press.
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by A.D. Baxevanis and B.F.F Ouellette, Wiley – interscience.

References:

- Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology by D. Gusfield, Cambridge University Press

- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by G. Von Heijne and G. Von Heijne, Academic Press.
- Computational Molecular Biology: An Algorithmic Approach by P.A. Pevzner, MIT Press
- Computer Methods for Macromolecular Sequence Analysis by R.F. Doolittle, J.N, Abelson, M.I. Simon, Academic press
- Essentials of Genomics and Bioinformatics C.W. Sensen, John Wiley and Sons Inc.
- Introduction to Computational Biology: Maps, Sequences and Genomes by M. Waterman, Chapman and Hall
- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by G. V. Heijne and G.V. Heijne, Academic Press

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Basics of sequence analysis Retrieving a sequence- Protein	Practical	MTB 123.1	Mid Term-1, Quiz & End Sem Exam
2	Basics of sequence analysis Retrieving a sequence-nucleic acid	Practical	MTB 123.1	Mid Term-1, Quiz & End Sem Exam
3	Local Alignment	Practical	MTB 123.2	Mid Term-1, Quiz & End Sem Exam
4	Global Alignment	Practical	MTB 123.2	Mid Term-1, Quiz & End Sem Exam
5	Pair wise sequence alignment	Practical	MTB 123.2	Mid Term-1, Quiz & End Sem Exam
6	Multiple sequence alignment	Practical	MTB 123.2	End Sem Exam
7	Motif and pattern searching	Practical	MTB 123.3	End Sem Exam
8	Structure prediction, Protein structure classification resources	Practical	MTB 123.3	End Sem Exam
9	Structure superposition tools, Energy minimization and simulated annealing	Practical	MTB 123.3	End Sem Exam
10	Phylogenetic prediction and analysis	Practical	MTB 123.4	End Sem Exam
11	Docking	Practical	MTB 123.3	End Sem Exam
12	Finding transcription regulatory signals	Practical	MTB 123.3	End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 123.1.	Understand about Retrieving of nucleotide and protein sequence through NCBI database.	3	3	1	3	1				2	1	3	2	1	1
MTB 123.2.	Understand the nucleotide and protein sequence alignment methods through different types of algorithm and able to make phylogenetic tree.	3	3	1	3	1				2	1	3	2	1	1
MTB 123.3.	Experimental understanding of different structure of protein.	3	3	1	3	1				1	1	3	2	1	1
MTB 123.4.	Experimental prediction of the databases related to Phylogenetic	3	3	2	3	2				1	1	3	2	1	1
MTB 123.5.	Describe the molecular docking and visualization of structure.	2	3	1	2	3				2	1	3	2	1	1
MTB 123.6.	Experimental demonstration of finding of transcription regulatory signals.	2	3	1	2	3				2	1	3	2	1	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course *Advanced Immunology lab*/Course code *MTB 320* is level 3 for the academic year 2018-19

ASharma

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
I	MTB 104	3	3	3	1	1	-	-	1	2	1	3	2	1	1

AMITY UNIVERSITY
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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOINFORMATICS
Course Code : MTB 104, Crédits : 04, Session :2018-19 (Odd Sem.), Class : M.Tech 1st Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe data models and database management systems with an emphasis on biologically important techniques to store various data on DNA sequencing structures, genetic mapping, phylogenetic analysis. Multiple sequence alignment, protein structure prediction, and comparative genome analysis.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MTB 104.1. Understand about nucleotide and protein sequence retrieval, submission through NCBI database.

MTB 104.2. Understand the nucleotide and protein sequence alignment methods through different types of algorithm used.

MTB 104.3. Predict the phylogenetic tree and evolutionary relationship.

MTB 104.4. Predict the databases related to functional gene sequences and their analysis through identification and classification

MTB 104.5. Describe the molecular modeling using protein databank, docking and visualization of structure.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with

detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9. Inculcation of ability to think independently for problem solving.

PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction and overview

The NCBI, sequence databases, sequence retrieval, sequence file formats, submitting DNA, protein sequences and sequence assembly.

Module II

Exact string matching -classical comparison based methods, semi numerical string matching, suffix trees -construction and application, Databases and rapid sequence analysis –Blast and Fasta , sequence comparison by statistical content; Dynamic programming alignment -The number of alignments, shortest and longest paths in a network, global distance and similarity alignments, Fitting one sequence onto the other, trace backs, parametric sequence comparison

Module III

Global and local alignments, scoring matrices-pam and blosum and gap penalties, filtering, position specific scoring matrices, internet resources , uses of multiple sequence alignment programs and methods pattern searching programs, family and superfamily representation & profit analysis.

Module IV

Trees-representation of sequences, tree interpretation, Distance – additive, ultrameric and nonadditive distances, tree building methods, phylogenetic analysis, parsimony, Bootstrap, maximum likelihood trees , estimating the rate of change, likelihood and trees; analysis software.

Module V

Annotation, ESTs – databases, comparative genome analysis clustering, gene discovery, protein identification, physical properties, motifs and patterns, structure, folding classes, structure classification; Structure databases– PDB and MMDB, visualizing structural information, Docking of Molecules, structure prediction in proteins, prediction of buried residues in proteins, RNA secondary structure –minimum free-energy structures, Genome analysis, genome rearrangements with inversions, gene identification, gene expression, expression analysis, gene identification and functional classification.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Essentials of Genomics and Bioinformaticsby C.W. Sensen, John Wiley and Sons
- Bioinformatics: Sequence and Genome Analysis by D.W. Mount, Cold Spring Harbor Laboratory Press.
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by A.D. Baxevanis and B.F.F Ouellette, Wiley – interscience.

References:

- Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology by D. Gusfield, Cambridge University Press
- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by G. Von Heijne and G. Von Heijne, Academic Press.
- Computational Molecular Biology: An Algorithmic Approach by P.A. Pevzner, MIT Press
- Computer Methods for Macromolecular Sequence Analysis by R.F. Doolittle, J.N, Abelson, M.I. Simon, Academic press
- Essentials of Genomics and Bioinformatics C.W. Sensen, John Wiley and Sons Inc.
- Introduction to Computational Biology: Maps, Sequences and Genomes by M. Waterman, Chapman and Hall
- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by G. V. Heijne and G.V. Heijne, Academic Press

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	The NCBI, sequence databases, sequence retrieval, sequence file formats	Lecture	MTB 104.1.	Mid Term-1, Quiz & End Sem Exam
2	Submitting DNA, protein sequences and sequence assembly.	Lecture	MTB 104.1.	Mid Term-1, Quiz & End Sem Exam
3	Exact string matching - classical comparison based methods, semi numerical string matching, suffix trees - construction and application	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
4	Databases and rapid sequence analysis –Blast and Fasta	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
5	Sequence comparison by statistical content;	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
6	Dynamic programming alignment -The number of alignments, shortest and longest paths in a network, global distance and similarity alignments,	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
7	Fitting one sequence onto the other, trace backs, parametric sequence comparison	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
8	Global and local alignments	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam
9	Scoring matrices-pam and blosum	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam
10	Gap penalties, filtering, position specific scoring matrices,	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam
11	Internet resources,	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam
12	Uses of multiple sequence alignment programs and methods pattern searching programs, family and superfamily	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam

	representation & profit analysis.			
13	Trees-representation of sequences	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
14	Tree interpretation, Distance – additive, ultrameric and nonadditive distances, tree building methods,	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
15	Phylogenetic analysis, parsimony,	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
16	Phylogenetic analysis, parsimony,	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
17	Bootstrap, maximum likelihood trees , estimating the rate of change, likelihood and trees;	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
18	Bootstrap, maximum likelihood trees , estimating the rate of change, likelihood and trees;	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
19	Analysis software	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
20	Analysis software	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
21	Annotation, ESTs – databases,	Lecture	MTB 104.5	Mid Term-2, Quiz & End Sem Exam
22	comparative genome	Lecture	MTB 104.5	Mid Term-2, Quiz & End Sem Exam
23	analysis clustering,	Lecture	MTB 104.5	Mid Term-2, Quiz & End Sem Exam
24	gene discovery,	Lecture	MTB 104.5	Quiz & End Sem Exam
25	protein identification,	Lecture	MTB 104.5	Quiz & End Sem Exam
26	Physical properties,	Lecture	MTB 104.5	Quiz & End Sem Exam
27	Motifs and patterns,	Lecture	MTB 104.5	Quiz & End Sem Exam
28	Structure, folding classes,	Lecture	MTB 104.5	Quiz & End

				Sem Exam
29	structure classification; Structure databases– PDB and MMDB,	Lecture	MTB 104.5	Quiz & End Sem Exam
30	Visualizing structural information,	Lecture	MTB 104.5	Quiz & End Sem Exam
31	Docking of Molecules,	Lecture	MTB 104.5	Quiz & End Sem Exam
32	Structure prediction in proteins,	Lecture	MTB 104.5	Quiz & End Sem Exam
33	Prediction of buried residues in proteins,	Lecture	MTB 104.5	Quiz & End Sem Exam
34	RNA secondary structure –	Lecture	MTB 104.5	Quiz & End Sem Exam
35	minimum free	Lecture	MTB 104.5	Quiz & End Sem Exam
36	minimum free	Lecture	MTB 104.5	Quiz & End Sem Exam
37	Genome analysis	Lecture	MTB 104.5	Quiz & End Sem Exam
38	Genome analysis	Lecture	MTB 104.5	Quiz & End Sem Exam
39	Genome rearrangements with inversions	Lecture	MTB 104.5	Quiz & End Sem Exam
40	Genome rearrangements with inversions	Lecture	MTB 104.5	Quiz & End Sem Exam
41	Gene identification,	Lecture	MTB 104.5	Quiz & End Sem Exam
42	Gene identification,	Lecture	MTB 104.5	Quiz & End Sem Exam
43	Gene expression,	Lecture	MTB 104.5	Quiz & End Sem Exam
44	Gene expression	Lecture	MTB 104.5	Quiz & End Sem Exam
45	Gene expression	Lecture	MTB 104.5	Quiz & End Sem Exam
45	Expression analysis,	Lecture	MTB 104.5	Quiz & End Sem Exam
46	Expression analysis,	Lecture	MTB 104.5	Quiz & End Sem Exam
47	Gene identification and functional classification.	Lecture	MTB 104.5	Quiz & End Sem Exam
48	Gene identification and functional classification.	Lecture	MTB 104.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 104.1	Understand about nucleotide and protein sequence retrieval, submission through NCBI database.	3	3	1	3	1				2	1	3	2	1	1
MTB 104.2	Understand the nucleotide and protein sequence alignment methods through different types of algorithm used.	3	3	1	3	1				2	1	3	2	1	1
MTB 104.3	Predict the phylogenetic tree and evolutionary relationship.	3	3	1	3	1				1	1	3	2	1	1
MTB 104.4	Predict the databases related to functional gene sequences and their analysis through identification and classification	3	3	2	3	2				1	1	3	2	1	1
MTB 104.5	Describe the molecular modeling using protein databank, docking and visualization of structure.	2	3	1	2	3				2	1	3	2	1	1

Sample Question Paper

Amity Institute Biotechnology
2018-19

Class: M.Tech. Biotechnology

I Semester

Subject Name: Computational Biology	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

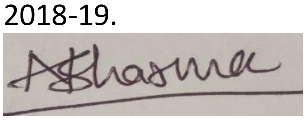
- Understand and explain the development of computational biology.
- Describe the fundamentals of bioinformatics databases and their application.
- Understand and explain the use of various computational methods for phylogentic studies.
- Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling.
- Explain the applications of computational biology in different fields of sciences.

CO Map	Question No.	Question	Marks
CO1	Q.1	Bioinformatics is the integrated field of science" Explain this statement with suitable examples.	6
CO2	Q.2	What is a primary sequence database? Give any five examples of primary databases with features.	6
	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	Compare the Global and Local alignment methods with suitable example of matrix.	6
CO4	Q.5	Give the description of commonly used secondary databases of nucleic acid and protein.	6
CO3	Q.6	Write any five applications of bioinformatics in biological sciences and agriculture.	6
	Q.7	BLAST is a popular program for exploring protein family relationship. Discuss the types and applications of BLAST program.	10
CO4	Q.8	What is Neighbor-joining and UPGMA method? How it is useful in	10

		constructing phylogenetic tree.	
CO3	Q.9	What is sequence alignment? Write the difference between pairwise and multiple sequence alignment.	10
CO3	Q.10	A. Consider the following multiple sequence alignment: A.TCGGTAGGCT B. ACCGTTCCAT C. ACCCAAGGCT D. ATGGTAGGCT How many rooted and un-rooted phylogenies can you construct out of the taxa shown in the alignment? Explain any one method to construct a phylogenetic tree. B. Explain dendogram, cladogram and phylogram. How many different unrooted and rooted trees topologies are possible for 3, 4 and 5 species?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioinformatics***/Course code ***MTB 104*** is level **3** for the academic year 2018-19.



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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Technology (M.Tech.) BT, Academic Year – 2018-19

M. Tech. Biotechnology (Four Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF M.TECH. BIOTECHNOLOGY

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.
PO9. Inculcation of ability to think independently for problem solving.
PO10. Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
II SEM	MTB 206	3	2	3	2	1	-	1	2	1	2		3	3	1	1

AMITY UNIVERSITY

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL BIOTECHNOLOGY
Course Code : MTB 206, Crédits : 03, Session :2018-19 (Odd Sem.), Class : M.Tech 1st Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques used in *Environmental* biotechnology. To introduce the students to regenerate clean environment using biotechnology as the key tool and provide them the insight for eco-friendly approach along with the concept of sustainable development.

B. **Course Outcomes:** At the end of the course, students will be able to:

MTB 206.1. Understand concept of climate change, pollution and mitigation approaches.
MTB 206.2. Understand concept of energy sustainability, clean fuel technology, Biomass energy and biofuels.
MTB 206.3. Understand concept of Biodegradation, Bioremediation and Phytoremediation. Advances in bioleaching and biomineralization.
MTB 206.4. Understand Advanced waste water treatments.

MTB 206.5. Understand Agriculture Sustainability and Clean agricultural practices, Biosensors and biomarkers, Principles of ecotoxicity

MTB 206.6. Understand the Environmental impact assessment and Environmental audit, Related case studies from India.

C. **Programme Outcomes:**
M. Tech. Biotechnology (Four Semesters)

PROGRAMME OUTCOMES OF M.TECH. BIOTECHNOLOGY

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project.

Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of
biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9. Inculcation of ability to think independently for problem solving.

PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Environmental pollution and its major impacts on human beings, plants, animals and climate, concept of Global warming and climate change, Global Ozone Problem, Eutrophication, Land degradation, Biomagnification.

Module II

Non-renewable and renewable energy resources, concept of clean fuel technology, Biomass energy and biofuels

Module III

Biodegradation, Bioremediation and Phytoremediation of major pollutants (PAH, Pesticides etc), Use of microbial technology for mining of metals (Bioleaching) and Concept of Biomineralisation.

Module IV

Waste water engineering: physicochemical characteristic of water, waste water treatment of municipal wastes and industrial effluents with special focus on use of biological methods, Advanced waste water treatments

Module V

Bioassessment of environmental quality: Biosensors and biomarkers, Principles of ecotoxicity.

Agriculture Sustainability and Clean agricultural practices: Biofertilizers, Biopesticides and vermi composting

Module VI

Environmental impact assessment and Environmental audit, Related case studies from India.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Environmental Science, S.C. Santra
- Environmental Biotechnology, Pradipta Kumar Mohapatra
- Environmental Biotechnology – Concepts and Applications" by Hans-Joachim Jordening and Jesef Winter
- Waste Water Engineering by Metcalf and Eddy. Publisher: Tata McGraw hill
- Environmental Microbiology: Methods and Protocols by Alicia L. Ragout De Spencer, John F.T. Spencer
- Introduction to Environmental Biotechnology by Milton Wainwright
- Principles of Environmental Engineering by Gilbert Masters

Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspon ding CO**	**Mode of Assessing CO**
1	Environmental pollution and its major impacts	Lecture	MTB 206.1.	Mid Term-1, Quiz & End Sem Exam
2	Environmental pollution and its major impacts	Lecture		Mid Term-1, Quiz & End Sem Exam
3	concept of Global warming and climate change,	Lecture		Mid Term-1, Quiz & End Sem Exam
4	concept of Global warming and climate change,	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Global Ozone Problem,	Lecture		Mid Term-1, Quiz & End Sem Exam

6	Eutrophication,	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Land degradation, Biomagnification.	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Non-renewable energy resources,	Lecture	MTB 206.2.	Mid Term-1, Quiz & End Sem Exam
9	Non-renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
12	concept of clean fuel technology,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture	MTB 206.3.	Quiz & End Sem Exam
16	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture		Quiz & End Sem Exam
17	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Microbial technology for mining of metals (Bioleaching)	Lecture		Quiz & End Sem Exam
19	Microbial technology for mining of metals (Bioleaching)	Lecture		Quiz & End Sem Exam
20	Concept of Biomineralisation.	Lecture		Quiz & End Sem Exam
21	Waste water engineering: physicochemical characteristic of water,	Lecture	MTB 206.4.	Quiz & End Sem Exam
22	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
23	waste water treatment of	Lecture		Quiz & End Sem

	municipal wastes and industrial effluents			Exam
24	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
25	Advanced waste water treatments	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Bioassessment of environmental quality: Biosensors and biomarkers,	Lecture	MTB 206.5.	Quiz & End Sem Exam
27	Bioassessment of environmental quality: Biosensors and biomarkers,	Lecture		Quiz & End Sem Exam
28	Bioassessment of environmental quality: Principles of ecotoxicity.	Lecture		Quiz & End Sem Exam
29	Agriculture Sustainability and Clean agricultural practices:	Lecture		Quiz & End Sem Exam
30	Biofertilizers,	Lecture		Quiz & End Sem Exam
31	Biopesticides	Lecture		Quiz & End Sem Exam
32	Vermi composting	Lecture		Quiz & End Sem Exam
33	Environmental impact assessment	Lecture	MTB 206.6.	Quiz & End Sem Exam
34	Environmental impact assessment	Lecture		Quiz & End Sem Exam
35	Environmental audit,	Lecture		Quiz & End Sem Exam
36	Environmental audit,	Lecture		Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MTB 206.1.	Understand concept of climate change, pollution and mitigation approaches.	3	3	3	2	1	-	-	2	1	-		3	3	-	-
MTB 206.2.	Understand concept of energy sustainability, clean fuel technology, Biomass energy and biofuels.	3	3	3	2	1	-	-	2	1	-		3	3	1	1
MTB 206.3.	Understand concept of Biodegradation, Bioremediation and Phytoremediation. Advances in bioleaching and biomineralization.	3	2	3	2	1	-	-	2	1	-		3	3	-	-
MTB 206.4.	Understand Advanced waste water treatments.	3	3	3	2	1	-	-	2	1	-		3	3	1	-
MTB 206.5.	Understand Agriculture Sustainability and Clean agricultural practices, Biosensors and biomarkers, Principles of ecotoxicity	3	3	2	2	1	-	-	2	1	-		3	3	-	-
MTB 206.6.	Understand the Environmental impact assessment and Environmental	3	2	3	2	-	-	-	2	1	-		3	3	-	-

	audit, Related case studies from India.															

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2018-19</td></tr>
<tr><td colspan="7">Class: M. Tech Biotechnology
II Semester</td></tr>
<tr><td colspan="2">Subject Name: ENVIRONMENTAL BIOTECHNOLOGY</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,6</td><td>Q.2, 3, 7</td><td>Q.5,10</td><td>Q. 4, 8,</td><td>Q. 9,</td><td></td></tr>
<tr><td colspan="7">Student will be able to:</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Briefly explain the following (i) Activated sludge (ii) Biomethanation.	6
CO6	Q.2	Write a short note on different tools of conducting EIA	6
CO1	Q.3	Define clean fuels and their advantages? How they differ from fossil fuels?	6
CO2	Q.4	Write a short note on the problems associated with prolonged and indiscriminate use of chemical fertilizers and pesticides in present agriculture system.	6
CO5	Q.5	Briefly discuss the role and benefits of biofertilizers in sustainable agriculture system.	6

CO4	Q.6	Write a short note on modes of dispersion of toxic substances in the environment.	6
CO 1	Q.7	What is biodegradation? Discuss role of microbial enzymes especially microbial Dehalogenases and Phosphotriesterase (PTEs) in biodegradation of pesticides in soil.	10
CO3	Q.8	(a) Explain the Solar energy and Wind energy, point out their significance in context of environment and energy (b) Sustainability	10
CO5	Q.9	(c) Explain Explain the following with suitable example. (i) Rhizofilteration (ii) Biomagnification.	10
CO4	Q.10	Discuss the following in detail. (d) What is microbial leaching of metal ores? Explain any two ex-situ methods of microbial leaching from metal ore. How these methods are better eco-friendly options over conventional chemical metal extraction process? (e) Describe secondary treatment of municipal waste water through advanced biofilm based approaches. What impurities and toxic pollutants are usually removed during secondary waste water treatment?	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental Biotechnology/***Course code ***MTB 206*** is level **3** for the academic year ***2018-19***.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	MTB 301	3	3	3	1	1	-	-	1	2	1	3	2	1	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY
Course Code : MTB 301, Crédits : 03, Session :2018-19(Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The aim to teach immunology and immuno technology to the students for their better understanding of immune system, types and mechanism of immunity, immune responses, their tolerance and suppression as well as tools and techniques involved in diagnosis and identification of immune related diseases.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MTB 301.1. Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.

MTB 301.2. Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.

MTB 301.3. Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.

MTB 301.4. the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9. Inculcation of ability to think independently for problem solving.

PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Types of immunity - innate, aquired, passive and active physiology of immune response – MI and CMI specificity and memory. Antigen, antibody reactions. Antigens types Hapten, immunoglobuin structure, distribution and function

Module II

Molecular biology of Ig synthesis, Lymphoid tissues – ontogeny and physiology of immuno system - origin and development, differentiation of lymphocytes. Lymphocyte subpopulation of mouse and man. Structure and function of class I and II molecules antigen distribution in population – HLA in human health and diseases. Transplantation immunity – organ transplantation and HLA tissue typing.

Module III

Cell mediated cytotoxicity. Hypersensitivity reactions, cellular interaction in immune response. Antigen recognition. T.B. cell receptors, MHC restriction, Lymphocyte activation clonal proliferation, differentiation. Interleukins and their roles. The complement systems mode of activation, classical and alternate pathway biological functions.

Module IV

Introduction to tumor immunology, autoimmune disorders and immunology of infectious diseases.

Antigen antibody reactions in vitro methods agglutination precipitation, complement fixation, immunofluorescence, immunoelectrophoresis, ELISA, Radio immuno assays, In vitro methods, skin tests and immune complex tissue demonstrations. Applications of these methods in diagnosis of microbial infections, Vaccines

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;

A: Attendance

H. Suggested Text/Reference Books:

Text:

 Kuby Immunology, R.A. Goldsby, T.J. Kindt and B.A. Obsorne, Freeman
 Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company

References:

 Immunology (Sixth Edition), Roitt, Brostoff, Male, Panima Publication
 Fundamentals of Immunology, W. Paul, Lippincot Williams and Wilkins
 Immunology, W.L. Anderson, Frence Creek Publishing (Blackwell)
 Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.
 Immunology, Poitt, Mosby – Yearbook Inc.
 Perkin Elmer Antibody Manual
 Production of Monoclonal Antibodies – Detailed Protocol, G.K. Lewis, University of Maryland

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I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Type of immunity	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
2	Antigen and haptens	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
3	Antibody : function and structure	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
4	Types of antibody and their functions	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
5	Synthesis of Ig molecule	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
6	Light Chain gene rearrangement	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
7	Heavy Chain gene rearrangement	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
8	Antibody Diversity	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
9	Primary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
10	Primary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
11	Secondary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
12	Secondary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
13	MHC I: Structure, types and function	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam

14	MHC II: Structure, types and function	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
15	Transplantation Immunology	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
16	Cell mediated cytotoxicity	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
17	Hypersensitivity : Types and function.	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
18	Hypersensitivity : Types and function.	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
19	Complement system: Types and importance	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
20	Complement system: Types and importance and Regulation	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
21	Lymphocyte activation and clonal proliferation	Lecture	MTB 301.3	Mid Term-2, Quiz & End Sem Exam
22	Antigen recognition and T.B. cell receptor	Lecture	MTB 301.3	Mid Term-2, Quiz & End Sem Exam
23	Revision of module I and II	Lecture	MTB 301.3	Mid Term-2, Quiz & End Sem Exam
24	Introduction of tumor immunology	Lecture	MTB 301.3	Quiz & End Sem Exam
25	Tumor immunology	Lecture	MTB 301.4	Quiz & End Sem Exam
26	Autoimmune disorder: Organ specific	Lecture	MTB 301.4	Quiz & End Sem Exam
27	Autoimmune disorder: systemic	Lecture	MTB 301.4	Quiz & End Sem Exam
28	Autoimmunity : mechanism and regulation	Lecture	MTB 301.4	Quiz & End Sem Exam
29	Agglutination reaction	Lecture	MTB 301.4	Quiz & End Sem Exam
30	Precipitation reaction	Lecture	MTB 301.4	Quiz & End Sem Exam
31	Complement fixation	Lecture	MTB 301.4	Quiz & End Sem Exam
32	Immunofluorescence and immunoelectrophoresis	Lecture	MTB 301.4	Quiz & End Sem Exam
33	ELISA and RIA	Lecture	MTB 301.4	Quiz & End Sem Exam
34	Skin test and immune complex tissue demonstration	Lecture	MTB 301.4	Quiz & End Sem Exam
35	Application of these methods in diagnosis of microbial infection, Vaccines	Lecture	MTB 301.4	Quiz & End Sem Exam
36	Immunofluorescence and immunoelectrophoresis	Lecture	MTB 301.4	Quiz & End Sem Exam

J. **Course Articulation Matrix (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 301.1	Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.	3	3	3	1	1	-	-	1	2	1	3	2	1	1
MTB 301.2	Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MTB 301.3	Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MTB 301.4	the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer,	3	3	3	1	1	-	-	1	2	1	3	1	3	1

	including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.														

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2018-19</td></tr>
<tr><td colspan="7">Class: M.Tech. Biotechnology
IIISemester</td></tr>
<tr><td colspan="2">Subject Name: ADVANCED IMMUNOLOGY</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.7</td><td>Q. 8, 9,</td><td>Q. 10</td></tr>
<tr><td colspan="7">Student will be able to:
Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Specific immunity exhibits four characteristic attributes, which are mediated by lymphocytes. List these four attributes and briefly explain how they arise.	6
CO2	Q.2	Draw a schematic diagram of a typical IgG molecule and label each of the following parts: H chains, L chains, inter-chain disulfide bonds, intra-chain disulfide bonds, hinge, Fab, Fc, and all the domains. Indicate which domains are involved in antigen binding.	6

	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	What is antigen? Discuss about the typing procedures for HLA antigens.	6
CO4	Q.5	Describe one advantage and one disadvantage of N-nucleotide addition during the rearrangement of immunoglobulin heavy-chain gene segments.	6
CO3	Q.6	Explain why NK cells from a given host will kill many types of virus-infected cells but do not kill normal cells from that host.	6
	Q.7	Discuss about that the role of cell-Mediated Immunity is Important for Viral Control and Clearance.	10
CO4	Q.8	What is the mechanism of tumor generation and how does normal cells are differentiated from transformed cells?	10
CO3	Q.9	Describe the main stages of leukocyte migration from the blood to a site of inflammation.	10
CO3	Q.10	What are the hallmark features of adaptive immunity? An individual has a mutation severely inhibiting the natural function of the transporter associated with antigen processing (TAP). Which antigen processing pathway would be rendered inefficient? What classes of agents would the individual have a problem attacking and why?	20

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advanced Immunology***/Course code ***MTB 301*** is level **3** for the academic year 2018-19.

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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY LAB
Course Code : MTB 320, Crédits : 01, Session :2018-19 (Odd Sem.), Class : M.Tech. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe the immunological questions through experimentation. The aim is also to explain the antigen antibody interaction patterns through various experiments.

B. Course Outcomes: After successful completion of the course student will be able to:

MTB 320.1. Demonstrate detailed knowledge of purification of immunologlobulin, cells and antigen antibody interaction.

MTB 320.2. Apply knowledge and incorporate experimental understanding of the agglutination mechanism.

MTB 320.3. Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research

project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9. Inculcation of ability to think independently for problem solving.

PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			100%

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Course Contents:
1. Purification of immunoglobin G.
2. Study of antigen- antibody pattern (ODD).
3. Study of sandwich ELISA.
4. Study of haemeagglutination.
5. Study of immunoelectrophoresis.
6. Isolation and identification of rosette cells.
7. Antigen capture ELISA

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;
A: Attendance

H. Suggested Text/Reference Books:

- Manual of Molecular and Clinical Laboratory Immunology, 8th Edition Barbara Detrick (Editor), John L. Schmitz (Editor), Robert G. Hamilton (Editor) ISBN: 978-1-555-81871-5 May 2016 ASM Press
- Immunology Laboratory Manual Published by LAP LAMBERT Academic Publishing (2018) ISBN 10: 6138386175 ISBN 13: 9786138386179

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Purification of Immunoglobulin G	Lecture	MTB 320.1	Mid Term-1, Quiz & End Sem Exam
2	Radial Immuno Diffusion Test	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam
3	Double Immuno Diffusion Test	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam
4	Study of sandwich ELISA	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam
5	Study of DOT ELISA	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam
6	Study of heamagglutination (Blood group)	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam

7	Rh factor determination	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
8	Study of heamagglutination (Widal test)	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
9	Study of immunoelectrophoresis	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
10	Study of rocket immunoelectrophoresis	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
11	Isolation and identification of rostte cells	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
12	Revision and discussion	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 320.1	Demonstrate detailed knowledge of purification of immunoglobulin, cells and antigen antibody interaction.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MTB 320.2	Apply knowledge and incorporate experimental understanding of the agglutination mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MTB 320.3	Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

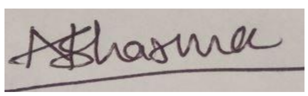
Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2018-19</td></tr>
<tr><td colspan="7">Class: M.Tech. Biotechnology
III Semester</td></tr>
<tr><td colspan="2">Subject Name: Advanced Immunology Lab</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.3 & Q.4</td><td>Q.1</td><td></td><td>Q.2</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to:
• Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
• Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
• Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
• the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Perform Dot Elisa for detection of antigen-antibody interaction.	35
CO2	Q.2	Perform hemagglutination (Blood group) test.	15
	Q.3	*Viva-voce*	10
CO 3	Q.4	Record	10

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course *Advanced Immunology lab*/Course code *MTB 320* is level 3 for the academic year 2018-19.



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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MICROBIOLOGY
Course Code : BMB 302, Crédits : 04, Session :2019-2020 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: The course imparts the knowledge of different types of microorganisms that are invisible to our naked eyes. Discovery origin and evaluation of different forms of bacteria, fungi, protozoa and viruses constitute the basics of biotechnology.

B. Course Outcomes: After successful completion of the course student will be able to:

BMB 302.1. Understand the microbiological techniques for the isolation and characterization of microbes.
BMB 302.2. Understand the mechanism of different metabolic processes.
BMB 302.3. Know the physiology and survival mechanism of extremophilic bacteria.
BMB 302.4. Know the concept of virus lytic and lysogenic cycle is quite clear to students.
BMB 302.5. Understand the epidemiology and microbial pathogenesis.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic

weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/ HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the

causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization,

Module II

Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, continuous culture, culture collection and maintenance of cultures.

Module III

Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV

Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archaea

Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles Viruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI

Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII

Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian

- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott

- The microbes – An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

References:

- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin & Cummings
- Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
- Industrial Microbiology, Casida, New Age International
- Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC. Brown Publisher.

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspond ing CO**	**Mode of Assessing CO**
1	Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
2	Role of microorganisms in transformation of organic matter and in the causation of diseases,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
3	Development of pure culture methods.	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
4	Methods in Microbiology -Principles of microbial nutrition,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
5	Culture media,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
6	Culture media,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
7	Physical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam

8	Physical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
9	Chemical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
10	Chemical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
11	Prokaryotic structure and function	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
12	Cell wall	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
13	Cell cytoplasmic membrane	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
14	Capsule	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
15	Surface appendages	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
16	Cytoplasm and cytoplasmic inclusion	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
17	Bacterial growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam

18	Mathematical expression of growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
19	Growth curve	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
20	Measurement of growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
21	Synchronous growth,	Lecture	BMB 302.2	Quiz & End Sem Exam
22	Continuous culture,	Lecture	BMB 302.2	Quiz & End Sem Exam
23	Culture collection and maintenance of cultures.	Lecture	BMB 302.2	Quiz & End Sem Exam
24	Systematics and taxonomy - new approaches to bacterial taxonomy,	Lecture	BMB 302.2	Quiz & End Sem Exam
25	Classification including ribotyping, ribosomal RNA sequencing,	Lecture	BMB 302.2	Quiz & End Sem Exam
26	Characteristics of primary domains, taxonomy, nomenclature and Bergey's manual	Lecture	BMB 302.2	Quiz & End Sem Exam
27	Metabolic Diversity among microorganisms- photosynthesis in microorganisms	Lecture	BMB 302.2	Quiz & End Sem Exam
28	Role of bacteriochlorophylls	Lecture	BMB 302.2	Quiz & End Sem Exam
29	carotenoids and phycobilins	Lecture	BMB 302.2	Quiz & End Sem Exam
30	Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria,	Lecture	BMB 302.2	Quiz & End Sem Exam
31	nitrate and sulphate reduction,	Lecture	BMB 302.2	Quiz & End Sem Exam
32	methanogenesis and acetogenesis,	Lecture	BMB 302.2	Quiz & End Sem Exam
33	Fermentations,	Lecture	BMB 302.2	Quiz & End Sem Exam
34	Nitrogen fixation,	Lecture	BMB 302.2	Quiz & End Sem Exam
35	Plant microbe interactions	Lecture	BMB 302.2	Quiz & End Sem Exam

36	Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BMB 302.3	Quiz & End Sem Exam
37	*Viruses: Bacterial, animal;*	Lecture	BMB	Quiz & End Sem
	structure of viruses;		302.4	Exam
38	*Reproduction and life cycle of RNA and DNA viruses; Viroids and prions.*	Lecture	BMB 302.4	Quiz & End Sem Exam
39	*Algae: Classification and Reproduction.*	Lecture	BMB 302.4	Quiz & End Sem Exam
40	*Fungi: Classification and Reproduction.*	Lecture	BMB 302.4	Quiz & End Sem Exam
41	Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract,	Lecture	BMB 302.5	Quiz & End Sem Exam
42	Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo) and their mode of actions,	Lecture	BMB 302.5	Quiz & End Sem Exam
43	Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission;	Lecture	BMB 302.5	Quiz & End Sem Exam
44	Sexually transmitted disease including AIDS, Food and water-borne diseases; pathogenic fungi.	Lecture	BMB 302.5	Quiz & End Sem Exam
45	Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins,	Lecture	BMB 302.5	Quiz & End Sem Exam
45	Broad spectrum antibiotics	Lecture	BMB 302.5	Quiz & End Sem Exam
46	Antifungal antibiotics	Lecture	BMB 302.5	Quiz & End Sem Exam
47	Antibiotics mode of action.	Lecture	BMB 302.5	Quiz & End Sem Exam
48	Antibiotics mode of action.	Lecture	BMB 302.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 302.1	Understand the microbiological techniques for the isolation and characterization of microbes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.2	Understand the mechanism of different metabolic processes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.3	Know the physiology and survival mechanism of extremophilic bacteria.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.4	Learn structure and function of the cell cytoskeleton, cilia and flagella.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.5	Understand the epidemiology and microbial pathogenesis	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

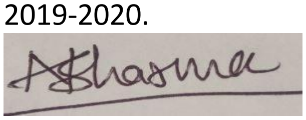
<table>
<tr><td colspan="7">Amity Institute Biotechnology
2019-2020</td></tr>
<tr><td colspan="7">Class: B.Sc.-M.Sc. (Dual Degree) Biotechnology
III Semester</td></tr>
<tr><td colspan="2">Subject Name: Microbiology</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.7</td><td>Q. 8, 9,</td><td>Q. 10</td></tr>
<tr><td colspan="7">Student will be able to:
• Understand the microbiological techniques for the isolation and characterization of microbes.
• Understand the mechanism of different metabolic processes.
• Know the physiology and survival mechanism of extremophilic bacteria.
• Know the concept of virus lytic and lysogenic cycle is quite clear to students.
• Understand the epidemiology and microbial pathogenesis.</td></tr>
</table>

<table>
<tr><th>CO Map</th><th>Question No.</th><th>Question</th><th>Marks</th></tr>
<tr><td>CO1</td><td>Q.1</td><td>Write the historical contributions of Louis Pasteur and Robert Koch in the field of microbiology.</td><td>6</td></tr>
<tr><td rowspan="2">CO2</td><td>Q.2</td><td>Write down the steps involved in Gram's staining procedure. Differentiate between Gram positive and gram negative bacteria.</td><td>6</td></tr>
<tr><td>Q.3</td><td>Explain the importance of extracellular appendages present in bacteria.</td><td>6</td></tr>
<tr><td>CO4</td><td>Q.4</td><td>Describe polyphasic taxonomy and discuss some of its advantages</td><td>6</td></tr>
<tr><td>CO4</td><td>Q.5</td><td>Discuss about the mechanism of photo-phosphorylation in bacterial system.</td><td>6</td></tr>
<tr><td rowspan="2">CO3</td><td>Q.6</td><td>Give an outline the nitrogen fixation, and explain the roles of microorganisms in this cycle</td><td>6</td></tr>
<tr><td>Q.7</td><td>What are the archaea? Briefly describe the major ways in which they differ from bacteria and eucaryotes.</td><td>10</td></tr>
</table>

CO4	Q.8	Write a note on viroids and prions with suitable example of disease.	10
CO3	Q.9	Discuss about normal microbiota present on different body region with suitable features	10
CO3	Q.10	What is penicillinase? Explain the role of penicillin against the synthesis of bacterial cell wall. How does a low concentration of penicillin G select for penicillin-resistant bacteria?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Microbiology***/Course code ***BMB 302*** is level **2** for the academic year 2019-2020.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BMB 401	3	3	3	3	1	-	-	2	2	1	3	1	-

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **Bioinformatics**
Course Code : BMB 401, Crédits : 3, Session :2019-20 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The course involves a basic understanding of computer and bioinformatics tools and skills in the field of biology

B. **Course Outcomes:** After successful completion of the course student will be able to:

BMB 401.1. Understand and explain the structural organization and characteristics of computers and its parts

BMB 401.2. Describe the concept of use of internet in bioinformatics.

BMB 401.3. Explain the concept and organization of biological databases..

BMB 401.4. Understand and explain the structure and functions of the phylogenetic analytic tools.

BMB 401.5. Interrogate major database sources and be able to integrate this information with clinical data.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Computers
General introduction (characteristics, capabilities, generations), software, hardware : organization of hardware (input devices, memory, control unit arithmetic logic unit, output devices); software : (System software; application software, languages -low level, high level), interpreter, compiler, data processing; batch, on-line, real-time (examples from bioindustries; e.g. application of computers in co-ordination of solute concentration, ph, temperature, etc., of a fermenter in operation); internet application.

Module II: Basic Bioinformatics
Introduction to Internet, Search Engines (Google, Yahoo, Entrez etc)

Module III: Biological Databases
Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL), Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc), Cluster databases-An Introduction, Specialised databases (KEGG, etc), Database technologies (Flat-file), Structural databases (PDB)

Module IV: Phylogenetic Analysis
Trees-splits and metrices on trees, tree interpretation, Distance – additive, ultrameric and nonadditive distances,tree building methods, phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains, estimating the rate of change, likelihood and trees; analysis software.

Module V: Genome analysis
Annotation, comparison of different methods; ESTs – databases, clustering, gene discovery and identification, and functional classification. Reconstruction of metabolic pathways; Genome analysis, genome anatomy, genome rearrangements with inversions, signed inversions, gene identification, gene expression, expression analysis, gene identification and functional classification

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Computer Science, J.G. Brookshear, Pearson, Addison Wesley
- Introduction to Bioinformation – T.Attawood

References:
- A book on C by Kelley : Programming in C, Addison-Wesley Publishing
- Introduction to C++ for Engineers and Scientists, Prentice-Hall
- Schaum’s Outline of Introduction of Computer Science, P. Cushman and R. Mata-Toledo, McGraw Hill

Trade
- Bioinformatics – Managing Scientific Data, Zoe’ Lacroix and Terence Critchlow
- Bioinformatics – Sequence, Structure and Databanks, Des Higgins & Willie Taylor
- Structural Bioinformatics, Philip E. Bourne, Helge Weissig 2003
- Statistical Methods in Bioinformatics: An Introduction, G.R. Grant, W.J. Ewens, Springer Verlag

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**
1	General introduction (characteristics, capabilities, generations),	Lecture	**BMB 401.1**.	Mid Term-1, Quiz & End Sem Exam

2	software, hardware : organization of hardware (input devices, memory, control unit	Lecture	**BMB 401.1**.	Mid Term-1, Quiz & End Sem Exam
	arithmetic logic unit, output devices),			
3	organization of hardware	Lecture	**BMB 401.2**.	Mid Term-1, Quiz & End Sem Exam
4	*organization of software*	Lecture	**BMB 401.2**.	Mid Term-1, Quiz & End Sem Exam
5	Interpreter, compiler, data processing; batch, on-line, real-time	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
6	Introduction and application of Internet	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
7	Search Engines (Google, Yahoo, Entrez etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
8	Revision	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
9	Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
10	Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
11	Cluster data bases-An Introduction. Specialized databases (KEGG, etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
12	Database technologies (Flat-file)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
13	Revision	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
14	Introduction of phylogenetics analysis	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
15	Trees-splits and metrices on trees, tree interpretation	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
16	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
17	phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
18	Estimating the rate of change, likelihood and trees; analysis software	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam

19	Annotation, comparison of different methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
20	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
21	Revision	Lecture	**BMB 401.4**	Quiz & End Sem
				Exam
22	ESTs – databases, clustering	Lecture	**BMB 401.4**	Quiz & End Sem Exam
23	Gene discovery	Lecture	**BMB 401.4**	Mid Term-2, Quiz & End Sem Exam
24	Identification and classification	Lecture	**BMB 401.5**	Quiz & End Sem Exam
25	Revision	Lecture	**BMB 401.5**	Quiz & End Sem Exam
26	Reconstruction of metabolic pathways	Lecture	**BMB 401.5**	Quiz & End Sem Exam
27	Genome analysis, genome anatomy	Lecture	**BMB 401.4**	Quiz & End Sem Exam
28	Genome rearrangements with inversions	Lecture	**BMB 401.4**	Quiz & End Sem Exam
29	signed inversions, gene identification	Lecture	**BMB 401.4**	Quiz & End Sem Exam
30	Reconstruction of metabolic pathways	Lecture	**BMB 401.4**	Quiz & End Sem Exam
31	Genome analysis, genome anatomy	Lecture	**BMB 401.4**	Quiz & End Sem Exam
32	Gene expression	Lecture	**BMB 401.4**	Quiz & End Sem Exam
33	Gene expression analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
34	Gene identification methods	Lecture	**BMB 401.1**	Quiz & End Sem Exam
35	Functional classification	Lecture	**BMB 401.1**	Quiz & End Sem Exam
36	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
37	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
38	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam
39	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam
40	Gene expression	Lecture	**BMB 401.1**	Quiz & End Sem Exam
41	Gene expression analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
42	Gene identification methods	Lecture	**BMB 401.1**	Quiz & End Sem Exam
43	Functional classification	Lecture	**BMB 401.1**	Quiz & End Sem Exam

44	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
45	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
45	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 401.1	Understand and explain the structural organization and characteristics of computers and its parts	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.2	Describe the concept of use of internet in bioinformatics.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.3	Explain the concept and organization of biological databases	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.4	Understand and explain the structure and functions of the phylogenetic analytic tools.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.5	Interrogate major database sources and be able to integrate this information with clinical data.	3	3	3	3	1	-	-	2	2	1	3	1	-

<u>Sample Question Paper</u>

Amity Institute Biotechnology 2019-20						
Class: B.Sc. Biotechnology IV Semester						
Subject Name: **Bioinformatics**		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

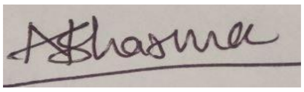
- Understand the basic knowledge of computer hardware and software.
- Understand the advanced techniques of bioinformatics.
- Understand the application of bioinformatics in different area.
- Understand the role of computational biology in drug designing.
- Understand the importance of phylogenetic analysis in species development.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about the importance of input and output device of computer. Also differentiate between input and output devices.	6
CO2	Q.2	Discuss about the anatomy of E. mail and www.	6
	Q.3	Explain about the different databases present in NCBI. Give a comparison between protein databases and nucleotide databases with examples.	6
CO4	Q.4	Discuss about the different terminology used in phylogenetic tree with the suitable diagram.	6
CO4	Q.5	Write about the genome of between prokaryotic and eukaryotic organism.	6
CO3	Q.6	Discuss a general classification of computer generations with suitable examples, merits and demerits	6
	Q.7	What is topology of computer networking? Write advantages and disadvantages of different topology networking.	10
CO4	Q.8	Write a detail note on RCSB, Genbank, and DDBJ with advantages.	10
CO3	Q.9	What is sequence similarity? Explain about the different quantitative methods of sequence similarity	10

CO3	Q.10	. A. Explain the different methods used for gene prediction. Discuss one of the methods in detail with suitable diagram. B. By writing the corresponding match states into columns we get the following alignment: ATGA AGTA	20
		What is its score under the following scoring scheme? Match +2, Mismatch -1 and Gap +1.Explain with global alignment algorithm.	

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Bioinformatics** /Course code ***BMB 401*** is level **2** for the academic year 2019-20.

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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BMB 403	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **IMMUNOLOGY & IMMUNOTECHNOLOGY**
Course Code : BMB 403, Crédits : 04, Session :2019-2020 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. Course Outcomes: After successful completion of the course student will be able to:

BMB 403.1. Understand and explain the phylogeny of immune system, types of immunity, immune response.

BMB 403.2. Describe the concept of clonal selection theory, humoral and cell mediated immunity.

BMB 403.3. Understand and explain the structure and functions of the organs and cells of the immune system.

BMB 403.4. Understand the mechanism of antigen-antibody interaction.

BMB 403.5. Describe the structure of antibodies, their types and functions in immunity.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.
PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I :
Descriptors/Topics
Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.

Module II:
Descriptors/Topics
The organs and cells of the immune system.

Module III :

Descriptors/Topics

Histocompatibility: structure of MHC class I, II & III antigens & their mode of antigen presentation, MHC restriction; Antigens & antigenicity;

Module IV :

Descriptors/Topics

Antibody structure in relation to function and antigen-binding; Types of antibodies and their structures: isotypes, allotypes, idiotypes. Antibodies in targeting therapeutic agents. Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application

Module V :

Descriptors/Topics

Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.

Module VI :

Descriptors/Topics

Measurement of antigen – antibody interaction: agglutination, precipitation immunodiffusion, immuno-electrophoresis, ELISA, RIE

Module VII :

Descriptors/Topics

Tissue and organ transplantation

Module VIIII :

Descriptors/Topics

Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.

Autoimmunity and autoimmune diseases: Hashimoto's thyroiditis; Myasthenia gravis; Rheumatoid Arthritis, Pernicious anemia, Asthma.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Freeman

References:

- Immunology, Roitt, Mosby – Yearbook Inc.
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.1**.	Mid Term-1, Quiz & End Sem Exam
2	Innate and specific immunity. Humoral immunity,	Lecture	**BMB 403.1**.	Mid Term-1, Quiz & End Sem Exam
3	Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.2**.	Mid Term-1, Quiz & End Sem Exam
4	Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.2**.	Mid Term-1, Quiz & End Sem Exam
5	The organs of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
6	The organs of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
7	The cells of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
8	The cells of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
9	Histocompatibility: structure of MHC class I, II & III	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
10	Histocompatibility: structure of MHC class I, II & III	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
11	Antigens	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
12	Mode of antigen presentation,	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
13	MHC restriction; Antigens & antigenicity	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam

14	MHC restriction; Antigens & antigenicity	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
15	Antibody structure in relation to	Lecture	**BMB 403.4**	Mid Term-1,
	function and antigen-binding			Quiz & End Sem Exam
16	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
17	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
18	Antibodies in targeting therapeutic agents.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
19	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
20	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
21	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application,	Lecture	**BMB 403.4**	Quiz & End Sem Exam
22	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Quiz & End Sem Exam
23	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.4**	Mid Term-2, Quiz & End Sem Exam
24	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam
25	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam

26	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam
27	Measurement of antigen – antibody interaction: agglutination,	Lecture	**BMB 403.5**	Quiz & End Sem Exam
28	Precipitation	Lecture	**BMB 403.5**	Quiz & End Sem Exam
29	immunodiffusion,	Lecture	**BMB 403.5**	Quiz & End Sem Exam
30	immuno-electrophoresis,	Lecture	**BMB 403.5**	Quiz & End Sem Exam
31	ELISA,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
32	RIE,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
33	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
34	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
35	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
36	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
37	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
38	Autoimmunity	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
39	Autoimmunity	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
40	Autoimmune diseases: Hashimoto's thyroiditis;	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
41	Myasthenia gravis;	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
42	Rheumatoid Arthritis,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
43	Pernicious anemia,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
44	Pernicious anemia,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
45	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam

45	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
46	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
47	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
48	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 403.1	Understand and explain the phylogeny of immune system, types of immunity, immune response.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.2	Describe the concept of clonal selection theory, humoral and cell mediated immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.3	Understand and explain the structure and functions of the organs and cells of the immune system	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.4	Understand the mechanism of antigen-antibody interaction	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.5	Describe the structure of antibodies, their types and functions in immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

Amity Institute Biotechnology 2019-2020		
Class: B.Sc.-M.Sc. (Dual Degree) Biotechnology IV Semester		
Subject Name: **Immunology & Immunotechnology**	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand and explain the phylogeny of immune system, types of immunity, immune response.
- Describe the concept of clonal selection theory, humoral and cell mediated immunity.
- Understand and explain the structure and functions of the organs and cells of the immune system.
- Understand the mechanism of antigen-antibody interaction.
- Describe the structure of antibodies, their types and functions in immunity.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about innate and adaptive immunity. Discuss about the different types of innate immunity with characters.	6
CO2	Q.2	Write a note on different phases of cytotoxic cell mediated targeting killing mechanism.	6
	Q.3	Write a general organization of class I and class II MHC molecules with suitable diagram.	6
CO4	Q.4	Discuss the role of IgG immunoglobulin in immune system.	6
CO4	Q.5	What is antibody diversity? Discuss the role of light chain gene rearrangement in antibody diversity.	6
CO3	Q.6	Draw a well labeled diagram of hybridoma technology with production of monoclonal antibody.	6
	Q.7	Discuss the role of innate and adaptive immunity in tissue grafting. Explain with suitable example.	10
CO4	Q.8	Give a comparison between all type of vaccine with examples and applications.	10
CO3	Q.9	Discuss about features of any two primary lymphoid organs with suitable diagram	10

CO3	Q.10	A. Although all lymphocytes are formed in bone marrow. Explain how these cells get differentiated into B cell and T cell. B Where the CDR regions located on an antibody molecule and what are are their functions? Discuss the ELISA method on the basis of antigen and antibody interaction.	20

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Immunology and immunotechnology**/Course code ***BMB 403*** is level **2** for the academic year 2019-2020.

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Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Genetics
Course Code : BSB301, Credits : 03, Session : 2019-20 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To acquaint the students to understand the basic concept of genetics incorporating the concepts of classical, molecular genetics. Students will learn about Mendelian Laws, Extension of Mendels Law, Multiple allele and isoallele, etc. Mutation, Mutagen, Chromosomal Aberrations, Human Genetic Disorders. Knowledge of methods of sex determination, Chromosomal non-disjunction, Chromosomal theory of inheritance, Sex linked, Sex limited and Sex limited Inheritance, Extra-chromosomal inheritance. Understanding of Population Genetics, Hardy-Weinberg Equilibrium, Gene and Genotype Frequencies.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB301.1. Students will develop an understanding of History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance.

BSB301.2. Understanding the pre-Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation.

BSB301.3. To study the classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage.

BSB301.4. Students will develop a basic understanding of Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders.

BSB301.5. Knowledge of Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance.

BSB301.6. Students will learn about extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA.

BSB301.7. Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies.

C. **Programme Outcomes:**

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills,

working under several aseptic procedures, isolation and identification. This course

also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Program Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Brief history, scope and significance of Genetics. Mendelian law of inheritance. Lethality and interaction of gene. Multiple allele and isoallele. Penetrance and Expressivity. Linkage and crossing over. Mapping of genes. interference and coincidence.

Module II: Basic microbial genetics, Conjugation, transformation, transduction and their use in genetic mapping.

Module III: Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over and complementation test, Benzers work on rII locus in T4 Bacteriophage.

Module IV: Mutation; spontaneous and induced, Mutagen;chemical and physical. Chromosomal aberrations; structural and numerical. Economic importance of mutation. Genetic disorders in human; Kleinefelter, Turner, Cri-du-Chat and Down syndrome.

Module V: Sex determination in plant and animal. Non disjunction as a proof of chromosomal theory of inheritance. Sex linked, sex influenced and sex limited inheritance.

Module VI: Extra chromosomal inheritance; cytoplasmic inheritance, Mitochondrial and Chloroplast genetic system.

Module VII: Population genetics; Hardy-Weinberg equilibrium law, Gene and genotype

frequencies.

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

Principles of Genetics, E. J. Gardner, John Wiley & Sons Inc.

Genetics, P.K. Gupta, Rastogi Publication.

Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, Pearson Education.

Genetics, M.W. Strickberger, Prentice Hall College Division.

Genetics, P.J. Russell, Benjamin/Cummings.

Genetics, R. Goodenough, International Thomson Publishing.

Introduction to Genetic Analysis, A.J. F. Griffiths, W.H. Freeman and Company.

Principles of Genetics, D.P. Snustad& M.J. Simmons, John Wiley and Sons Inc.

Molecular Biology of the Gene (Fifth Edition), J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison Wiesley Publishing.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Brief history, scope and significance of Genetics	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
2	Mendelian law of inheritance	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
3	Lethality and interaction of gene. Multiple allele and isoallele.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
4	Penetrance and Expressivity. Linkage and crossing over.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
5	Mapping of genes. Interference and coincidence.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
6	Basic microbial genetics	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam

7	Conjugation	Lecture	BSB301.2	Mid Term, Quiz & End
				Sem Exam
8	Transformation	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
9	Transduction	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
10	Genetic Mapping	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
11	Classical and modern concept of gene	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
12	Pseudoallelism, position effect	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
13	Intragenic crossing over	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
14	Mapping of genes	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
15	Interference and coincidence	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
16	Mutation; spontaneous and induced	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
17	Mutagen; chemical and physical	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
18	Chromosomal aberrations	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
19	Structural and numerical Aberration	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
20	Economic importance of mutation	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
21	Genetic disorders in human	Lecture	BSB301.4	Quiz & End Sem Exam
22	Sex determination in plant	Lecture	BSB301.5	Quiz & End Sem Exam

23	Sex determination in animal	Lecture	BSB301.5	Quiz & End Sem Exam
24	Non disjunction	Lecture	BSB301.5	Quiz & End Sem Exam
25	Non disjunction as a proof of chromosomal theory of inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
26	Sex linked inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
27	Sex influenced and sex limited inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
28	Extra chromosomal inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
29	Cytoplasmic inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
30	Mitochondrial DNA	Lecture	BSB301.6	Quiz & End Sem Exam
31	Chloroplast genetic system	Lecture	BSB301.6	Quiz & End Sem Exam
32	Significance of Extra chromosomal inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
33	Significance of cytoplasmic inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
34	Population genetics	Lecture	BSB301.7	Quiz & End Sem Exam
35	Hardy-Weinberg equilibrium law	Lecture	BSB301.7	Quiz & End Sem Exam
36	Gene and genotype frequencies	Lecture	BSB301.7	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3

BSB301.1	History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB301.2	Pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB301.3	Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage	3	2	2	2	2	2	2	2	3	3	3	2	2
BSB301.4	Mutation- Types, Mutagen- Types, and Chromosomal aberrations- structural & numerical and human genetic disorders	3	3	2	3	2	2	2	2	2	2	3	2	2

BSB301.5	Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance	3	2	3	2	2	3	2	2	2	2	3	2	2
BSB301.6	Extra-chromosomal inheritance, cytoplasmic inheritance,	3	3	2	3	2	2	2	2	2	2	3	2	2
	Mitochondrial and Chloroplast DNA													
BSB301.7	Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies	3	2	2	3	2	2	2	2	2	2	3	2	2

Sample Question Paper

<table>
<tr><td colspan="7" align="center">Amity Institute of Biotechnology
MID-SEMESTER 2019-20</td></tr>
<tr><td colspan="7" align="center">Class: B.Sc. (Biotech) III Semester</td></tr>
<tr><td colspan="2">Subject Name:
BSB 301 GENETICS</td><td colspan="3">Time: 2 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzin
g</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q. 1,4</td><td>Q. 2,3</td><td>Q. 4</td><td>Q. 2,5,6</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to
CO1: History and scope of Genetics
CO2: Understanding the pre Mendelian genetic concepts</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the scope and significance of genetics.	3
CO1	Q.2a	What are different steps involved in genetic mapping ?	3
	Q.2b	How is mechanism of conjugation is different from transformation ?	3
CO1	Q.3	How classical concept of gene is different from modern concept of gene ?	6
CO2	Q.4	Explain the significance of extra-chromosomal inheritance and cytoplasmic inheritance.	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **GENETICS/BSB 301** is **level 3** for the academic year 2019-20.

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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
III	BSB 302	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MICROBIOLOGY
Course Code : BSB 302, Crédits : 04, Session :2019-2020 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: The course imparts the knowledge of different types of microorganisms that are invisible to our naked eyes. Discovery origin and evaluation of different forms of bacteria, fungi, protozoa and viruses constitute the basics of biotechnology.

B. Course Outcomes: After successful completion of the course student will be able to:

BSB 302.1. Understand the microbiological techniques for the isolation and characterization of microbes.
BSB 302.2. Understand the mechanism of different metabolic processes.
BSB 302.3. Know the physiology and survival mechanism of extremophilic bacteria.
BSB 302.4. Know the concept of virus lytic and lysogenic cycle is quite clear to students.
BSB 302.5. Understand the epidemiology and microbial pathogenesis.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.
PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.
PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/ HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the

causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization,

Module II

Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, continuous culture, culture collection and maintenance of cultures.

Module III

Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV

Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archaea

Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles Viruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI

Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII

Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian

- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill
  Microbiology by Prescott

- The microbes – An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

References:

- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin & Cummings
- Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
- Industrial Microbiology, Casida, New Age International
- Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC. Brown Publisher.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
2	Role of microorganisms in transformation of organic matter and in the causation of diseases,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
3	Development of pure culture methods.	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
4	Methods in Microbiology -Principles of microbial nutrition,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
5	Culture media,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam

6	Culture media,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem
				Exam
7	Physical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
8	Physical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
9	Chemical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
10	Chemical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
11	Prokaryotic structure and function	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
12	Cell wall	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
13	Cell cytoplasmic membrane	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam

14	Capsule	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
15	Surface appendages	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
16	Cytoplasm and cytoplasmic inclusion	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
17	Bacterial growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
18	Mathematical expression of growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
19	Growth curve	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
20	Measurement of growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
21	Synchronous growth,	Lecture	BSB 302.2	Quiz & End Sem Exam
22	Continuous culture,	Lecture	BSB 302.2	Quiz & End Sem Exam

23	Culture collection and maintenance of cultures.	Lecture	BSB 302.2	Quiz & End Sem Exam
24	Systematics and taxonomy - new approaches to bacterial taxonomy,	Lecture	BSB 302.2	Quiz & End Sem Exam
25	Classification including ribotyping, ribosomal RNA sequencing,	Lecture	BSB 302.2	Quiz & End Sem Exam
26	Characteristics of primary domains, taxonomy, nomenclature and Bergey's manual	Lecture	BSB 302.2	Quiz & End Sem Exam
27	Metabolic Diversity among microorganisms- photosynthesis in microorganisms	Lecture	BSB 302.2	Quiz & End Sem Exam
28	Role of bacteriochlorophylls	Lecture	BSB 302.2	Quiz & End Sem Exam
29	carotenoids and phycobilins	Lecture	BSB 302.2	Quiz & End Sem Exam
30	Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria,	Lecture	BSB 302.2	Quiz & End Sem Exam
31	nitrate and sulphate reduction,	Lecture	BSB 302.2	Quiz & End Sem Exam
32	methanogenesis and acetogenesis,	Lecture	BSB 302.2	Quiz & End Sem Exam
33	Fermentations,	Lecture	BSB 302.2	Quiz & End Sem Exam
34	Nitrogen fixation,	Lecture	BSB 302.2	Quiz & End Sem Exam
35	Plant microbe interactions	Lecture	BSB 302.2	Quiz & End Sem Exam

36	Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BSB 302.3	Quiz & End Sem Exam
37	*Viruses: Bacterial, animal; structure of viruses;*	Lecture	BSB 302.4	Quiz & End Sem Exam
38	*Reproduction and life cycle of RNA and DNA viruses; Viroids and prions.*	Lecture	BSB 302.4	Quiz & End Sem Exam
39	*Algae: Classification and Reproduction.*	Lecture	BSB 302.4	Quiz & End Sem Exam
40	*Fungi: Classification and Reproduction.*	Lecture	BSB 302.4	Quiz & End Sem Exam
41	Host-parasite relationship - Normal micro flora of skin, oral cavity, gastrointestinal tract,	Lecture	BSB 302.5	Quiz & End Sem Exam
42	Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo) and their mode of actions,	Lecture	BSB 302.5	Quiz & End Sem Exam
43	Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission;	Lecture	BSB 302.5	Quiz & End Sem Exam
44	Sexually transmitted disease including AIDS, Food and water-borne diseases; pathogenic fungi.	Lecture	BSB 302.5	Quiz & End Sem Exam
45	Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins,	Lecture	BSB 302.5	Quiz & End Sem Exam
45	Broad spectrum antibiotics	Lecture	BSB 302.5	Quiz & End Sem Exam
46	Antifungal antibiotics;	Lecture	BSB 302.5	Quiz & End Sem Exam

47	Antibiotics mode of action.	Lecture	BSB 302.5	Quiz & End Sem Exam
48	Antibiotics mode of action.	Lecture	BSB 302.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB 302.1	Understand the microbiological techniques for the isolation and characterization of microbes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.2	Understand the mechanism of different metabolic processes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.3	Know the physiology and survival mechanism of extremophilic bacteria.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.4	Learn structure and function of the cell cytoskeleton, cilia and flagella.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.5	Understand the epidemiology and microbial pathogenesis	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

Amity Institute Biotechnology 2019-2020						
Class: B.Sc. Biotechnology III Semester						
Subject Name: Microbiology		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

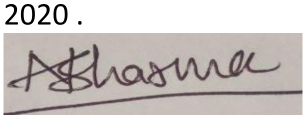
- Understand the microbiological techniques for the isolation and characterization of microbes.
- Understand the mechanism of different metabolic processes.
- Know the physiology and survival mechanism of extremophilic bacteria.
- Know the concept of virus lytic and lysogenic cycle is quite clear to students.
- Understand the epidemiology and microbial pathogenesis.

CO Map	Question No.	Question	Marks
CO1	Q.1	Write the historical contributions of Louis Pasteur and Robert Koch in the field of microbiology.	6
CO2	Q.2	Write down the steps involved in Gram's staining procedure. Differentiate between Gram positive and gram negative bacteria.	6
	Q.3	Explain the importance of extracellular appendages present in bacteria.	6
CO4	Q.4	Describe polyphasic taxonomy and discuss some of its advantages	6
CO4	Q.5	Discuss about the mechanism of photo-phosphorylation in bacterial system.	6
CO3	Q.6	Give an outline the nitrogen fixation, and explain the roles of microorganisms in this cycle	6
	Q.7	What are the archaea? Briefly describe the major ways in which they differ from bacteria and eucaryotes.	10

CO4	Q.8	Write a note on viroids and prions with suitable example of disease.	10
CO3	Q.9	Discuss about normal microbiota present on different body region with suitable features	10
CO3	Q.10	What is penicillinase? Explain the role of penicillin against the synthesis of bacterial cell wall. How does a low concentration of penicillin G select for penicillin-resistant bacteria?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Microbiology***/Course code ***BSB 302*** is level **3** for the academic year 2019-2020 .



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BSB 401	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **Bioinformatics**
Course Code : BSB 401, Crédits : 3, Session :2019-20 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The course involves a basic understanding of computer and bioinformatics tools and skills in the field of biology

B. **Course Outcomes:** After successful completion of the course student will be able to:

BMB 401.1. Understand and explain the structural organization and characteristics of computers and its parts

BMB 401.2. Describe the concept of use of internet in bioinformatics.

BMB 401.3. Explain the concept and organization of biological databases..

BMB 401.4. Understand and explain the structure and functions of the phylogenetic analytic tools.

BMB 401.5. Interrogate major database sources and be able to integrate this information with clinical data.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Computers
General introduction (characteristics, capabilities, generations), software, hardware : organization of hardware (input devices, memory, control unit arithmetic logic unit, output devices); software : (System software; application software, languages -low level, high level), interpreter, compiler, data processing; batch, on-line, real-time (examples from bioindustries; e.g. application of computers in co-ordination of solute concentration, ph, temperature, etc., of a fermenter in operation); internet application.

Module II: Basic Bioinformatics
Introduction to Internet, Search Engines (Google, Yahoo, Entrez etc)

Module III: Biological Databases

Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL), Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc), Cluster databases-An Introduction, Specialised databases (KEGG, etc), Database technologies (Flat-file), Structural databases (PDB)

Module IV: Phylogenetic Analysis

Trees-splits and metrices on trees, tree interpretation, Distance – additive, ultrameric and nonadditive distances,tree building methods, phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains, estimating the rate of change, likelihood and trees; analysis software.

Module V: Genome analysis

Annotation, comparison of different methods; ESTs – databases, clustering, gene discovery and identification, and functional classification. Reconstruction of metabolic pathways; Genome analysis, genome anatomy, genome rearrangements with inversions, signed inversions, gene identification, gene expression, expression analysis, gene identification and functional classification

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

• Computer Science, J.G. Brookshear, Pearson, Addison Wesley

• Introduction to Bioinformation – T.Attawood

References:

• A book on C by Kelley : Programming in C, Addison-Wesley Publishing

• Introduction to C++ for Engineers and Scientists, Prentice-Hall

• Schaum's Outline of Introduction of Computer Science, P. Cushman and R. Mata-Toledo, McGraw Hill

Trade

• Bioinformatics – Managing Scientific Data, Zoe' Lacroix and Terence Critchlow

• Bioinformatics – Sequence, Structure and Databanks, Des Higgins & Willie Taylor

• Structural Bioinformatics, Philip E. Bourne, Helge Weissig 2003

• Statistical Methods in Bioinformatics: An Introduction, G.R. Grant, W.J. Ewens, Springer Verlag

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**
1	General introduction (characteristics, capabilities, generations),	Lecture	**BSB 401.1**.	Mid Term-1, Quiz & End Sem Exam

2	software, hardware : organization of hardware (input devices, memory, control unit	Lecture	**BSB 401.1**.	Mid Term-1, Quiz & End Sem Exam
	arithmetic logic unit, output devices),			
3	organization of hardware	Lecture	**BSB 401.2**.	Mid Term-1, Quiz & End Sem Exam
4	*organization of software*	Lecture	**BSB 401.2**.	Mid Term-1, Quiz & End Sem Exam
5	Interpreter, compiler, data processing; batch, on-line, real-time	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
6	Introduction and application of Internet	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
7	Search Engines (Google, Yahoo, Entrez etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
8	Revision	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
9	Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
10	Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
11	Cluster data bases-An Introduction. Specialized databases (KEGG, etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
12	Database technologies (Flat-file)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
13	Revision	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
14	Introduction of phylogenetics analysis	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
15	Trees-splits and metrices on trees, tree interpretation	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
16	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
17	phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
18	Estimating the rate of change, likelihood and trees; analysis software	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam

19	Annotation, comparison of different methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
20	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
21	Revision	Lecture	**BSB 401.4**	Quiz & End Sem
				Exam
22	ESTs – databases, clustering	Lecture	**BSB 401.4**	Quiz & End Sem Exam
23	Gene discovery	Lecture	**BSB 401.4**	Mid Term-2, Quiz & End Sem Exam
24	Identification and classification	Lecture	**BSB 401.5**	Quiz & End Sem Exam
25	Revision	Lecture	**BSB 401.5**	Quiz & End Sem Exam
26	Reconstruction of metabolic pathways	Lecture	**BSB 401.5**	Quiz & End Sem Exam
27	Genome analysis, genome anatomy	Lecture	**BSB 401.4**	Quiz & End Sem Exam
28	Genome rearrangements with inversions	Lecture	**BSB 401.4**	Quiz & End Sem Exam
29	signed inversions, gene identification	Lecture	**BSB 401.4**	Quiz & End Sem Exam
30	Reconstruction of metabolic pathways	Lecture	**BSB 401.4**	Quiz & End Sem Exam
31	Genome analysis, genome anatomy	Lecture	**BSB 401.4**	Quiz & End Sem Exam
32	Gene expression	Lecture	**BSB 401.4**	Quiz & End Sem Exam
33	Gene expression analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
34	Gene identification methods	Lecture	**BSB 401.1**	Quiz & End Sem Exam
35	Functional classification	Lecture	**BSB 401.1**	Quiz & End Sem Exam
36	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
37	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
38	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam
39	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam
40	Gene expression	Lecture	**BSB 401.1**	Quiz & End Sem Exam
41	Gene expression analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
42	Gene identification methods	Lecture	**BSB 401.1**	Quiz & End Sem Exam
43	Functional classification	Lecture	**BSB 401.1**	Quiz & End Sem Exam

44	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
45	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
45	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB 401.1	Understand and explain the structural organization and characteristics of computers and its parts	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.2	Describe the concept of use of internet in bioinformatics.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.3	Explain the concept and organization of biological databases	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.4	Understand and explain the structure and functions of the phylogenetic analytic tools.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.5	Interrogate major database sources and be able to integrate this information with clinical data.	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2019-20</td></tr>
<tr><td colspan="7">Class: B.Sc. Biotechnology
IV Semester</td></tr>
<tr><td colspan="2">Subject Name:
Bioinformatics</td><td colspan="2">Time: 3 Hrs</td><td colspan="3">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.7</td><td>Q. 8, 9,</td><td>Q. 10</td></tr>
</table>

Student will be able to:

- Understand the basic knowledge of computer hardware and software.
- Understand the advanced techniques of bioinformatics.
- Understand the application of bioinformatics in different area.
- Understand the role of computational biology in drug designing.
- Understand the importance of phylogenetic analysis in species development.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about the importance of input and output device of computer. Also differentiate between input and output devices.	6
CO2	Q.2	Discuss about the anatomy of E. mail and www.	6
	Q.3	Explain about the different databases present in NCBI. Give a comparison between protein databases and nucleotide databases with examples.	6
CO4	Q.4	Discuss about the different terminology used in phylogenetic tree with the suitable diagram.	6
CO4	Q.5	Write about the genome of between prokaryotic and eukaryotic organism.	6
CO3	Q.6	Discuss a general classification of computer generations with suitable examples, merits and demerits	6
	Q.7	What is topology of computer networking? Write advantages and disadvantages of different topology networking.	10
CO4	Q.8	Write a detail note on RCSB, Genbank, and DDBJ with advantages.	10
CO3	Q.9	What is sequence similarity? Explain about the different quantitative methods of sequence similarity	10

CO3	Q.10	. A. Explain the different methods used for gene prediction. Discuss one of the methods in detail with suitable diagram. B. By writing the corresponding match states into columns we get the following alignment: ATGA AGTA	20
		What is its score under the following scoring scheme? Match +2, Mismatch -1 and Gap +1.Explain with global alignment algorithm.	

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Bioinformatics** /Course code ***BSB 401*** is level **2** for the academic year 2019-20.


AMITY INSTITUTE OF BIOTECHNOLOGY
AUMP

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BSB 403	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **IMMUNOLOGY & IMMUNOTECHNOLOGY**
Course Code : BSB 403, Crédits : 04, Session :2019-2020(Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. Course Outcomes: After successful completion of the course student will be able to:

BSB 403.1. Understand and explain the phylogeny of immune system, types of immunity, immune response.
BSB 403.2. Describe the concept of clonal selection theory, humoral and cell mediated immunity.
BSB 403.3. Understand and explain the structure and functions of the organs and cells of the immune system.
BSB 403.4. Understand the mechanism of antigen-antibody interaction.
BSB 403.5. Describe the structure of antibodies, their types and functions in immunity.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.
PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.
PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I :
Descriptors/Topics
Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.

Module II:
Descriptors/Topics
The organs and cells of the immune system.

Module III :
Descriptors/Topics
Histocompatibility: structure of MHC class I, II & III antigens & their mode of antigen presentation, MHC restriction; Antigens & antigenicity;

Module IV :
Descriptors/Topics
Antibody structure in relation to function and antigen-binding; Types of antibodies and their structures: isotypes, allotypes, idiotypes. Antibodies in targeting therapeutic agents. Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application

Module V :
Descriptors/Topics
Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.

Module VI :
Descriptors/Topics
Measurement of antigen – antibody interaction: agglutination, precipitation immunodiffusion, immuno-electrophoresis, ELISA, RIE

Module VII :
Descriptors/Topics
Tissue and organ transplantation

Module VIIII :
Descriptors/Topics
Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.
Autoimmunity and autoimmune diseases: Hashimoto’s thyroiditis; Myasthenia gravis; Rheumatoid Arthritis, Pernicious anemia, Asthma.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Freeman

References:
- Immunology, Roitt, Mosby – Yearbook Inc.
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.1**.	Mid Term-1, Quiz & End Sem Exam
2	Innate and specific immunity. Humoral immunity,	Lecture	**BSB 403.1**.	Mid Term-1, Quiz & End Sem Exam
3	Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.2**.	Mid Term-1, Quiz & End Sem Exam
4	Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.2**.	Mid Term-1, Quiz & End Sem Exam
5	The organs of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
6	The organs of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
7	The cells of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
8	The cells of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
9	Histocompatibility: structure of MHC class I, II & III	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
10	Histocompatibility: structure of MHC class I, II & III	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
11	Antigens	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
12	Mode of antigen presentation,	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam

13	MHC restriction; Antigens & antigenicity	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
14	MHC restriction; Antigens & antigenicity	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
15	Antibody structure in relation to function and antigen-binding	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
16	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
17	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
18	Antibodies in targeting therapeutic agents.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
19	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
20	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
21	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
22	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Quiz & End Sem Exam
23	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.4**	Mid Term-2, Quiz & End Sem Exam
24	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam

25	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam
26	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam
27	Measurement of antigen – antibody interaction: agglutination,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
28	Precipitation	Lecture	**BSB 403.4**	Quiz & End Sem Exam
29	immunodiffusion,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
30	immuno-electrophoresis,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
31	ELISA,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
32	RIE,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
33	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
34	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
35	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
36	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
37	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
38	Autoimmunity	Lecture	**BSB 403.1**	Quiz & End Sem Exam
39	Autoimmunity	Lecture	**BSB 403.1**	Quiz & End Sem Exam
40	Autoimmune diseases: Hashimoto’s thyroiditis;	Lecture	**BSB 403.1**	Quiz & End Sem Exam
41	Myasthenia gravis;	Lecture	**BSB 403.1**	Quiz & End Sem Exam
42	Rheumatoid Arthritis,	Lecture	**BSB 403.1**	Quiz & End Sem Exam
43	Pernicious anemia,	Lecture	**BSB 403.1**	Quiz & End Sem Exam

44	Pernicious anemia,	Lecture	**BSB 403.1**	Quiz & End Sem Exam
45	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
45	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
46	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
47	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
48	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 403.1	Understand and explain the phylogeny of immune system, types of immunity, immune response.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.2	Describe the concept of clonal selection theory, humoral and cell mediated immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.3	Understand and explain the structure and functions of the organs and cells of the immune system	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.4	Understand the mechanism of antigen-antibody interaction	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.5	Describe the structure of antibodies, their types and functions in immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

Amity Institute Biotechnology 2019-20		
Class: B.Sc. Biotechnology IV Semester		
Subject Name: **Immunology & Immunotechnology**	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

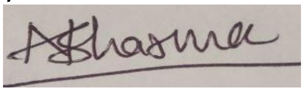
- Understand and explain the phylogeny of immune system, types of immunity, immune response.
- Describe the concept of clonal selection theory, humoral and cell mediated immunity.
- Understand and explain the structure and functions of the organs and cells of the immune system.
- Understand the mechanism of antigen-antibody interaction.
- Describe the structure of antibodies, their types and functions in immunity.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about innate and adaptive immunity. Discuss about the different types of innate immunity with characters.	6
CO2	Q.2	Write a note on different phases of cytotoxic cell mediated targeting killing mechanism.	6
	Q.3	Write a general organization of class I and class II MHC molecules with suitable diagram.	6
CO4	Q.4	Discuss the role of IgG immunoglobulin in immune system.	6
CO4	Q.5	What is antibody diversity? Discuss the role of light chain gene rearrangement in antibody diversity.	6
CO3	Q.6	Draw a well labeled diagram of hybridoma technology with production of monoclonal antibody.	6
	Q.7	Discuss the role of innate and adaptive immunity in tissue grafting. Explain with suitable example.	10
CO4	Q.8	Give a comparison between all type of vaccine with examples and applications.	10
CO3	Q.9	Discuss about features of any two primary lymphoid organs with suitable diagram	10

CO3	Q.10	A. Although all lymphocytes are formed in bone marrow. Explain how these cells get differentiated into B cell and T cell. B Where the CDR regions located on an antibody molecule and what are are their functions? Discuss the ELISA method on the basis of antigen and antibody interaction.	20

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Immunology and immunotechnology**/Course code ***BSB 403*** is level **2** for the academic year 2019-20.




AMITY INSTITUTE OF BIOTECHNOLOGY
AUUP

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Cell Biology
Course Code : BSB101, Credits : 03, Session : 2019-20(Odd Sem.), Class : B.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To acquaint the students to understand the basic concept of cell biology and cell as a unit of living system, its various organelles, their structure, function and metabolic processes. Further, to help students to understand the concept of cellular evolution. Enable students to strengthen the cellular structure of cell organelle and their function.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB101.1. To study cell as a basic unit of life. Cell Theory. Understanding cellular organisation of Plant and animal cells. Their tissue, organ and organisational structure.

BSB101.2. To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, ribosomes, cytoskeletal, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.

BSB101.3. Students will learn about Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome and eu and hetero-chromatin.

BSB101.4. To develop deeper knowledge about Cell cycle, interphase, mitosis and meiosis.

BSB101.5. Knowledge of cell locomotion, cell senescence and apoptosis.

BSB101.6. Understanding of mechanism of cell differentiation and difference between normal and cancer cell.

C. **Programme Outcomes:**

PO1. Knowledge: Biotechnology deals with developing knowledge of biological

sciences and effective implementation of engineering technologies that manipulate

living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO 2: Achieve the scientific acumen and ability to identify research-

based problems and develop suitable approach by designing protocols and

their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Cell as a basic unit of living systems: The cell theory, precellular evolution; broad classification of cell types: archaebacteria, PPLOs, bacteria, eukaryotic microbes, plant and animal cells; cell, tissue, organ and organisms, different levels of organization.

Module II: Ultrastructure of the cell membrane and cell organelles**:** Ultrastructure of cell membrane and function, Structure of cell organelles; golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes; cytoskeletal structures (actin, microtubules.), mitochondria, chloroplast, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus).

Module III: Chromosomes**:** Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome organisations; eu-and heterochromatin.

Module IV: Cell division and cell cycle**:** Cell cycle, interphase, mitosis and meiosis.

Module V: Cell interaction: Cell locomotion (amoeboid, flagellar and ciliar); cell

senescence and death (apoptosis).

Module VI: Cell differentiation: Mechanism of cell differention (e.g., RBC); difference between normal and cancer cells.

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.
- Cell and Molecular Biology –Sheelar & Bianchi, John Wiley
- Essential Cell Biology : An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company
- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J. Danell, W.H. Preeman and Company.
- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell Biology, Singh & Tomar
- The world of the cell Becker, Klinshmith & Harden, Pearson

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Cell Theory	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
2	Precellular Evolution	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
3	Broad Classification of Cell Types	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam

4	Eukaryotic Microbes	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
5	Plant and animal cells, tissues and organs	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
6	Different levels of organization	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
7	Ultrastructure of cell membrane and function	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
8	Structure of cell organelles	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
9	Golgi bodies, Endoplasmic Reticulum (Smooth and Rough), Ribosomes	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
10	Cytokeletal Structures (Actin and Microtubules)	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
11	Mitochondria, Chloroplast	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
12	Lysosomes and Peroxisomes	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
13	Nucleus Structure	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
14	Nuclear Membrane, Nucleoplasm, Nucleolus	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam

15	Structural organisation of chromosomes	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
16	Chromatids	Lecture	BSB101.3	Mid Term, Quiz & End Sem
				Exam
17	Centromere and Telomere	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
18	Streptomycin and Tatracycline	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
19	Chromatin and Nucleosome Organization	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
20	Eu and Hetero-Chromatin	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
21	Cell Cycle	Lecture	BSB101.4	Quiz & End Sem Exam
22	Interphase	Lecture	BSB101.4	Quiz & End Sem Exam
23	Mitosis	Lecture	BSB101.4	Quiz & End Sem Exam
24	Meiosis	Lecture	BSB101.4	Quiz & End Sem Exam
25	Cell Locomotion	Lecture	BSB101.5	Quiz & End Sem Exam
26	Amoeboid, Flagellar and Cilliar	Lecture	BSB101.5	Quiz & End Sem Exam
27	Cell Senescence	Lecture	BSB101.5	Quiz & End Sem Exam

28	Cell Death	Lecture	BSB101.5	Quiz & End Sem Exam
29	Apoptosis	Lecture	BSB101.5	Quiz & End Sem Exam
30	Cell Division	Lecture	BSB101.5	Quiz & End Sem Exam
31	Mechanisms of Cell Differentiation	Lecture	BSB101.6	Quiz & End Sem Exam
32	RBCs	Lecture	BSB101.6	Quiz & End Sem Exam
33	Cancer	Lecture	BSB101.6	Quiz & End Sem Exam
34	Carcinogens	Lecture	BSB101.6	Quiz & End Sem Exam
35	p53 Gene and its role in cancer development	Lecture	BSB101.6	Quiz & End Sem Exam
36	Difference between normal and cancer cell	Lecture	BSB101.6	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3

BSB101.1	To study cell as a basic unit of life. Cell Theory. Understanding cellular organization of Plant and animal cells. Their tissue, organ and organizational structure.	3	2	2	2	2	2	2	2	2	2	3	2	3

BSB101.2	To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, robosomes, cytoskeletal, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.	3	2	2	2	2	2	2	2	3	2	3	3	2
BSB101.3	Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome and eu and hetero-chromatin.	3	2	2	3	2	2	2	2	3	2	3	3	2
BSB101.4	To develop deeper knowledge about Cell cycle, interphase, mitosis and meiosis.	3	3	2	3	2	2	2	1	3	2	3	2	2
BSB101.5	Knowledge of cell locomotion, cell senescence and apoptosis.	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB101.6	Understanding of mechanism of cell differentiation and difference between normal and cancer cell.	3	3	2	2	2	2	2	2	2	2	3	2	2

Sample Question Paper

Amity Institute of Biotechnology MID-SEMESTER 2019-20						
Class: BSB101 (Biotech) I Semester						
Subject Name: BSB 101 Cell Biology		Time: 2 Hrs		Max. Marks: 30		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		
Student will be able to CO1: To understand cell as a basic unit of life. Cell Theory. Understanding cellular organization of Plant and animal cells, their tissue, organ and organizational structure. CO2: To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, ribosome's, cytoskeleton, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.						

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the Cell Theory.	3
CO1	Q.2a	What are different cytoskeletal structures?	3
	Q.2b	How is mode of functioning of Peroxysomes and lysosomes are different from each other ?	3
CO1	Q.3	How Nucleosome organization affects eu and heterochromatin region of DNA ?	6
CO2	Q.4	Explain the different stages of cellular reductional division i.e. Meiosis.	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **CELL BIOLOGY/BSB 101** is **level 3** for the academic year 2019-20.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY ISTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in

multidisciplinary settings. Having a good management skill related to project.

PROGRAMME SPECIFIC OUTCOMES

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	BTB 301	3	3	3	1	-	-	1	2	2	1	3	1	-	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : CELL BIOLOGY
Course Code : BTB 301, Crédits : 03, Session :2019-20 (Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Cell biology plays a central role to connect the different fields of biotechnology which is highly interdisciplinary. It incorporates elements of biology, maths, physics and chemistry with combination of computers and electronics. The object of the present course is to understand the structure and function of the cellular and sub cellular components of cells and tissues with the help of recent techniques.

B. Course Outcomes: After successful completion of the course student will be able to:

BTB 301.1. Understand and explain the cell theory origin of life, and evolution.
BTB 301.2. Understand the cell cycle, regulation and checkpoints' in the cell-cycle.
BTB 301.3. Understand structure of cell membranes, transport of solutes across cell membranes.
BTB 301.4. Learn structure and function of the cell cytoskeleton, cilia and flagella.
BTB 301.5. Understand mechanism of signaling and receptors involved in signaling process.
BTB 301.6. Understand mechanism of cancer and cancer mechanism. .
BTB 301.7. Understand mechanism of apoptosis process.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%

End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

The cell theory, pre cellular evolution, prokaryotic and eukaryotic cells.

Module II

Cell cycle - molecular events, cell division, mitosis and meiosis.

Module III

Cellular organelles - structure and function of cell wall, plasma membrane nucleus, Mitochondria, Chloroplast, Nucleus, lysosomes, peroxisomes, golgi bodies, and transport across membranes.

Module IV

Cell locomotion- cytoskeleton, structure and function of cilia and flagella.

Module V

Cellular signaling –general mechanism of signaling and structures of the various types of receptors.

Module VI

Types of cancer, etiology of cancer, metastasis, cytological role of p53 and p21 genes in cancer development.

Module VII

Apoptosis.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.

References:

- Cell in Development and Inheritance, E.B. Wilson, Macmilian
- Developmental Biology, S.F. Gilbert, Sinauer Associates Inc.
- Essential Cell Biology : An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company
- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J.

Danell, W.H. Preeman and Company.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	The cell theory,	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
2	Pre cellular evolution,	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
3	Prokaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
4	Prokaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
5	Eukaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
6	Eukaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
7	Cell cycle - molecular events	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
8	Cell division	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
9	Mitosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
10	Mitosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
11	Meiosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
12	Meiosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
13	Cellular organelles - structure and function of cell wall,	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
14	Plasma Membrane	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
15	Nucleus	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
16	Mitochondria	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
17	Chloroplast	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
18	Lysosome	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
19	Peroxisomes	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
20	Golgi Bodies	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
21	Transportation	Lecture	BTB 301.3	Mid Term-2, Quiz & End Sem Exam
22	Transportation	Lecture	BTB 301.3	Mid Term-2, Quiz & End Sem Exam

23	Cell locomotion-cytoskeleton	Lecture	BTB 301.4	Mid Term-2, Quiz & End Sem Exam
24	Cell locomotion-cytoskeleton	Lecture	BTB 301.4	Quiz & End Sem Exam
25	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
26	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
27	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
28	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
29	Cellular signaling –general mechanism of signaling	Lecture	BTB 301.5	Quiz & End Sem Exam
30	Structures of the various types of receptors.	Lecture	BTB 301.5	Quiz & End Sem Exam
31	Structures of the various types of receptors..	Lecture	BTB 301.5	Quiz & End Sem Exam
32	Types of cancer, etiology of cancer, metastasis	Lecture	BTB 301.6	Quiz & End Sem Exam
33	Cytological role of p53 and p21 genes in cancer development.	Lecture	BTB 301.6	Quiz & End Sem Exam
34	Apoptosis	Lecture	BTB 301.7	Quiz & End Sem Exam
35	Apoptosis	Lecture	BTB 301.7	Quiz & End Sem Exam
36	Apoptosis	Lecture	BTB 301.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 301.1	Understand and explain the cell theory origin of life, and evolution.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.2	Understand the cell cycle, regulation and checkpoints' in the cell-cycle.	3	3	3	1	-	-	1	2	2	1	3	1	-	1

BTB 301.3	Understand structure of cell membranes, transport of solutes across cell membranes	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.4	Learn structure and function of the cell cytoskeleton, cilia and flagella.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.5	Understand mechanism of signaling and receptors involved in signaling process.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.6	Understand mechanism of cancer and cancer mechanism	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.7	Understand mechanism of apoptosis process.														

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Cell Biology*** Course code ***BTB 301*** is level **3** for the academic year 2019-20.

A Sharma

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Microbiology
Course Code : BTB303, Credits : 04, Session : 2019-20(Odd Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Manish Kumar

A. Introduction: This fundamental paper discusses the importance of microorganisms. The course throws light on types of microorganisms in and around humans. At the end of the course, the student has understanding on the metabolism and mechanism of microbial life. Students will gain knowledge about the different cell organelles of microorganisms and their detailed functions. Students will also study the growth and control of microbes as well as different bacteriological techniques involved in microbiology. Students will learn about the biomolecules by studying their structures and types.

B. Course Outcomes: At the end of the course, students will be able to:

BTB303.1. Students will learn about the historical perspective of microbial world, spontaneous generation, role of microbes, pure culture, microbial nutrition, culture media, and sterilization.

BTB303.2. Students will gain knowledge of prokaryotic cell, structural and functional anatomy of cell and organelles. Growth and growth curve, culture types – batch and continuous, culture collection and maintenance of cultures.

BTB303.3. Students will gain knowledge about the Systematics and taxonomy of bacteria, ribotyping, nomenclature and Bergey's manual.

BTB303.4. Students will know about the Metabolic Diversity among microorganisms, microbial photosynthesis, photosynthetic pigments, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions.

BTB303.5. Students will develop deeper understanding of Archae, thermophiles,

psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles. Viruses –

Bacterial and Animal, their structure, reproduction. Viroids and Prions. Algae and Fungi – their reproduction and classification.

BTB303.6. Students will learn about the Host-parasite relationship, micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections, types of toxins (Exo, endo, entro) and their mechanism of action. Microbial pathogenesis and sexually transmitted disease.

BTB303.7. Students will have knowledge of Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics.

C. Programme Outcomes:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and

responsibilities and norms of the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioral attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization.

Module II: Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, Fed batch culture, continuous culture, culture collection and maintenance of cultures.

Module III: Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV: Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-ironnitrite- oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophilesViruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI: Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII: Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott
The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.
The Microbial World, Roger Y. Stanier, Prentice Hall
Microbiology, Tortora, Funke and Chase, Benzamin& Cummings
Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
Industrial Microbiology, Casida, New Age International
Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC.Brown Publisher.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Discovery of the microbial world	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
2	Controversy over spontaneous generation	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
3	Role of microorganisms in transformation of organic matter and in the causation of diseases	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
4	Development of pure culture methods	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
5	Methods in Microbiology	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
6	Principles of microbial nutrition, Culture media	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
7	Theory and practice of sterilization	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam

8	Prokaryotic structure and function	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
9	Functional anatomy of bacteria: cell envelope, cell	Lecture	BTB303.2	Mid Term,
	wall, cytoplasmic membrane, capsule			Quiz & End Sem Exam
10	Functional anatomy of bacteria: surface appendages, cytoplasm and cytoplasmic Inclusions	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
11	Growth - The definition of growth, mathematical expression of growth, growth curve	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
12	Measurement of growth, Synchronous growth	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
13	Fed batch culture, continuous culture	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
14	Culture collection and maintenance of cultures	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
15	Systematics and taxonomy	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
16	New approaches to bacterial taxonomy	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
17	Classification including ribotyping	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
18	Ribosomal RNA sequencing	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
19	Characteristics of primary domains	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
20	Taxonomy, nomenclature	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
21	Bergey's manual	Lecture	BTB303.3	Quiz & End Sem Exam
22	Metabolic Diversity among microorganisms	Lecture	BTB303.4	Quiz & End Sem Exam
23	Photosynthesis in microorganisms	Lecture	BTB303.4	Quiz & End Sem Exam

24	Role of bacteriochlorophylls, carotenoids and phycobilins	Lecture	BTB303.4	Quiz & End Sem Exam
25	Chemolithotrophy, hydrogen-iron-nitrite-oxidizing bacteria	Lecture	BTB303.4	Quiz & End Sem Exam
26	Nitrate and Sulphate reduction, methanogenesis and acetogenesis	Lecture	BTB303.4	Quiz & End Sem Exam
27	Fermentations, nitrogen fixation	Lecture	BTB303.4	Quiz & End Sem Exam
28	Plant microbe interactions (mycorrhizae)	Lecture	BTB303.4	Quiz & End Sem Exam
29	Archae as earliest life forms	Lecture	BTB303.5	Quiz & End Sem Exam
30	Thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BTB303.5	Quiz & End Sem Exam
31	Viruses: Bacterial, animal	Lecture	BTB303.5	Quiz & End Sem Exam
32	Structure of viruses	Lecture	BTB303.5	Quiz & End Sem Exam
33	Reproduction and life cycle of RNA and DNA viruses	Lecture	BTB303.5	Quiz & End Sem Exam
34	Viroids and prions.	Lecture	BTB303.5	Quiz & End Sem Exam
35	Algae and Fungi: Classification and Reproduction	Lecture	BTB303.5	Quiz & End Sem Exam
36	Host-parasite relationship	Lecture	BTB303.6	Quiz & End Sem Exam
37	Normal micro flora of skin, oral cavity, gastrointestinal tract	Lecture	BTB303.6	Quiz & End Sem Exam
38	Respiratory infections; entry of pathogens into the host	Lecture	BTB303.6	Quiz & End Sem Exam
39	Types of toxins (Exo, endo, entro) and their mode of actions	Lecture	BTB303.6	Quiz & End Sem Exam
40	Microbial pathogenesis - Disease reservoirs	Lecture	BTB303.6	Quiz & End Sem Exam
41	Epidemiological terminologies; Infectious disease transmission	Lecture	BTB303.6	Quiz & End Sem Exam
42	Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi	Lecture	BTB303.6	Quiz & End Sem Exam
43	Chemotherapy/antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam

44	Antimicrobial agents, sulfa drugs	Lecture	BTB303.7	Quiz & End Sem Exam
45	Antibiotics - Penicillin and Cephalosporins	Lecture	BTB303.7	Quiz & End Sem Exam
46	Broad spectrum antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam
47	Antifungal antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam
48	Mode of action of antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BTB303.1	historical perspective of microbial world, spontaneous generation, role of microbes, pure culture, microbial nutrition, culture media, and sterilization	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

BTB303.2	prokaryotic cell, structural and functional anatomy of cell and organelles. Growth and growth curve, culture types – batch and continuous, culture collection and maintenance of cultures	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.3	Systematics and taxonomy of bacteria, ribotyping, nomenclature and Bergey's manual	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.4	Metabolic Diversity among microorganisms, microbial photosynthesis, photosynthetic pigments, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

BTB303.5	Archaea, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles. Viruses – Bacterial and Animal, their structure, reproduction. Viroids and Prions. Algae and Fungi – their reproduction and classification	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.6	Host-parasite relationship, micro flora of skin, oral cavity, gastrointestinal tract,	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
	Respiratory infections, types of toxins (Exo, endo, entro) and their mechanism of action. Microbial pathogenesis and Sexually transmitted disease															

BTB303.7	Chemotherapy/ antibiotics - Antimicrobial agents, sulfa drugs, penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2019-20		
Class: B.Tech. Biotechnology III Semester		
Subject Name: BTB 303 MICROBIOLOGY	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

Student will be able to
CO1: Enumerate bacterial count their isolation and development of pure culture.
CO2: Apply generation time calculation for different microbial entities.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief about microbial evolution.	3
CO1	Q.2a	What do you understand by isolation of culture?	3
	Q.2b	How are prokaryotic microbes different from eukaryotic microbes?	3
CO1	Q.3	Give an account of DNA sequencing.	6
CO2	Q.4	Explain the significance of bacterial toxins.	3

CO2	Q.5a	What are the factors favoring enteric bacteria?	3
	Q.5b	Discuss the different factors affecting the growth of bacteria.	3
CO2	Q 6	Differentiate between monoauxic and diauxic bacterial growth curve.	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **MICROBIOLOGY/BTB 303** is **level 3** for the academic year 2019-20.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	BTB 320	3	3	3	1	-	-	1	2	2	1	3	1	-	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : CELL BIOLOGY LAB
Course Code : BTB 320, Crédits : 01, Session :2019-20(Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** Cell biology plays a central role to connect the different fields of biotechnology which is highly interdisciplinary. It incorporates elements of biology, maths, physics and chemistry with combination of computers and electronics. The object of the present course is to understand the structure and function of the cellular and sub cellular components of cells and tissues with the help of recent techniques.

B. **Course Outcomes:** After successful completion of the course student will be able to:

BTB 320.1. Understand and explain the different types of microscopy
BTB 320.2 Understand the about the plant cell and cell organelles.
BTB 320.3. Understand the about the cell cycle, regulation and checkpoints' in the cell-cycle.
BTB 320.4. Understand mechanism of cancer and cancer mechanism.
BTB 320.5. Understand mechanism of apoptosis process.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and

give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Module I
Microscopy: Light microscopy, Bright field, Phase contrast & Gram's staining.
Module II
Study of chromoplasts, chloroplast in plant cell.
Module III: Cell Division
Mitosis and Meiosis
Module IV
Study of permanent slides of types of cancer
Module V
Study of apoptosis

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.

References:
- Cell in Development and Inheritance, E.B. Wilson, Macmilian
- Developmental Biology, S.F. Gilbert, Sinauer Associates Inc.
- Essential Cell Biology : An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company
- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J. Danell, W.H. Preeman and Company.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Bright Field Microscopy	Practical	BTB 320.1	Mid Term-1, Quiz & End Sem Exam
2	Phase Contrast Microscopy	Practical	BTB 320.1	Mid Term-1, Quiz & End Sem Exam
3	Gram's Staining	Practical	BTB 320.1	Mid Term-1, Quiz & End Sem Exam
4	Study of chromoplasts, in plant cell.	Practical	BTB 320.2	Mid Term-1, Quiz & End Sem Exam
5	Study of chloroplast in plant cell.	Practical	BTB 320.2	Mid Term-1, Quiz & End Sem Exam
6	Mitosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
7	Mitosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
8	Mitosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
9	Meiosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
10	Meiosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
11	Study of permanent slides of types of cancer	Practical	BTB 320.4	Mid Term-1, Quiz & End Sem Exam
12	Study of Apoptosis	Practical	BTB 320.5	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BTB 320.1.	Understand and explain the different types of microscopy	3	3	3	1	-	-	1	2	2	1	3	1	-
BTB 320.2.	Understand the about the plant cell and cell organelles	3	3	3	1	-	-	1	2	2	1	3	1	-

BTB 320.3.	Understand the about the cell cycle,	3	3	3	1	-	-	1	2	2	1	3	1	-
	regulation and checkpoints’ in the cell-cycle													
BTB 320.4.	Understand mechanism of cancer and cancer mechanism	3	3	3	1	-	-	1	2	2	1	3	1	-
BTB 320.5.	Understand mechanism of apoptosis process	3	3	3	1	-	-	1	2	2	1	3	1	-

Sample Question Paper

Amity School of Engineering and Technology Department of Computer Science and Engineering I MID-SEMESTER (SEM –VII) 2019-20
Class: B.Tech.(CSE) VII Semester

Subject Name: CSE 703 CLOUD COMPUTING	Time: 2 Hrs	Max. Marks: 30

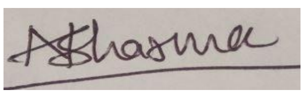
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

Student will be able to
CO1: List the broad perceptive of cloud architecture and model.
CO2: Apply different cloud programming models as per need.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the cloud computing concept.	3
CO1	Q.2a	What are the essential characteristics of cloud computing?	3
	Q.2b	How is cloud computing requirements and cloud servicerequirement services related to each other?	3
CO1	Q.3	Sketch NIST Cloud Computing Reference Architecture and depictits elements	6
CO2	Q.4	Explain the significance of Cloud Reference Model	3
CO2	Q.5a	Elaborate different cloud types with example.	3
	Q.5b	Write characteristics of private cloud.	3
CO2	Q 6	How virtualization is applied in cloud computing scenario?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Cell Biology lab*** Course code ***BTB 320*** is level **3** for the academic year 2019-20.



AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Microbiology Lab
Course Code : BTB322, Credits : 01, Session : 2019-20(Odd Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To understand the basics of microbiology and different culture techniques. Preparation of culture media – liquid, slant and solid. Growth curve and different types of staining – grams, endospore and capsule staining. Isolation and identification of rhizobium from root nodules

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB322.1. Students will learn about preparation of solid and liquid media.

BTB322.2. Students will do isolation and maintenance of organisms by plating, streaking and serial dilution.

BTB322.3. Students will know about the preparation of slant cultures.

BTB322.4. Students will learn about growth curve measurement of bacterial population by turbidometry.

BTB322.5. Students will know about measurement of bacterial population by dilution method.

BTB322.6. Students will gain knowledge of effect of temperature, pH, carbon and nitrogen sources on growth of bacteria.

BTB322.7. Students will do microscopic examination of bacteria by gram staining.

BTB322.8. Students will learn about Endospore staining.

BTB322.9. Students will be acquainted with Capsule Staining.

BTB322.10. Students will experimentally perform isolation and identification of Rhizobium from root nodules.

C. **Programme Outcomes:**

PO1. Engineering knowledge: Apply the knowledge of mathematics, science,

engineering fundamentals, and an engineering specialization to the solution of

complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability

to engage in independent and life-long learning in the broadest context of

technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Internal Examination	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%

End Semester Examination	External Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Preparation of solid and liquid media.

Module II: Isolation and maintenance of organisms by plating, streaking and serial dilution.

Module III: Preparation of slant cultures.

Module IV: Growth curve measurement of bacterial population by turbidometry.

Module V: Measurement of bacterial population by dilution method.

Module VI: Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria.

Module VII: Microscopic examination of bacteria by gram staining.

Module VIII: Endospore staining.

Module IX: Capsule Staining.

Module X: Isolation and identification of Rhizobium from root nodules.

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian

Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott

The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

The Microbial World, Roger Y. Stanier, Prentice Hall

Microbiology, Tortora, Funke and Chase, Benzamin& Cummings

Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.

Industrial Microbiology, Casida, New Age International
Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of

Microbiology, R.M. Atlas, WMC.Brown Publisher.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Preparation of solid and liquid media	Practical	BTB322.1	Internal & External Exam
2	Learning about autoclave, laminar air flow	Practical	BTB322.1	Internal & External Exam
3	Isolation and maintenance of organisms by plating and streaking	Practical	BTB322.1	Internal & External Exam
4	Isolation and maintenance of organisms by serial dilution	Practical	BTB322.1	Internal & External Exam
5	Measurement of bacterial population by dilution	Practical	BTB322.1	Internal & External Exam
6	Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria	Practical	BTB322.1	Internal & External Exam
7	Microscopic examination of bacteria by gram staining	Practical	BTB322.1	Internal & External Exam
8	Endospore staining	Practical	BTB322.2	Internal & External Exam
9	Capsule staining	Practical	BTB322.2	Internal & External Exam
10	Collection of Root Nodules	Practical	BTB322.2	Internal & External Exam
11	Isolation of Rhizobium from root nodules	Practical	BTB322.2	Internal & External Exam
12	Identification of Rhizobium from root nodules	Practical	BTB322.2	Internal & External Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BTB 322.1	Preparation of solid and liquid media	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.2	Isolation and maintenance of organisms by plating, streaking and serial dilution	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.3	Preparation of slant cultures	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.4	Growth curve measurement of bacterial population by turbidometry	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.5	Measurement of bacterial population by dilution method	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.6	Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.7	Microscopic examination of bacteria by gram staining	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.8	Endospore staining	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.9	Capsule Staining	3	2	2	2	3	2	2	2	2	2	3	2	2
BTB 322.10	Isolation and identification of Rhizobium from root nodules	3	2	2	2	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

Amity Institute of Biotechnology MID-SEMESTER 2019-20		
Class: B.Tech (Biotech) III Semester		
Subject Name: BTB 322 Microbiology Lab	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to
CO1: List the broad perceptive of cloud architecture and model.
CO2: Apply different cloud programming models as per need.

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss the development of pure cultures.	3
CO1	Q.2a	Differentiate between bacteria and fungi.	3
	Q.2b	Write a short note on bacterial DNA marker.	3
CO1	Q.3	Differentiate between genotype and ribotype.	6
CO2	Q.4	Explain about the capsule staining and	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **MICROBIOLOGY LAB/BTB 322** is **level 2** for the academic year 2019-20.

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : GENETICS
Course Code : BTB 402, Credits : 04, Session : 2019-20.(Even Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Pushpika Udawat

A. **Introduction :** To acquaint the students to understand the basic concept of genetics incorporating the concepts of classical, molecular genetics. Students will learn about Mendelian Laws, Extension of Mendels Law, Multiple allele and isoallele, etc. Mutation, Mutagen, Chromosomal Aberrations, Human Genetic Disorders. Knowledge of methods of sex determination, Chromosomal non-disjunction, Chromosomal theory of inheritance, Sex linked, Sex limited and Sex limited Inheritance, Extra-chromosomal inheritance. Understanding of Population Genetics, Hardy-Weinberg Equilibrium, Gene and Genotype Frequencies.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB402.1. Students will develop an understanding of History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance.

BTB402.2. Understanding the pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation.

BTB402.3. To study the classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage.

BTB402.4. Students will develop a basic understanding of Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders.

BTB402.5. Knowledge of Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance.

BTB402.6. Students will learn about extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA.

BTB402.7. Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies.

C. **Programme Outcomes:**

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to

provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyze problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective

multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioral attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Brief history, scope and significance of Genetics. Mendelian law of inheritance. Lethality and interaction of gene. Multiple allele and isoallele. Penetrance and Expressivity. Linkage and crossing over. Mapping of genes. interference and coincidence.

Module II: Basic microbial genetics, Conjugation, transformation, transduction and their use in genetic mapping.

Module III: Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over and complementation test, Benzers work on rII locus in T4 Bacteriophage.

Module IV: Mutation; spontaneous and induced, Mutagen;chemical and physical. Chromosomal aberrations; structural and numerical. Economic importance of mutation. Genetic disorders in human; Kleinefelter, Turner, Cri-du-Chat and Down syndrome.

Module V: Sex determination in plant and animal. Non disjunction as a proof of chromosomal theory of inheritance. Sex linked, sex influenced and sex limited inheritance.

Module VI: Extra chromosomal inheritance; cytoplasmic inheritance, Mitochondrial and Chloroplast genetic system.

Module VII: Population genetics; Hardy-Weinberg equilibrium law, Gene and genotype frequencies.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Principles of Genetics, E. J. Gardner, John Wiley & Sons Inc.

Genetics, P.K. Gupta, Rastogi Publication.

Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, Pearson Education.

Genetics, M.W. Strickberger, Prentice Hall College Division.

Genetics, P.J. Russell, Benjamin/Cummings.

Genetics, R. Goodenough, International Thomson Publishing.

Introduction to Genetic Analysis, A.J. F. Griffiths, W.H. Freeman and Company.

Principles of Genetics, D.P. Snustad & M.J. Simmons, John Wiley and Sons Inc.

Molecular Biology of the Gene (Fifth Edition), J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison Wiesley Publishing.

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**
1	Brief history of Genetics	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
2	Scope and significance of Genetics	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
3	Mendelian law of inheritance	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
4	Lethality and interaction of gene.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam

5	Multiple allele and isoallele.	Lecture	BTB402.1	Mid Term, Quiz & End
				Sem Exam
6	Penetrance and Expressivity.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
7	Linkage and crossing over.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
8	Mapping of genes.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
9	Interference and coincidence.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
10	Basic microbial genetics	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
11	Conjugation	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
12	Transformation	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
13	Transduction	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
14	Genetic Mapping	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
15	Uses of Conjugation, Transformation and Transduction in Genetic Mapping	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
16	Significance of Genetic Mapping	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
17	Classical and modern concept of gene	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam
18	Pseudoallelism,	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam
19	Position effect	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam

20	Intragenic crossing over	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam
21	Mapping of genes	Lecture	BTB402.3	Quiz & End Sem Exam
22	Interference	Lecture	BTB402.3	Quiz & End Sem Exam
23	Coincidence	Lecture	BTB402.3	Quiz & End Sem Exam
24	Mutation; spontaneous and induced	Lecture	BTB402.4	Quiz & End Sem Exam
25	Mutagen; chemical and physical	Lecture	BTB402.4	Quiz & End Sem Exam
26	Chromosomal aberrations Structural	Lecture	BTB402.4	Quiz & End Sem Exam
27	Chromosomal aberrations numerical Aberration	Lecture	BTB402.4	Quiz & End Sem Exam
28	Economic importance of mutation	Lecture	BTB402.4	Quiz & End Sem Exam
29	Genetic disorders in human	Lecture	BTB402.4	Quiz & End Sem Exam
30	Kleinfelters, Terners, Cri-Du-Chat and Down Syndrome	Lecture	BTB402.4	Quiz & End Sem Exam
31	Sex determination in plants	Lecture	BTB402.5	Quiz & End Sem Exam
32	Sex determination in animals	Lecture	BTB402.5	Quiz & End Sem Exam
33	Non disjunction of chromosomes	Lecture	BTB402.5	Quiz & End Sem Exam
34	Non disjunction as a proof of chromosomal theory of inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
35	Sex linked inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
36	Sex influenced inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
37	Sex limited inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
38	Extra chromosomal inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
39	Cytoplasmic inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
40	Mitochondrial DNA	Lecture	BTB402.6	Quiz & End Sem Exam

41	Chloroplast genetic system	Lecture	BTB402.6	Quiz & End Sem Exam
42	Significance of Extra chromosomal inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
43	Significance of Cytoplasmic inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
44	Example of Cytoplasmic Inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
45	Population genetics	Lecture	BTB402.7	Quiz & End Sem Exam
46	Hardy-Weinberg equilibrium law	Lecture	BTB402.7	Quiz & End Sem Exam
47	Gene frequencies	Lecture	BTB402.7	Quiz & End Sem Exam
48	Genotype frequencies	Lecture	BTB402.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BTB402.1	History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance	3	2	2	2	2	2	2	2	2	2	3	2	2

BTB402.2	Pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.3	To study the classical and modern concept of gene,	3	2	2	2	2	2	2	2	2	2	3	2	2
	pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage													
BTB402.4	Mutation- Types, Mutagen- Types, and Chromosomal aberrations- structural & numerical and human genetic disorders	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.5	Knowledge of Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.6	Extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA	3	2	2	2	2	2	2	2	2	2	3	2	2

BTB402.7	Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies	3	2	2	2	2	2	2	2	2	2	3	2	2

Sample Question Paper

Amity Institute of Biotechnology MID-SEMESTER 2019-20.		
Class: B. Tech (Biotech) IV Semester		
Subject Name: BTB 402 GENETICS	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to

CO1: History and scope of Genetics

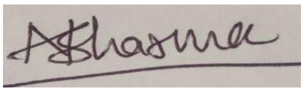
CO2: Understanding the pre Mendelian genetic concepts

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the scope and significance of genetics.	3
CO1	Q.2a	What are different steps involved in genetic mapping ?	3
	Q.2b	How is mechanism of conjugation is different from transformation ?	3
CO1	Q.3	How classical concept of gene is different from modern concept of gene ?	6
CO2	Q.4	Explain the significance of extra-chromosomal inheritance and cytoplasmic inheritance.	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1

Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Genetics*** Course code ***BTB 402*** is level **3** for the academic year 2019-20.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
V	BTB 503	3	3	3	1	-	-	1	2	2	3	2	1	3	1	-	1

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : STRUCTURAL BIOLOGY
Course Code : BTB 503, Crédits : 03, Session :2019-20(Odd Sem.), Class : B.Tech 3rd Year
Faculty Name : DR. NEHA SHARMA and DR. PUSHPIKA UDAWAT

A. **Introduction:** The course aims to provide an understanding of the principles and applications of proteins, enzymes and nucleic acids for their role in biochemical pathway as well as interactions among themselves.

B. **Course Outcomes:** After successful completion of the course student will be able to:

BTB503.1. Students will learn about amino acids structure and function, Primary, secondary, tertiary and quaternary structure of protein; Motifs and domains of protein structures; Conformational analysis, Protein folding.

BTB503.2. Students will develop an understanding of Architecture and building blocks of proteins. : Evaluate different mechanism of substrate recognition, its structural basis, reaction mechanism of enzymes and G-protein coupled receptors.

BTB503.3. Students will understand the protein denaturation, refolding and stabilization.

BTB503.4. Students will understand structural parameters of DNA molecule understand about the protein-DNA interaction and its mechanism.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

1. PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering

activities with an understanding of the limitations.

6. PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
7. PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
9. PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%

Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves	A	5%
	including medical leaves.		
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Chemistry of amino acids and peptides: Side chain structure and function in protein folding and functionality: Secondary structure of proteins - helices, sheets, loops and turns; Structural and functional proteins. Tertiary structure of proteins, homo and hetero-dimers, trimers and tetramers; forces governing protein-protein interactions; open tertiary structure; Classification of proteins; Structure and function of an antibody; structure of haemoglobin, muscle proteins; Sequence and structural motifs in proteins.
Module II: Protein-ligand interactions: Lock and key versus handshake mechanism of substrate recognition; structural basis of recognition; reaction mechanisms of enzymes, G-Protein coupled receptors.
Module III: Protein solubility, protein stability and stabilization: Salting in and salting out, Parameters affecting; enthalpic and entropic stabilization, mutations increasing stability, .helix capping; Native, partially denatured and denatured proteins; Protein denaturation, Physical and chemical denaturants; Refolding.
Module IV: DNA structure: Covalent structure of DNA, base pairing, hydrogen bonding, DNA melting and annealing, difference between AT and GC pairing, DNA models, The Watson Crick model; Crystal structure of B-DNA, major and minor groves, dyad symmetry, base pair stacking, propellor twist, A and Z- DNA, triple stranded DNA, telomeric sequences and structure, G-quartcts, palindromic and tandem sequences, Base pair flipping and DNA bulges, DNA methylation; Protein-DNA interactions; drug-DNA interactions; Databases of sequences and structure for protein and DNA, public domain softwares for visualizing and modelling biomolecules -Rasmol, Deepview, Whatif.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Biochemistry, R.H. Abeles, P.A. Frey and W.A. Jencks, Jones and Bartlett.
- Essentials of Molecular Biology, D. Freifelder, Jones and Bartlett Publications.
- Genes VII, B. Lewin, Oxford University Press.

References:

- Introduction to Protein Structure, C. Branden and J Tooze, Garland Publishing Company.
- Protein Structure, M. Perutz, Oxford University Press.
- Proteins (Structures and Molecular Properties), T.E. Creighton, W.H. Freeman and Company.
- Database Annotation in Molecular Biology, Arthur M. Lesk.
- From Genes to Clones, E.L. Winnacker.

- Genes & Genomes, M.S. Paul Berg.
- Structure and Machanism in Protein Science, Alan Fersht.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Side chain structure and function in protein folding and functionality	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
2	Secondary structure of proteins - helices, sheets, loops and turns	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
3	Structural and functional proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
4	Tertiary structure of proteins, homo and hetero-dimers, trimers and tetramers	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
5	Forces governing protein-protein interactions	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
6	Open tertiary structure	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
7	Classification of proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
8	Structure and function of an antibody	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
9	Structure of *haemoglobin*	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
10	Muscle proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
11	Protein Sequences	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
12	Structural motifs in proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
13	Lock and key mechanism of substrate recognition	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam

14	Handshake mechanism of substrate recognition	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
15	Structural basis of substrate recognition	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
16	Reaction mechanisms of enzymes	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
17	G-Protein coupled receptors	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
18	Mechanism of G-Protein coupled receptors	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
19	Salting in and salting out,	Lecture	BTB503.3	Quiz & End Sem Exam
20	Parameters affecting; enthalpic and entropic	Lecture	BTB503.3	Quiz & End Sem Exam
21	stabilization, mutations increasing stability,	Lecture	BTB503.3	Quiz & End Sem Exam
22	Helix capping; Native, partially denatured and denatured proteins	Lecture	BTB503.3	Quiz & End Sem Exam
23	Protein denaturation,	Lecture	BTB503.3	Quiz & End Sem Exam
24	Physical and chemical denaturants; Refolding	Lecture	BTB503.3	Quiz & End Sem Exam
25	Covalent structure of DNA, base pairing,	Lecture	BTB503.4	Quiz & End Sem Exam
26	Hydrogen bonding, DNA melting and annealing,	Lecture	BTB503.4	Quiz & End Sem Exam
27	Difference between AT and GC pairing,	Lecture	BTB503.4	Quiz & End Sem Exam
28	DNA models, The Watson Crick model; Crystal structure of B-DNA, major and minor groves, dyad symmetry,	Lecture	BTB503.4	Quiz & End Sem Exam
29	base pair stacking, propellor twist, A and Z- DNA, triple stranded DNA,	Lecture	BTB503.4	Quiz & End Sem Exam

30	telomeric sequences and structure, G-quartcts	Lecture	BTB503.4	Quiz & End Sem Exam
31	Palindromic and tandem sequences,	Lecture	BTB503.4	Quiz & End Sem Exam
32	Base pair flipping and DNA bulges, DNA methylation;	Lecture	BTB503.4	Quiz & End Sem Exam
33	Protein-DNA interactions; drug-DNA interactions;	Lecture	BTB503.4	Quiz & End Sem Exam
34	Databases of sequences and structure for protein and DNA,	Lecture	BTB503.4	Quiz & End Sem Exam
35	Public domain softwares for visualizing and modeling biomolecules -Rasmol, Deepview, Whatif.	Lecture	BTB503.4	Quiz & End Sem Exam
36	Public domain softwares for visualizing and modeling biomolecules -Rasmol, Deepview, Whatif.	Lecture	BTB503.4	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 503.1	Students will learn about amino acids structure and function, Primary, secondary, tertiary and quaternary structure of protein; Motifs and domains of protein structures; Conformational analysis, Protein folding.	3	3	3	1	-	-	1	2	2	1	3	1	-	1

BTB 503.2	Students will develop an understanding of Architecture and building blocks of proteins. : Evaluate different mechanism of substrate recognition, its structural basis, reaction mechanism of enzymes and G-protein coupled receptors	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 503.3	Students will understand the protein denaturation, refolding and stabilization	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 503.4	Students will understand structural parameters of DNA molecule understand about the protein-DNA interaction and its mechanism.	3	3	3	1	-	-	1	2	2	1	3	1	-	1

<u>Sample Question Paper</u>

<table>
<tr><td colspan="7" align="center">Amity Institute Biotechnology
2019-20</td></tr>
<tr><td colspan="7" align="center">Class: B.Tech. Biotechnology
VI Semester</td></tr>
<tr><td colspan="2">Subject Name:
Immunology & Immunotechnology</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.7</td><td>Q. 8, 9,</td><td>Q. 10</td></tr>
</table>

Student will be able to:

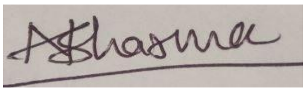
- Students will learn about amino acids structure and function, Primary, secondary, tertiary and quaternary structure of protein; Motifs and domains of protein structures; Conformational analysis, Protein folding.
- Students will develop an understanding of Architecture and building blocks of proteins. : Evaluate different mechanism of substrate recognition, its structural basis, reaction mechanism of enzymes and G-protein coupled receptors.
- Students will understand the protein denaturation, refolding and stabilization.
- Students will understand structural parameters of DNA molecule understand about the protein-DNA interaction and its mechanism.

CO Map	Question No.	Question	Marks
CO1	Q.1	What are the salient features of structure of Watson crick model? Explain with diagram.	6
	Q.2	Vhat is CpG dinucleotides? Explain the role of CpG dinucleotide in methylation.	6
CO2			
	Q.3	Explain Anfinsen experiment and discuss the role of different factors in protein stability.	6
CO4	Q.4	Which DNA double helix do you think would be harder to separate into two strands: DNA composed predominantly of AT base pairs, or of GC base pairs? Why?	6
CO4	Q.5	Discuss about the software which is used in visualization of structure of DNA.	6
CO3	Q.6	Discuss the importance of Chaperonins during protein folding with suitable diagram.	6
	Q.7	What is salting-in and salting-out? Explain the importance of precipitation protein in salting-in process.	10
CO4	Q.8	Explain the different types of interactions are involved in protein-DNA recognition	10
CO3	Q.9	What are the four pairs of DNA bases that form in the double helix? Draw the structure of each base.	10
CO3	Q.10	What is protein danaturation? Explain the role of denaturants such as urea and guanidinium hydrochloride in protein denaturation.	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2

Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Structural Biology**/Course code ***BTB 503*** is level **2** for the academic year 2019-20.

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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
V	BTB 522	3	3	3	1	-	-	1	2	2	1	3	1	-	1

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : STRUCTURAL BIOLOGY LAB
Course Code : BTB 522, Crédits : 01, Session :2019-20(Odd Sem.), Class : B.Tech 2ndYear
Faculty Name : DR. NEHA SHARMA

A. Introduction: The objective is to describe physical properties of protein, analysis of protein structure, protein finger printing, fraction folding and degradation.

B. Course Outcomes: After successful completion of the course student will be able to:

BTB 522.1. Experimental Understanding of physical properties of protein, analysis of protein structure, finger printing, protein fractionation.

BTB 522.2. Understand the mechanism of protein folding and degradation through experiments.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective

presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Course Contents:

1. Study of physical properties of proteins. **(02 Hours)**
2. Analysis of protein structure.
3. Study of protein finger printing
4. Study of protein fractionation
5. Study of protein folding
6. Study of protein degradation.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Practical based on online available softwares.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Study of physical properties of proteins.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
2	Study of physical properties of proteins.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
3	Analysis of protein structure.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
4	Analysis of protein structure.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
5	Study of protein finger printing	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
6	Study of protein finger printing	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
7	Study of protein fractionation	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
8	Study of protein fractionation	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam

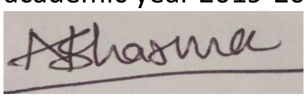
9	Study of protein folding	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam
10	Study of protein folding	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam
11	Study of protein degadation.	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam
12	Study of protein degadation.	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 522.1.	Experimental Understanding of physical properties of protein, analysis of protein structure, finger printing, protein fractionation	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 522.2.	Understand the mechanism of protein folding and degradation through experiments	3	3	3	1	-	-	1	2	2	1	3	1	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Structural Biology Lab*** Course code ***BTB 522*** is level **3** for the academic year 2019-20.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
VI	BTB 603	3	3	3	1	-	-	1	2	2	1	3	3	3	1	-	1

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : IMMUNOLOGY AND IMMUNOTECHNOLOGY
Course Code : BTB 603, Crédits : 04, Session :2019-20 (Even Sem.), Class : B.Tech. 3rd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. **Course Outcomes :** After successful completion of the course student will be able to:

- **BTB 603.1**. Understand the phylogeny of immune system, types of immunity and immune response.
- **BTB 603.2**. Understand the organization and structure of lymphoid organs and immune cells
- **BTB 603.3**. Understand and explain the concept of antibody and antigen.
- **BTB 603.4**. Understand and explain the concept and types of hypersensitivity and vaccination.
- **BTB 603.5**. Understand the mechanism of autoimmune disorders, transplantation and immune response against tumor.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

1. PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the

professional engineering practice.

7. PO7. Environment and sustainability: Understand the impact of the professional engineering

solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
9. PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leavesincluding medical leaves.	A	5%

End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Introduction

Phylogeny of Immune System, Innate and acquired immunity, clonal nature of Immune Response. Organization and structure of lymphoid organs Nature and Biology of antigens and super antigens Antibody structure and function; Types of immunity- innate, acquired, active and passive.

Module II: Major Histocompatibilty

MHC, BCR and TCR, generation of antibody diversity, Complement system

Module III: Cells of the immune system

Hematopoiesis and differentiation, lymphocyte trafficking, B-Lymphocytes, T -Lymphocytes, macrophages, dendritic cells, natural killer, lymphokines and lymphokine activated killer cells, eosinophils, neutrophils and mast cells

Module IV: Regulation of immune response

Antigen processing and presentation, activation of B and T lymphocytes, cytokines and their role in immune regulation, T cell regulation and MHC restriction, immunological tolerance

Module V: Cell mediated toxicity

Mechanism of T cell and NK cell mediated lysis and macrophage mediated cytotoxicity.

Module VI: Hypersensitivity

Module VII: Autoimmunity

Module VIII: Tumor immunology, Immunity to infectious agents

Module IX: Transplantation Immunology

Module X: Synthetic vaccines

Vaccines: General consideration, ideotype network hypothesis, Synthetic vaccines

Module XI: Hnmunological Techniques

Immuno diffusion, immuno-electrophoresis, ELISA, RIA, fluorescence activated cell sorter

Module XII: Hybridoma technology and its applications

Fusion of myeloma cells with lymphocytes

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

Text:

- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company

References:

- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.

- Immunology, Roitt, Mosby – Yearbook Inc.
- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Free

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Phylogeny of Immune System, Innate and acquired immunity,	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
2	Phylogeny of Immune System, Innate and acquired immunity	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
3	Clonal nature of Immune Responses	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
4	Clonal nature of Immune Responses	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
5	Organization and structure of lymphoid organs	Lecture	BTB 603.2	Mid Term-1, Quiz & End Sem Exam
6	Organization and structure of lymphoid organs	Lecture	BTB 603.2	Mid Term-1, Quiz & End Sem Exam
7	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
8	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
9	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
10	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
11	Antibody structure and function; Types of immunity- innate, acquired, active and passive.	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
12	Antibody structure and function; Types of immunity- innate, acquired, active and passive	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
13	Antibody structure and function	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
14	Antibody structure and function	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
15	Types of immunity- innate, acquired, active and passive	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
16	MHC	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
17	BCR	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
18	TCR	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
19	Generation of antibody diversity	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
20	Generation of antibody diversity	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam

21	Complement system	Lecture	BTB 603.3	Quiz & End Sem Exam
22	Complement system	Lecture	BTB 603.3	Quiz & End Sem Exam
23	Hematopoiesis and differentiation, lymphocyte trafficking,	Lecture	BTB 603.3	Quiz & End Sem Exam
24	B-Lymphocytes,	Lecture	BTB 603.3	Quiz & End Sem Exam
25	T -Lymphocytes,	Lecture	BTB 603.3	Quiz & End Sem Exam
26	Macrophages, dendritic cells, natural killer	Lecture	BTB 603.3	Quiz & End Sem Exam
27	lymphokines and lymphokine activated killer cells,	Lecture	BTB 603.3	Quiz & End Sem Exam
28	NK cells	Lecture	BTB 603.3	Quiz & End Sem Exam
29	Eosinophils, neutrophils and mast cells	Lecture	BTB 603.3	Quiz & End Sem Exam
30	Antigen processing and presentation,	Lecture	BTB 603.3	Quiz & End Sem Exam
31	activation of B and T lymphocytes,	Lecture	BTB 603.3	Quiz & End Sem Exam
32	cytokines and their role in immune regulation,	Lecture	BTB 603.3	Quiz & End Sem Exam
33	T cell regulation and MHC restriction, immunological tolerance	Lecture	BTB 603.3	Quiz & End Sem Exam
34	Mechanism of T cell and NK cell mediated lysis and macrophage mediated cytotoxicity.	Lecture	BTB 603.3	Quiz & End Sem Exam
35	Mechanism of T cell and NK cell mediated lysis and macrophage mediated cytotoxicity.	Lecture	BTB 603.3	Quiz & End Sem Exam
36	Hypersensitivity	Lecture	BTB 603.4	Quiz & End Sem Exam
37	Hypersensitivity	Lecture	BTB 603.4	Quiz & End Sem Exam
38	Autoimmunity	Lecture	BTB 603.4	Quiz & End Sem Exam
39	Autoimmunity	Lecture	BTB 603.4	Quiz & End Sem Exam
40	Tumor immunology	Lecture	BTB 603.4	Quiz & End Sem Exam
41	Immunity to infectious disease	Lecture	BTB 603.4	Quiz & End Sem Exam
42	Transplantation	Lecture	BTB 603.4	Quiz & End Sem Exam
43	Transplantation	Lecture	BTB 603.4	Quiz & End Sem Exam
44	Vaccines: General consideration, ideotype network hypothesis, Synthetic vaccines	Lecture	BTB 603.4	Quiz & End Sem Exam
45	Immuno diffusion, immuno-electrophoresis,	Lecture	BTB 603.5	Quiz & End Sem Exam
46	ELISA, RIA, fluorescence activated cell sorter	Lecture	BTB 603.5	Quiz & End Sem Exam

47	Hybridoma technology and its applications Fusion of myeloma cells with lymphocytes	Lecture	BTB 603.5	Quiz & End Sem Exam
48	Hybridoma technology and its applications Fusion of myeloma cells with lymphocytes	Lecture	BTB 603.5	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 603.1.	Understand the phylogeny of immune system, types of immunity and immune response.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.2.	Understand the organization and structure of lymphoid organs and immune cells	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.3.	Understand and explain the concept of antibody and antigen.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.4.	Understand and explain the concept and types of hypersensitivity and vaccination.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.5.	Understand the mechanism of autoimmune disorders, transplantation and immune response against tumor.														

Sample Question Paper

Amity Institute Biotechnology 2019-20						
Class: B.Tech. Biotechnology VI Semester						
Subject Name: **Immunology & Immunotechnology**		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

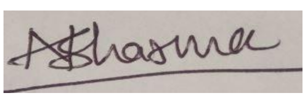
- Understand and explain the phylogeny of immune system, types of immunity, immune response.
- Describe the concept of clonal selection theory, humoral and cell mediated immunity.
- Understand and explain the structure and functions of the organs and cells of the immune system.
- Understand the mechanism of antigen-antibody interaction.
- Describe the structure of antibodies, their types and functions in immunity.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about innate and adaptive immunity. Discuss about the different types of innate immunity with characters.	6
CO2	Q.2	Write a note on different phases of cytotoxic cell mediated targeting killing mechanism.	6
	Q.3	Write a general organization of class I and class II MHC molecules with suitable diagram.	6
CO4	Q.4	Discuss the role of IgG immunoglobulin in immune system.	6
CO4	Q.5	What is antibody diversity? Discuss the role of light chain gene rearrangement in antibody diversity.	6
CO3	Q.6	Draw a well labeled diagram of hybridoma technology with production of monoclonal antibody.	6
	Q.7	Discuss the role of innate and adaptive immunity in tissue grafting. Explain with suitable example.	10
CO4	Q.8	Give a comparison between all type of vaccine with examples and applications.	10

CO3	Q.9	Discuss about features of any two primary lymphoid organs with suitable diagram	10
CO3	Q.10	A. Although all lymphocytes are formed in bone marrow. Explain how these cells get differentiated into B cell and T cell. B Where the CDR regions located on an antibody molecule and what are are their functions? Discuss the ELISA method on the basis of antigen and antibody interaction.	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Immunology and immunotechnology**/Course code ***BTB 603*** is level **2** for the academic year 2019-20.



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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2019-20

		PROGRAMME ARTICULATION MATRIX														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3
VI SEM	BTB620	3	3	1	2	-	-	-	1	2	1	3	1	3	1	1

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High) If there is no correlation, put "- "

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : Immunology and immunotechnology Lab
Course Code : BTB 622, Crédits : 01, Session: 2019-20(Even Sem.), Class : B.Tech. IIIrd Year
Faculty Name : (Dr.) Neha Sharma

A. **Introduction:** Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. **Course Outcomes :** After successful completion of the course student will be able to:

- **BTB 603.1**. Understand the phylogeny of immune system, types of immunity and immune response.
- **BTB 603.2**. Understand the organization and structure of lymphoid organs and immune cells
- **BTB 603.3**. Understand and explain the concept of antibody and antigen.
- **BTB 603.4**. Understand and explain the concept and types of hypersensitivity and vaccination.
- **BTB 603.5**. Understand the mechanism of autoimmune disorders, transplantation and immune response against tumor.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

1. PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to

the professional engineering practice.

7. PO7. Environment and sustainability: Understand the impact of the professional engineering

solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
9. PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%

End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Course Contents:

1. Purification of immunoglobin G.
2. Study of antigen- antibody pattern (ODD).
3. Study of sandwich ELISA.
4. Study of haemeagglutination.
5. Study of immunoelectrophoresis.
6. Isolation and identification of rosette cells.
7. Antigen capture ELISA

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Manual of Molecular and Clinical Laboratory Immunology, 8th Edition Barbara Detrick (Editor), John L. Schmitz (Editor), Robert G. Hamilton (Editor) ISBN: 978-1-555-81871-5 May 2016 ASM Press
- Immunology Laboratory Manual Published by LAP LAMBERT Academic Publishing (2018) ISBN 10: 6138386175 ISBN 13: 9786138386179

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Purification of Immunoglobulin G	Lecture	**MSB 320.1**	Mid Term-1, Quiz & End Sem Exam
2	Radial Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
3	Double Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
4	Study of sandwich ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
5	Study of DOT ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
6	Study of heamagglutination (Blood group)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
7	Rh factor determination	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
8	Study of heamagglutination (Widal test)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
9	Study of immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
10	Study of rocket immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
11	Isolation and identification of rostte cells	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
12	Revision and discussion	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4

MSB 320.1	Demonstrate detailed knowledge of purification of immunoglobulin, cells and antigen antibody interaction.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 320.2	Apply knowledge and incorporate experimental understanding of the agglutination mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 320.3	Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

Amity Institute Biotechnology 2018-19						
Class: B.Tech Biotechnology VI Semester						
Subject Name: Advanced Immunology Lab		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.3 & Q.4	Q.1		Q.2		

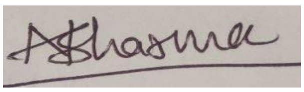
Student will be able to:

- Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
- Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
- Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
- the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

CO Map	Question No.	Question	Marks
C	Q.1	Perform Dot Elisa for detection of antigen-antibody interaction.	35
O 1			
C O 2	Q.2	Perform hemagglutination (Blood group) test.	15
	Q.3	*Viva-voce*	10
C O 3	Q.4	Record	10

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Immunology and immunotechnology Lab***/Course code ***BTB 622*** is level **3** for the academic year 2019-20.




INSTITUTE OF BIOTECHNOLOGY • AMITY

Sample Question Paper

Amity School of Engineering and Technology Department of Computer Science and Engineering I MID-SEMESTER (SEM –VII) 2019-20		
Class: B.Tech.(CSE) VII Semester		
Subject Name: CSE 703 CLOUD COMPUTING	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

Student will be able to
CO1: List the broad perceptive of cloud architecture and model.
CO2: Apply different cloud programming models as per need.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the cloud computing concept.	3
CO1	Q.2a	What are the essential characteristics of cloud computing?	3
	Q.2b	How is cloud computing requirements and cloud servicerequirement services related to each other?	3
CO1	Q.3	Sketch NIST Cloud Computing Reference Architecture and depictits elements	6
CO2	Q.4	Explain the significance of Cloud Reference Model	3
CO2	Q.5a	Elaborate different cloud types with example.	3
	Q.5b	Write characteristics of private cloud.	3
CO2	Q 6	How virtualization is applied in cloud computing scenario?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

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[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY-I
Course Code : BTB-302 Credits: 03, Session :2021-22 (Odd Sem.), Class : B. Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

B. Course Outcomes: At the end of the course, students will be able to:

BTB302.1. Learn about chemical interactions in biological system.

BTB302.2. Develop the understanding between structure and function of carbohydrates & lipids.

BTB302.3. Learn the concept of metabolism and energy involved in metabolic pathways.

BTB302.4. Understand the metabolic pathways and regulations of carbohydrates metabolism.

BTB302.5. Learn about the digestion, transport, anabolism and catabolism of lipids in the body.

C. Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in

diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction aims and scope

Chemical foundations of Biology -Properties of water, acids, bases and buffers, covalent bonds, Non-covalent interactions in biological systems.

Module II

Introduction to biomolecules - *Carbohydrates* -Sugars; Polysaccharides

Lipids -classification, structure and function. Lipids and biological membranes, Lipid linked proteins and lipoproteins, Atherosclerosis.

Module III

Metabolism and bioenergetics -First and second law, free energy and chemical equilibrium, Organic reaction mechanisms, Design of metabolism-concept of free energy, ATP-ADP cycle. Cellular energy transactions -role of mitochondria and chloroplast

Module IV

Carbohydrate metabolism-glycolysis pathway and reactions, Glycogen breakdown and synthesis, control of glycogen metabolism, glycogen storage and its diseases, Citric acid cycle -Overview, Metabolic sources of Acetyl Co-A, enzymes and regulation, The amphibolic nature of the Citric acid cycle Electron transport chain and oxidative photophosphorylation - mitochondrion and electron transport, phosphorylation and control of ATP production Gluconeogenesis, The glyoxylate pathway, Pentose phosphate pathway

Module V

Lipid metabolism -Lipid digestion, absorption and transport, fatty acid oxidation, ketone bodies, fatty acid biosynthesis, regulation of fatty acid metabolism. Cholesterol and Arachidonic Acid metabolism, Phospholipids, Sphingolipids and Glycolipids

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Harper's Biochemistry, K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw-Hill/Appleton and Lange.
- Biochemistry, L. Stryer, W.H. Freeman and Company
- Tools of Biochemistry, T.G. Cooper, John Wiley and Sons Inc.

References:

- Cellular Biophysics I & II, Thomas F. Weiss 1995, MIT Press
- Biochemical calculations, I.H. Segal. Publisher, John Wiley and Sons
- Biochemistry, C.K. Mathews, K.E. Van Holde and K.G. Ahern, Benjamin / Cummings.
- Devlin's Textbook of Biochemistry with Clinical correlations, John Wiley and Sons Inc.
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox, Worth Publishing

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction aims and scope	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
2	Chemical Foundations of Biology- Properties of water, acids, bases and buffers	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
3	Chemical Foundations of Biology- Properties of water, acids, bases and buffers	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
4	Covalent and Non-covalent interactions in biological systems	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
5	Introduction to biomolecules- Carbohydrates, Sugars, Polysaccharides	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
6	Introduction to biomolecules- Carbohydrates, Sugars, Polysaccharides	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
7	Lipids- Classification, Structure and Function	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
8	Lipids and biological membranes	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
9	Lipid linked proteins and lipoproteins, Atherosclerosis	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
10	Metabolism and bioenergetics- First and Second law	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
11	Free energy and chemical equilibrium	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
12	Organic reaction mechanisms	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
13	Design of metabolism-concept of free energy, ATP-ADP cycle	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
14	Cellular energy transactions- role of mitochondria and chloroplast	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
15	Carbohydrate pathway- glycolysis pathway and reactions	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
16	Glycogen breakdown and synthesis	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
17	Glycogen breakdown and synthesis	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
18	Control of glycogen metabolism, glycogen storage and its diseases	Lecture	BTB302.4	Quiz & End Sem Exam
19	Citric acid cycle-Overview, Metabolic sources of Acetyl Co-A	Lecture	BTB302.4	Quiz & End Sem Exam
20	Enzymes and regulation	Lecture	BTB302.4	Quiz & End Sem Exam

21	Amphibolic nature of the Citric acid cycle	Lecture	BTB302.4	Quiz & End Sem Exam
22	Electron transport chain	Lecture	BTB302.4	Quiz & End Sem Exam
23	Oxidative phosphorylation	Lecture	BTB302.4	Quiz & End Sem Exam
24	Mitochondrion and electron transport	Lecture	BTB302.4	Quiz & End Sem Exam
25	Phosphorylation and control of ATP production	Lecture	BTB302.4	Quiz & End Sem Exam
26	Gluconeogenesis	Lecture	BTB302.4	Quiz & End Sem Exam
27	Glyoxylate pathway	Lecture	BTB302.4	Quiz & End Sem Exam
28	Pentose phosphate pathway	Lecture	BTB302.4	Quiz & End Sem Exam
29	Lipid metabolism- Lipid digestion	Lecture	BTB302.5	Quiz & End Sem Exam
30	Absorption and transport	Lecture	BTB302.5	Quiz & End Sem Exam
31	Fatty acid oxidation, Ketone bodies	Lecture	BTB302.5	Quiz & End Sem Exam
32	Fatty acid biosynthesis	Lecture	BTB302.5	Quiz & End Sem Exam
33	Regulation of fatty acid metabolism	Lecture	BTB302.5	Quiz & End Sem Exam
34	Cholesterol and Arachidonic acid metabolism	Lecture	BTB302.5	Quiz & End Sem Exam
35	Phospholipids, Sphingolipids and Glycolipids	Lecture	BTB302.5	Quiz & End Sem Exam
36	Phospholipids, Sphingolipids and Glycolipids	Lecture	BTB302.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB302.1.	Learn about chemical interactions in biological system.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.2.	Develop the understanding between structure and function of carbohydrates & lipids.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.3.	Learn the concept of metabolism and energy involved in metabolic pathways.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.4.	Understand the metabolic pathways and regulations of carbohydrates metabolism.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.5.	Learn about the digestion, transport, anabolism and catabolism of lipids in the body.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2021-22						
Class: B.Tech. Biotechnology III Semester						
Subject Name: BTB 302 BIOCHEMISTRY-I		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biopolymers with examples.	3
CO1	Q.2a	What do you understand by proton hopping?	3
	Q.2b	How is monosaccharide different from polysaccharide?	3
CO1	Q.3	Give an account of lipid digestion in body.	6
CO2	Q.4	Explain the significance of lipoproteins in clinics.	3
CO2	Q.5a	What are the factors favoring glycogenolysis.	3
	Q.5b	Discuss the different factors affecting fat oxidation.	3
CO2	Q 6	Glycolysis and Gluconeogenesis will never occur simultaneously. Why?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry-I**/Course code **BTB-302** is level **3** for the academic year 2019-20.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR BIOLOGY
Course Code : BTB-304, Credits: 04, Session :2021-22 (Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. Course Outcomes: At the end of the course, students will be able to:

BTB304.1. Learn about the mechanism of replication of DNA in prokaryotes and eukaryotes.

BTB304.2. Learn and compare the mechanism of transcription in prokaryotes and eukaryotes.

BTB304.3. Learn the various post-transcriptional processes in cell.

BTB304.4. Learn about the mechanism of protein synthesis in prokaryotes and eukaryotes.

BTB304.5. Understand about gene expression regulation.

BTB304.6. Understand about various mechanisms of gene silencing.

C. Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

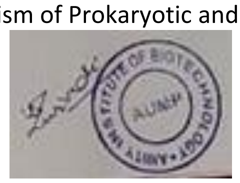
E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: DNA Replication and repair

Nucleic Acid Structure and Functions, Mechanism of Prokaryotic and Eukaryotic DNA replication, Enzymes and accessory



proteins involved in DNA replication, DNA repair Mechanism.

Module II: Transcription
Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements.

Module III: Modifications in RNA
5'-cap formation, transcription termination, 3 '-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA and mRNA stability.

Module IV: Translation
Prokaryotic and Eukaryotic translation, the translation Machinery; Mechanisms of initiation, elongation and termination, regulation of translation, co-and post-translational modifications of proteins.

Module V: Regulation of Gene Expression in prokaryotic and eukaryotic systems
Lac operon, Ara operan, regulation in Eukaryotes, Epigenetics.

Module VI: Antisense and Ribozyme technology
Molecular mechanism of antisense molecules, inhibition of spilicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of Ribozyme; Hammerhead, hairpin and other ribozymes, strategies for designing ribozymes, applications of antisense and ribozyme technologies.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education
- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Biology of the Cell. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing
- Gene VIII, Benjamin Lewin 2005, Oxford University Press

References:

- Molecular Cell Biology, H. Lodish, A.Berk, S. Zipursky, P Matsundaira, D.Baltimore and J.E. Barnell, W.H. Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Nucleic Acid Structure and Functions	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
2	Mechanism of Prokaryotic and Eukaryotic DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
3	Mechanism of Prokaryotic and Eukaryotic DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
4	Enzymes and accessory proteins involved in DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
5	Enzymes and accessory proteins involved in DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
6	DNA repair Mechanism	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
7	DNA repair Mechanism	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
8	Tutorial	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
9	Prokaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
10	Prokaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
11	Eukaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
12	Eukaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
13	RNA polymerase	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
14	General and specific transcription factors	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
15	Regulatory elements	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
16	Tutorial	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
17	5'-cap formation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
18	transcription termination	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
19	3'-end processing and polyadenylation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
20	3'-end processing and polyadenylation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
21	Splicing, Editing	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
22	Nuclear export of mRNA and mRNA stability	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam

23	Tutorial	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
24	Prokaryotic and Eukaryotic translation	Lecture	BTB304.4	Mid Term, Quiz & End Sem Exam
25	Prokaryotic and Eukaryotic translation	Lecture	BTB304.4	Quiz & End Sem Exam
26	the translation Machinery	Lecture	BTB304.4	Quiz & End Sem Exam
27	Mechanisms of initiation	Lecture	BTB304.4	Quiz & End Sem Exam
28	elongation and termination	Lecture	BTB304.4	Quiz & End Sem Exam
29	regulation of translation	Lecture	BTB304.4	Quiz & End Sem Exam
30	co-and post-translational modifications of proteins	Lecture	BTB304.4	Quiz & End Sem Exam
31	Tutorial	Lecture	BTB304.4	Quiz & End Sem Exam
32	Lac operon	Lecture	BTB304.5	Quiz & End Sem Exam
33	Ara operon	Lecture	BTB304.5	Quiz & End Sem Exam
34	regulation in Eukaryotes	Lecture	BTB304.5	Quiz & End Sem Exam
35	Epigenetics	Lecture	BTB304.5	Quiz & End Sem Exam
36	Tutorial	Lecture	BTB304.5	Quiz & End Sem Exam
37	Molecular mechanism of antisense molecules	Lecture	BTB304.6	Quiz & End Sem Exam
38	Molecular mechanism of antisense molecules	Lecture	BTB304.6	Quiz & End Sem Exam
39	inhibition of spilicing, polyadenylation and translation	Lecture	BTB304.6	Quiz & End Sem Exam
40	disruption of RNA structure and capping	Lecture	BTB304.6	Quiz & End Sem Exam
41	Biochemistry of Ribozyme	Lecture	BTB304.6	Quiz & End Sem Exam
42	Hammerhead, hairpin and other ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
43	Hammerhead, hairpin and other ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
44	strategies for designing ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
45	applications of antisense	Lecture	BTB304.6	Quiz & End Sem Exam
46	ribozyme technologies	Lecture	BTB304.6	Quiz & End Sem Exam

47	Applications of ribozyme technologies	Lecture	BTB304.6	Quiz & End Sem Exam
48	Tutorial	Lecture	BTB304.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB304.1.	Learn about the mechanism of replication of DNA in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.2.	Learn and compare the mechanism of transcription in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.3.	Learn the various post-transcriptional processes in cell.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.4.	Learn about the mechanism of protein synthesis in prokaryotes and eukaryotes	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.5.	Understand about gene expression regulation.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.6.	Understand about various mechanisms of gene silencing.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
I MID-SEMESTER (SEM –III) 2021-22</td></tr>
<tr><td colspan="7">Class: B.Tech. Biotechnology III Semester</td></tr>
<tr><td colspan="2">Subject Name:
BTB 304 MOLECULAR BIOLOGY</td><td colspan="3">Time: 1.5 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4</td><td>Q.2,3</td><td>Q.4</td><td>Q.2,5,6</td><td></td><td></td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the nucleic acids with examples.	3
CO1	Q.2	What do you understand by semi discontinuous replication of DNA?	6
CO1	Q.3	Give an account of RNA synthesis in *E. coli*.	6
CO2	Q.4	Explain the significance of 5'-capping in RNA.	3
CO2	Q.5a	How does tRNA bring amino acid to ribosome for protein synthesis?	3
	Q.5b	Discuss the different mechanisms of gene silencing.	3
CO2	Q 6	How does cell ensure the correct incorporation of amino acids in translation?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology**/Course code **BTB-304** is level **3** for the academic year 2019-20.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	3	3	3	3	-	1	2	2	2	3	1	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR BIOLOGY LAB
Course Code : BTB-323, Credits: 01, Session :2021-22 (Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB323.1. Practical based understanding of preparation of genomic and plasmid DNA.

BTB323.2. Practical based understanding of isolation of RNA.

BTB323.3. Practical based understanding of RFLP analysis.

BTB323.4. Practical based understanding of gel filtration.

BTB323.5. Practical based understanding of Preparation of Competent Cells.

BTB323.6. Practical based understanding of Restriction Digestion and Ligation of DNA.

C. **Programme Outcomes:**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

F. Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Preparation of DNA: genomic, Plasmid

Module II

Isolation of RNA

Module III
RFLP analysis
Module IV
Gel filtration
Module V
Preparation of Competent Cells
Module VI
Restriction Digestion and Ligation of DNA

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:

Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

I. Lecture Plan

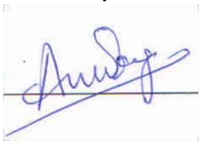
Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Preparation of DNA: genomic, Plasmid	Practical	BTB323.1	Class Test (Practical Based) & End Sem Exam
2	Preparation of DNA: genomic, Plasmid	Practical	BTB323.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of RNA	Practical	BTB323.2	Class Test (Practical Based) & End Sem Exam
4	Isolation of RNA	Practical	BTB323.2	Class Test (Practical Based) & End Sem Exam
5	RFLP analysis	Practical	BTB323.3	Class Test (Practical Based) & End Sem Exam
6	RFLP analysis	Practical	BTB323.3	Class Test (Practical Based) & End Sem Exam
7	Gel filtration	Practical	BTB323.4	Class Test (Practical Based) & End Sem Exam
8	Gel filtration	Practical	BTB323.4	Class Test (Practical Based) & End Sem Exam
9	Preparation of Competent Cells	Practical	BTB323.5	Class Test (Practical Based) & End Sem Exam
10	Preparation of Competent Cells	Practical	BTB323.5	Class Test (Practical Based) & End Sem Exam
11	Restriction Digestion and Ligation of DNA	Practical	BTB323.6	Class Test (Practical Based) & End Sem Exam
12	Restriction Digestion and Ligation of DNA	Practical	BTB323.6	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB323.1.	Practical based understanding of preparation of genomic and plasmid DNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.2.	Practical based understanding of isolation of RNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.3.	Practical based understanding of RFLP analysis.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.4.	Practical based understanding of gel filtration.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.5.	Practical based understanding of Preparation of Competent Cells.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.6.	Practical based understanding of Restriction Digestion and Ligation of DNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology Lab**/Course code **BTB-323** is level **3** for the academic year 2019-20.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY - II
Course Code : BTB-401, Credits : 04, Session :2021-22 (Even Sem.), Class : B. Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

B. Course Outcomes: At the end of the course, students will be able to:

BTB401.1. Understand relationships between structure and functions Amino acids and Proteins and the concept of Enzymes, their mode of action and regulation.

BTB401.2. Understand the structure and properties of Nucleic acids – DNA and RNA.

BTB401.3. Learn and understand the amino acid metabolism.

BTB401.4. Understand the metabolism of purines and pyrimidines in the body.

C. Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Proteins -Amino acids and peptides - classification, chemical reactions and physical properties. Introduction to protein structure and function. Cis-trans peptide bond formation. Glycoproteins -structure and function, *Vitamins and Coenzymes*: structure and function of water soluble vitamins.
Enzymes -Introduction to kinetic and catalytic mechanisms of enzymes; Regulation of enzyme activity; Effects of physical parameters on enzyme activity, enzyme inhibitors – types of inhibition.

Module II

Nucleic acids - nitrogenous bases, nucleotides, types, structure and properties of nucleic acids

Module III

Amino acid metabolism -Amino acid deamination, urea cycle, biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine,
Tyrosine. Specialized Products of Amino Acids, Nitrogen fixation

Module IV

Nucleotide Metabolism -structure and metabolism of purines and pyrimidines, biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN; Catabolism of heam and clinical significance of bilirubin.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Harper's Biochemistry, K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw-Hill/Appleton and Lange.
- Biochemistry, L. Stryer, W.H. Freeman and Company
- Tools of Biochemistry, T.G. Cooper, John Wiley and Sons Inc.

References:

- Cellular Biophysics I & II, Thomas F. Weiss 1995, MIT Press
- Biochemical calculations, I.H. Segal. Publisher, John Wiley and Sons
- Biochemistry, C.K. Mathews, K.E. Van Holde and K.G. Ahern, Benjamin / Cummings.
- Devlin's Textbook of Biochemistry with Clinical correlations, John Wiley and Sons Inc.
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox, Worth Publishing

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
2	Proteins - Amino acids and peptides - classification	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
3	Proteins - Amino acids and peptides - classification	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
4	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
5	Chemical reactions and physical properties	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
6	Introduction to protein structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
7	Introduction to protein structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
8	Glycoproteins -structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
9	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
10	Vitamins and Coenzymes: structure and function of water soluble vitamins	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
11	Vitamins and Coenzymes: structure and function of water soluble vitamins	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
12	Enzymes - Introduction to kinetic mechanisms of enzymes	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
13	Catalytic mechanisms of enzymes	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
14	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
15	Regulation of enzyme activity	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
16	Effects of physical parameters on enzyme activity	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
17	Enzyme inhibitors – types of inhibition.	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
18	Enzyme inhibitors – types of inhibition.	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
19	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
20	Nucleic acids - nitrogenous bases	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam
21	Nucleotides, types, structure and properties of nucleic acids	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam

22	Nucleotides, types, structure and properties of nucleic acids	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam
23	Amino acid metabolism - Amino acid deamination	Lecture	BTB401.3	Mid Term, Quiz & End Sem Exam
24	TUTORIAL	Lecture	BTB401.3	Mid Term, Quiz & End Sem Exam
25	Urea cycle	Lecture	BTB401.3	Quiz & End Sem Exam
26	Urea cycle	Lecture	BTB401.3	Quiz & End Sem Exam
27	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
28	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
29	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
30	Tutorial	Lecture	BTB401.3	Quiz & End Sem Exam
31	Specialized Products of Amino Acids	Lecture	BTB401.3	Quiz & End Sem Exam
32	Specialized Products of Amino Acids	Lecture	BTB401.3	Quiz & End Sem Exam
33	Nitrogen fixation	Lecture	BTB401.3	Quiz & End Sem Exam
34	Nitrogen fixation	Lecture	BTB401.3	Quiz & End Sem Exam
35	TUTORIAL	Lecture	BTB401.3	Quiz & End Sem Exam
36	Nucleotide Metabolism -structure of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
37	Nucleotide Metabolism -structure of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
38	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
39	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
40	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam

41	Biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN)	Lecture	BTB401.4	Quiz & End Sem Exam
42	Biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN)	Lecture	BTB401.4	Quiz & End Sem Exam
43	Biosynthesis of nucleotide	Lecture	BTB401.4	Quiz & End Sem
	coenzymes (NAD, NADP, FAD, FMN)			Exam
44	TUTORIAL	Lecture	BTB401.4	Quiz & End Sem Exam
45	Catabolism of heam	Lecture	BTB401.4	Quiz & End Sem Exam
46	Catabolism of heam	Lecture	BTB401.4	Quiz & End Sem Exam
47	Clinical significance of bilirubin	Lecture	BTB401.4	Quiz & End Sem Exam
48	Clinical significance of bilirubin	Lecture	BTB401.4	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB401.1.	Understand relationships between structure and functions Amino acids and Proteins and the concept of Enzymes, their mode of action and regulation.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.2.	Understand the structure and properties of Nucleic acids – DNA and RNA.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.3.	Learn and understand the amino acid metabolism.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.4.	Understand the metabolism of purines and pyrimidines in the body.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –IV) 2021-22						
Class: B.Tech. Biotechnology IV Semester						
Subject Name: BTB 401 BIOCHEMISTRY-II		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the amino acids with examples.	3
CO1	Q.2	What do you understand by enzyme kinetics?	6
CO1	Q.3	Give an account of biochemistry of glycoproteins.	6
CO2	Q.4	Explain the significance of peptide bond.	3
CO2	Q.5a	How does inhibitors work against enzymes?	3
	Q.5b	Discuss the importance of SGOT and SGPT in liver and kidney function tests.	3
CO2	Q 6	Discuss the importance of mis regulation in nucleic acid metabolism.	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry-II**/Course code **BTB-401** is level **3** for the academic year 2019-20.

AMITY UNIVERSITY
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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

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PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

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Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	3	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY LAB-II
Course Code : BTB-420, Credits: 01, Session :2021-22 (Even Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend understanding of the qualitative and quantitative estimation of proteins and nucleic acids.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB420.1. Practical based understanding of qualitative and quantitative tests of protein and amino acids.

BTB420.2. Practical based understanding of qualitative and quantitative tests of DNA and RNA.

C. **Programme Outcomes:**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

F. Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Colour reactions of proteins (Ninhydrin test, Biuret test, Xanthoprotein test).

Estimation of proteins.

Module II

Biochemical estimation of DNA

Biochemical estimation of RNA

Quantitative determination of DNA and RNA by spectrophotometric method using UV range.

Determination of melting temperature of DNA from thermal denaturation characteristics.

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Ninhydrin test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Xanthoprotein test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
4	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
5	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
6	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
7	Biochemical estimation of DNA	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
8	Biochemical estimation of RNA	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
9	Quantitative determination of DNA and RNA by spectrophotometric method using UV range	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
10	Quantitative determination of DNA and RNA by spectrophotometric method using UV range	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
11	Determination of melting temperature of DNA from thermal denaturation characteristics	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
12	Determination of melting temperature of DNA from thermal denaturation characteristics	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB420.1.	Practical based understanding of qualitative and quantitative tests of protein and amino acids.	3	3	3	3	-	1	2	-	2	2	**-**	**2**	3	3	1	-
BTB420.2.	Practical based understanding of qualitative and quantitative tests of DNA and RNA.	3	3	3	3	-	1	2	-	2	2	**-**	**2**	3	3	1	-

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry lab-II**/Course code **BTB-420** is level **3** for the academic year 2019-20.

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **ADVANCED GENOMICS & PROTEOMICS**
Course Code : MSB 204, Crédits : 04, Session :2019-20(Even Sem.), Class : M.Sc. Ist Year
Faculty Name : Dr. MANISH KUMAR

A. **Introduction:** The course helps in developing a detailed understanding of eukaryotic genome complexity and organization. Current research on the molecular basis of the control of gene expression in eukaryotic has developed a detailed understanding of techniques of gene diagnostics and DNA profile to acquire the fundamental of genomics and bioinformatics, it is desirable to have in depth study on these lines.

B. **Course Outcomes:** At the end of the course, students will be able to:
MSB204.1 Understand the basic of genomics, Anatomy of genomics and human genome project
MSB204.2 Able to understand gene expression, and mapping
MSB204.3 Learn different DNA markers
MSB204.4 Understand Microarray and their applications in analysis of gene expression
MSB204.5 Develop knowledge of fundamental techniques in proteomics.
MSB204.6 Understand Post translational modification.
MSB204.7 Get detail knowledge and understanding of Protein – protein interaction.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological

change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction to Genomics: The human genome project “Anatomy of prokaryotic and eucaryotic genome: repetitive DNA and RNA Contents of genomes.

Module II

Transcriptomics and meta-transcriptomics: Introduction, method and uses. Genetic mapping

Module III
Microsatellite DNA markers, RFLP, DNA sequencing, Phylogeny

Module IV
Micro array: DNA micro array marker, computational methods.

PART-II: PROTEOMICS

Module V
Introduction to proteomics
Fundamental methods used in proteomics. 2-D gel electrophoresis + mass spectroscopy.

Module VI
Post translationalprotein modification

Module VII
Protein – protein interaction some examples

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Genes & Genomes, Maxine Singer and Paul Berg
- Genomes II, T.A. Brown

***References*:**

- A Primer of Genome Science, Greg Gibson and Spencer V. Muse
- Database Annotation in Molecular Biology: Principles and Practice, Arthur M. Lesk
- DNA: Structure and Function, Richard R. Sinden
- Recombinant DNA (Second Edition), James D. Watson and Mark Zoller
- Gene Cloning and DNA Analysis – An introduction (Fourth Edition), T.A. Brown
- www.panimatext.com

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
2	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam

3	Human Genome project	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
4	Human Genome project	Lecture	MSB204.1	Mid Term-1, Quiz
				& End Sem Exam
5	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
6	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
7	repetitive DNA and RNA Contents of genoms	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
8	repetitive DNA and RNA Contents of genoms	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
9	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
10	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
11	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
12	Introduction , method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
13	Introduction , method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
14	Introduction , method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
15	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
16	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
17	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
18	RFLP	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
19	RFLP	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
20	DNA sequencing, polyogemy	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
21	DNA sequencing, polyogemy	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
22	DNA sequencing, polyogemyprocedure	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
23	DNA sequencing, polyogemy	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
24	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam
25	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam

26	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam
27	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam
28	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam
29	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam
30	Introduction to proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
31	Introduction to proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
32	Fundamental methods used in proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
33	Fundamental methods used in proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
34	Fundamental methods used in proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
35	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
36	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
37	2-D gel electrophoresis + mass spectroscopy 2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
38	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
39	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
40	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
41	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
42	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
43	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
44	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
45	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
46	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
47	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
48	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB204.1	Understand the basic of genomics, Anatomy of genomics and human genome project	3	3	1	3	1	1	1	-	2	1	3	1	-	1
MSB204.2	Able to understand gene expression, and mapping	3	3	**2**	3	1	-	-	-	2	1	3	1	-	1
MSB204.3	Learn different DNA markers	3	3	2	3	1	-	-	1	2	1	3	1	1	1
MSB204.4	Understand Microarray and their applications in analysis of gene expression	3	3	1	3	1	-	-	-	2	1	3	1	-	1
MSB204.5	Develop knowledge of fundamental techniques in proteomics.	3	3	1	3	1	-	-	-	2	1	3	1	-	1
MSB204.6	Understand Post translational modification.	3	3	1	3	1	-	-	-	2	1	3	1	1	1
MSB204.7	Get detail knowledge and understanding of Protein – protein interaction.	3	3	1	3	1	-	-	-	2	1	3	1	1	1

Amity Institute of Biotechnology I MID-SEMESTER (SEM –II) 2019-20		
Class: M.Sc Biotechnology II Semester		
Subject Name: MSB 204 Advanced Genomics & Proteomics	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

Student will be able to
CO1: Understand the basics of genomics, Anatomy of genomics and human genome project.
CO2: understand gene expression, and mapping.

CO Map	Question No.	Question	Marks
CO1	Q.1	Differentiate between genomics and proteomics.	3
CO1	Q.2a	Discuss the separation processes in genomics.	3
	Q.2b	Discuss the separation processes in proteomics.	3
CO1	Q.3	Discuss physical mapping and use of restriction enzymes.	6
CO2	Q.4	Discuss linkage mapping with suitable example.	3
CO2	Q.5a	Write a short note on phylogeny.	3
	Q.5b	How genomic study is useful in the identification of genomes?	3
CO2	Q 6	Discuss the role of recombination and recombinants in the linkage mapping.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Genomics & Proteomics/MSB 204** is **level 3** for the academic year 2019-20.


AMITY INSTITUTE OF BIOTECHNOLOGY

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
II	MSB 205	3	3	3	1	1	-	-	1	2	1	3	1	3	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **COMPUTATIONAL BIOLOGY**
Course Code : MSB 205, Crédits : 03, Session :2019-20(Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe how molecular data can be used to construct a phylogenetic tree and characterize the rates and causes of nucleotide substitutions. The aim is also to explain how a gene/protein family arises and the mechanisms, which underlie evolution at the molecular level.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MSB 205.1 Understand and explain the development of computational biology.

MSB 205.2 Describe the fundamentals of bioinformatics databases and their application.

MSB 205.3 Understand and explain the use of various computational methods for phylogentic studies.

MSB 205.4 Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling. Explain the applications of computational biology in different fields of sciences.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction to Computational Biology. History of Bioinformatics
Module II: Bioinformatics Fundamentals

1. Major information Resources & Databases in Bioinformatics
 a. Information Resources: NCBI, EBI, ExPasy Entrez & SRS System
 b. Primary Sequence & Structure Databases: Genbank, SwissProt/Uniprot, EMBL, PIR, PDB, MMDB, NDB, CSD, KEGG etc.
 c. Derived (Secondry) Databases of Sequences and structure:
  i. Prosite, PRODOM, PRINTS, Pfam, BLOCK, INTERPRO etc.
  ii. SCOP, CATH, DSSP, FSSP, RNAbase,
 d. Genome Databases (at NCBI, EBI, TIGR, SANGER), High-throughput genomics sequence (EST, STS, GSS), ENSEMBL.
2. Sequence File formats: fasta, genbank, embl, Swiss-prot, pdb, nbrf, pir and multiple sequences formats (Aln, Mega, Pileup, phylip etc.)
3. Sequence Similarty Basics: Similarty, Indentity, Homology, Scoring, selectivity/Sensitivity, Gap cost, Linear and Affine Gap Penalty, Basic of scoring system and matrices (PAM, BIOSUM, GONNET etc.)
4. Pairwise Sequences Aligment: Brute Force method, Dot matrix method, Global (Needleman-Wunsch) and Local Alignment (Smith-Waterman) using Dynamic programming.
5. Scoring Matrices: Substitution Matrices, Concept log-odds, PAM & BLOSUM Series, Derivation of PAM & BLOSUM matrices, Distance and Similarity matrices.

6. Similarity Searching Tools: BLAST and FASTA, Theory and Algorithms, variants of BLAST and FASTA, PSI-BLAST and PHI BLAST, Statistical Significance.

7. Sequence Pattern and Profiles: Concepts of motif, pattern and profile, Profile construction and its application in Bioinformatics,

Module III: Computational Methods

Scoring methods of MSA (sum of pair, Multidimensional DP, Progressive, Iterative, Probabilistic)

Phylogenetics prediction mrthods: Basics, molecular clock, Substitution Models of evolution, Tree reconstruction methods (Distance based, character based method, statistical), Bootsstrapping.

Suffix tree and its applications in Bioinformatics

Gene Indentification Methods

Predictive Methods using DNA and Protein sequences.

Statistical Modeling: Log-likelihood, Bayesian network, Markov and hidden markov models.

Clustering Algorithms: K-means, Hierarchical and Mixture of Gaussion.

Module IV: Application and software tools

Software and Programmes for sequence comparison and analysis.

Phylogenetics analysis software.

Molecular Structure drawing tool.

Molecular modeling/Docking.

Application of computational biology/Bioinformatics in Agriculture, Human health, Enviroment, Biotechnology, Molecular Biology, Neurobiology, Drug Designing, Veterinary Science.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Computational Modeling of Genetic and Biochemical Networks, J.M. Bower and H. Bolouri, MIT Press
- Computational Molecular Biology: An Algorithmic Approach, P.A. Pevzner, MIT Press
- Computer Methods for Macromolecular Sequence Analysis, R.F. Doolittle, J.N, Abelson, M.I. Simon, Academic press
- Essentials of Genomics and Bioinformatics, C.W. Sensen, John Wiley and Sons Inc.
- Introduction to Bioinformatics, T. Attwood and D. Parry-Smith, Prentice Hall
- Introduction to Computational Biology: Maps, Sequences and Genomes, M. Waterman, Chapman and Hall
- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit, G. V. Heijne and G.V. Heijne, Academic Press

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Introduction to computational Biology & History of Bioinformatics	Lecture	**MSB 205.1**	Mid Term-1, Quiz & End Sem Exam
2	Major information Resources & Databases in Bioinformatics (a & b)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
3	Major information Resources & Databases in Bioinformatics (c & d)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
4	Sequence File formats & Multiple sequence formats	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
5	Sequence Similarity Basics	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
6	Basic of scoring system and matrices	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
7	Pairwise Sequences Aligment	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
8	Local Alignment	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
9	Scoring Matrices	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
10	Similarity Searching Tools (BLAST)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
11	Similarity Searching Tools (FASTA)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
12	Sequence Pattern and Profiles	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
13	Scoring methods of MSA	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
14	Phylogenetics prediction methods	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
15	Gene Identification Methods Predictive Methods using DNA and Protein sequences.	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
16	Statistical Modeling: Log-likelihood, Bayesian network, Markov	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
17	Hidden markov models	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
18	Clustering Algorithms: K-means, Hierarchical and Mixture of Gaussion	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam

19	Software and Programmes for	Lecture	**MSB 205.4**	Mid Term-1, Quiz
	sequence comparison and analysis			& End Sem Exam
20	Phylogenetics analysis software (I)	Lecture	**MSB 205.4**	Mid Term-1, Quiz & End Sem Exam
21	Molecular Structure drawing tool (I)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
22	Molecular Structure drawing tool (II)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
23	Molecular modeling/Docking (I)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
24	Molecular modeling/Docking (II)	Lecture	**MSB 205.4**	Quiz & End Sem Exam
25	Application of computational biology/Bioinformatics in Agriculture	Lecture	**MSB 205.4**	Quiz & End Sem Exam
26	Application of computational biology/Bioinformatics in Human health	Lecture	**MSB 205.4**	Quiz & End Sem Exam
27	Application of computational biology/Bioinformatics in Human health	Lecture	**MSB 205.4**	Quiz & End Sem Exam
28	Application of computational biology/Bioinformatics in Environment	Lecture	**MSB 205.4**	Quiz & End Sem Exam
29	Application of computational biology/Bioinformatics in Environment	Lecture	**MSB 205.4**	Quiz & End Sem Exam
30	Application of computational biology/Bioinformatics in Neurobiology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
31	Application of computational biology/Bioinformatics in Neurobiology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
32	Application of computational biology/Bioinformatics in molecular Biology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
33	Application of computational biology/Bioinformatics in molecular Biology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
34	Application of computational biology/Bioinformatics in Drug Designing	Lecture	**MSB 205.4**	Quiz & End Sem Exam

35	Application of computational biology/Bioinformatics in Drug	Lecture	**MSB 205.4**	Quiz & End Sem Exam
	Designing			
36	Application of computational biology/Bioinformatics in Veterinary Science	Lecture	**MSB 205.4**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 205.1	Understand and explain the development of computational biology	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.2	Describe the fundamentals of bioinformatics databases and their application	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.3	Understand and explain the use of various computational methods for phylogentic studies	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.3	Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling. Explain the applications of computational biology in different fields of sciences	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

Amity Institute Biotechnology 2019-20						
Class: M.Sc. Biotechnology II Semester						
Subject Name: Computational Biology		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

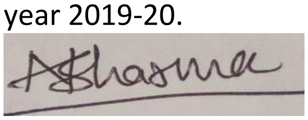
- Understand and explain the development of computational biology.
- Describe the fundamentals of bioinformatics databases and their application.
- Understand and explain the use of various computational methods for phylogentic studies.
- Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling.
- Explain the applications of computational biology in different fields of sciences.

CO Map	Question No.	Question	Marks
CO1	Q.1	Bioinformatics is the integrated field of science" Explain this statement with suitable examples.	6
CO2	Q.2	What is a primary sequence database? Give any five examples of primary databases with features.	6
	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	Compare the Global and Local alignment methods with suitable example of matrix.	6
CO4	Q.5	Give the description of commonly used secondary databases of nucleic acid and protein.	6
CO3	Q.6	Write any five applications of bioinformatics in biological sciences and agriculture.	6
	Q.7	BLAST is a popular program for exploring protein family relationship. Discuss the types and applications of BLAST program.	10

CO4	Q.8	What is Neighbor-joining and UPGMA method? How it is useful in constructing phylogenetic tree.	10
CO3	Q.9	What is sequence alignment? Write the difference between pairwise and multiple sequence alignment.	10
CO3	Q.10	A. Consider the following multiple sequence alignment: A.TCGGTAGGCT B. ACCGTTCCAT C. ACCCAAGGCT D. ATGGTAGGCT How many rooted and un-rooted phylogenies can you construct out of the taxa shown in the alignment? Explain any one method to construct a phylogenetic tree. B. Explain dendogram, cladogram and phylogram. How many different unrooted and rooted trees topologies are possible for 3, 4 and 5 species?	20

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Computational Biology***/Course code ***MSB 205*** is level **3** for the academic year 2019-20.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	MSB 301	3	3	3	1	1	-	-	1	2	1	3	2	1	1

AMITY UNIVERSITY
MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY
Course Code : MSB 301, Crédits : 03, Session :2019-20(Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: The aim to teach immunology and immuno technology to the students for their better understanding of immune system, types and mechanism of immunity, immune responses, their tolerance and suppression as well as tools and techniques involved in diagnosis and identification of immune related diseases.

B. Course Outcomes: After successful completion of the course student will be able to:

MSB 301.1. Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.

MSB 301.2. Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.

MSB 301.3. Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.

MSB 301.4. the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Types of immunity - innate, aquired, passive and active physiology of immune response – MI and CMI specificity and memory. Antigen, antibody reactions. Antigens types Hapten, immunoglobuin structure, distribution and function

Module II

Molecular biology of Ig synthesis, Lymphoid tissues – ontogeny and physiology of immuno system - origin and development, differentiation of lymphocytes. Lymphocyte subpopulation of mouse and man. Structure and function of class I and II molecules antigen distribution in population – HLA in human health and diseases. Transplantation immunity – organ transplantation and HLA tissue typing.

Module III

Cell mediated cytotoxicity. Hypersensitivity reactions, cellular interaction in immune response. Antigen recognition. T.B. cell receptors, MHC restriction, Lymphocyte activation clonal proliferation, differentiation. Interleukins and their roles. The complement systems mode of activation, classical and alternate pathway biological functions.

Module IV

Introduction to tumor immunology, autoimmune disorders and immunology of infectious diseases.

Antigen antibody reactions in vitro methods agglutination precipitation, complement fixation, immunofluorescence, immunoelectrophoresis, ELISA, Radio immuno assays, In vitro methods, skin

tests and immune complex tissue demonstrations. Applications of these methods in diagnosis of microbial infections, Vaccines

G. **Examination Scheme:**

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. **Suggested Text/Reference Books:**

Text:

- Kuby Immunology, R.A. Goldsby, T.J. Kindt and B.A. Obsorne, Freeman
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company

References:

- Immunology (Sixth Edition), Roitt, Brostoff, Male, Panima Publication
- Fundamentals of Immunology, W. Paul, Lippincot Williams and Wilkins
- Immunology, W.L. Anderson, Frence Creek Publishing (Blackwell)
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.
- Immunology, Poitt, Mosby – Yearbook Inc.
- Perkin Elmer Antibody Manual
- Production of Monoclonal Antibodies – Detailed Protocol, G.K. Lewis, University of Maryland

I. **Lecture Plan**

Lecture	**Topics**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing CO**
1	Type of immunity	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
2	Antigen and haptens	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
3	Antibody : function and structure	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
4	Types of antibody and their functions	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
5	Synthesis of Ig molecule	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
6	Light Chain gene rearrangement	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
7	Heavy Chain gene rearrangement	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
8	Antibody Diversity	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
9	Primary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam

10	Primary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam

11	Secondary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
12	Secondary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
13	MHC I: Structure, types and function	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
14	MHC II: Structure, types and function	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
15	Transplantation Immunology	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
16	Cell mediated cytotoxicity	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
17	Hypersensitivity : Types and function.	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
18	Hypersensitivity : Types and function.	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
19	Complement system: Types and importance	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
20	Complement system: Types and importance and Regulation	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
21	Lymphocyte activation and clonal proliferation	Lecture	**MSB 301.3**	Mid Term-2, Quiz & End Sem Exam
22	Antigen recognition and T.B. cell receptor	Lecture	**MSB 301.3**	Mid Term-2, Quiz & End Sem Exam
23	Revision of module I and II	Lecture	**MSB 301.3**	Mid Term-2, Quiz & End Sem Exam
24	Introduction of tumor immunology	Lecture	**MSB 301.3**	Quiz & End Sem Exam
25	Tumor immunology	Lecture	**MSB 301.4**	Quiz & End Sem Exam
26	Autoimmune disorder: Organ specific	Lecture	**MSB 301.4**	Quiz & End Sem Exam
27	Autoimmune disorder: systemic	Lecture	**MSB 301.4**	Quiz & End Sem Exam
28	Autoimmunity : mechanism and regulation	Lecture	**MSB 301.4**	Quiz & End Sem Exam
29	Agglutination reaction	Lecture	**MSB 301.4**	Quiz & End Sem Exam
30	Precipitation reaction	Lecture	**MSB 301.4**	Quiz & End Sem Exam
31	Complement fixation	Lecture	**MSB 301.4**	Quiz & End Sem Exam
32	Immunofluorescence and immunoelectrophoresis	Lecture	**MSB 301.4**	Quiz & End Sem Exam
33	ELISA and RIA	Lecture	**MSB 301.4**	Quiz & End Sem Exam

34	Skin test and immune complex tissue demonstration	Lecture	**MSB 301.4**	Quiz & End Sem Exam

35	Application of these methods in diagnosis of microbial infection, Vaccines	Lecture	**MSB 301.4**	Quiz & End Sem Exam
36	Immunofluorescence and immunoelectrophoresis	Lecture	**MSB 301.4**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 301.1	Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.	3	3	3	1	1	-	-	1	2	1	3	2	1	1
MSB 301.2	Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 301.3	Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

MSB 301.4	the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

Amity Institute Biotechnology 2019-20		
Class: M.Sc. Biotechnology IIISemester		
Subject Name: Computational Biology	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

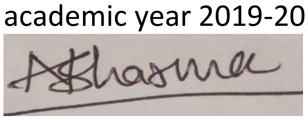
- Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
- Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
- Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
- the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

CO Map	Question No.	Question	Marks
CO1	Q.1	Specific immunity exhibits four characteristic attributes, which are mediated by lymphocytes. List these four attributes and briefly explain how they arise.	6
CO2	Q.2	Draw a schematic diagram of a typical IgG molecule and label each of the following parts: H chains, L chains, inter-chain disulfide bonds, intra-chain disulfide bonds, hinge, Fab, Fc, and all the domains. Indicate which domains are involved in antigen binding.	6

	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	What is antigen? Discuss about the typing procedures for HLA antigens.	6
CO4	Q.5	Describe one advantage and one disadvantage of N-nucleotide addition during the rearrangement of immunoglobulin heavy-chain gene segments.	6
CO3	Q.6	Explain why NK cells from a given host will kill many types of virus-infected cells but do not kill normal cells from that host.	6
	Q.7	Discuss about that the role of cell-Mediated Immunity is Important for Viral Control and Clearance.	10
CO4	Q.8	What is the mechanism of tumor generation and how does normal cells are differentiated from transformed cells?	10
CO3	Q.9	Describe the main stages of leukocyte migration from the blood to a site of inflammation.	10
CO3	Q.10	What are the hallmark features of adaptive immunity? An individual has a mutation severely inhibiting the natural function of the transporter associated with antigen processing (TAP). Which antigen processing pathway would be rendered inefficient? What classes of agents would the individual have a problem attacking and why?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advanced Immunology***/Course code ***MSB 301*** is level **3** for the academic year 2019-20.



AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY LAB
Course Code : MSB 320, Crédits : 01, Session :2019-20(Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe the immunological questions through experimentation. The aim is also to explain the antigen antibody interaction patterns through various experiments.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MSB 320.1. Demonstrate detailed knowledge of purification of immunologlobulin, cells and antigen antibody interaction.

MSB 320.2. Apply knowledge and incorporate experimental understanding of the agglutination mechanism.

MSB 320.3. Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge

base in premium processes and applications which will profoundly influence or utilized

for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Course Contents:

1. Purification of immunoglobin G.
2. Study of antigen- antibody pattern (ODD).
3. Study of sandwich ELISA.
4. Study of haemeagglutination.
5. Study of immunoelectrophoresis.
6. Isolation and identification of rosette cells.
7. Antigen capture ELISA

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;
A: Attendance

H. Suggested Text/Reference Books:

- Manual of Molecular and Clinical Laboratory Immunology, 8th Edition Barbara Detrick (Editor), John L. Schmitz (Editor), Robert G. Hamilton (Editor) ISBN: 978-1-555-81871-5 May 2016 ASM Press
- Immunology Laboratory Manual Published by LAP LAMBERT Academic Publishing (2018) ISBN 10: 6138386175 ISBN 13: 9786138386179

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Purification of Immunoglobulin G	Lecture	**MSB 320.1**	Mid Term-1, Quiz & End Sem Exam
2	Radial Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
3	Double Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
4	Study of sandwich ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
5	Study of DOT ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
6	Study of heamagglutination (Blood group)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
7	Rh factor determination	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
8	Study of heamagglutination (Widal test)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
9	Study of immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
10	Study of rocket immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
11	Isolation and identification of rostte cells	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam

12	Revision and discussion	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 320.1	Demonstrate detailed knowledge of purification of immunoglobulin, cells and antigen antibody interaction.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 320.2	Apply knowledge and incorporate experimental understanding of the agglutination mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 320.3	Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

Amity Institute Biotechnology
2019-20

Class: M.Sc. Biotechnology

III Semester

Subject Name: Advanced Immunology Lab	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.3 & Q.4	Q.1		Q.2		

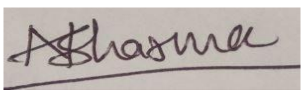
Student will be able to:

- Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
- Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
- Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
- the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

CO Map	Question No.	Question	Marks
CO1	Q.1	Perform Dot Elisa for detection of antigen-antibody interaction.	35
CO2	Q.2	Perform hemagglutination (Blood group) test.	15
	Q.3	*Viva-voce*	10
CO 3	Q.4	Record	10

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advanced Immunology lab***/Course code ***MSB 320*** is level **3** for the academic year 2019-20.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM SPECIFIC OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3: Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MSB101	3	3	2	3	1	3	2	2	2	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED BIOCHEMISTRY
Course Code : MSB 101, Credits: 04, Session :2021-22 (Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** Objective of this course is to help students navigate the discipline of biochemistry that explains how the collection of inanimate molecules that constitute the living systems interact, to maintain and perpetuate life. This knowledge has its roots in medicine, nutrition, agriculture, fermentation and natural products chemistry. It also aims to provide an understanding of the principles and application of primary and secondary metabolites.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB101.1. Understand the basics of structures of biopolymers.

MSB101.2. Learn carbohydrate metabolism in detail by analyzing all the pathways.

MSB101.3. Learn the various aspects of lipid metabolism and their regulation.

MSB101.4. Understand the metabolism of Nitrogen and excretion of urea from body.

MSB101.5. Learn Nucleotide metabolism and clinical disorders of purine metabolism.

MSB101.6. Develop advanced knowledge of action of major hormones.

MSB101.7. Understand the principles and application of primary and secondary metabolites.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Basics of structures of biopolymers; Carbohydrates, Lipids, Proteins and Nucleic Acids.

Module II
Carbohydrates Metabolsm – I
Anaerobic processes in generating metabolic energy

Glycolysis, fates of pyruvate: Lactate and ethanol metabolism, regulation of glycolysis, glycogen mobilization, regulation of glycogen breakdown.

Oxidative processes: Pyruvate oxidation, coenzymes involved in pyruvate oxidation and citric acid cycle, action of PDH, Complex, Krebs Cycle, Regulation of PDH and Krebs Cycle, anaplerotic sequences, glyoxylate cycle, PPP, Human genetic disorder involving PPP enzymes.

ETC and OP: Electron carriers in respiratory chain, OP, enzyme system for ATP synthesis, chemiosmotic coupling.

Carbohydrate Metabolism – II
Gluconeogenesis. Ethanol consumption and gluconeogenesis, reciprocal regulation of glycolysis and gluconeogenesis, glycogen metabolism in humans, photosynthesis.

Module III: Lipid Metabolism
Utilization and transport of fat and cholesterol, lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C

chain, control of fatty acid oxidation, biosynthesis of fatty acids, fatty acid desaturation, control of fatty acid synthesis, variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.

Module IV: Nitrogen Metabolism

Utilization of ammonia – GDH, GS, transamination, Biosynthetic of amino acids, amino acids degradation, detoxification and excretion of ammonia, urea cycle, transport of ammonia to liver, porphyrin and hememetabolism – The succinate-glycine pathway, Biological Nitrogen fixation.

Module V: Nucleotide Metabolism

De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides, purine degradation and clinical disorders of purine metabolism (Gout, lesch – nyhan syndrome, immuno deficiency), pyrimidine breakdown, reduction of ribonucleotides to deoxyibonucleotides, thymidylate synthetase – a target enzyme for chemotheraphy.

Module VI: Integration of cellular metabolism and hormonal regulation

Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation.

Module VII: Secondary Plant Metabolism

Importance of secondary metabolites, terpenes, classification, mevalonic acid pathway, phenolic compounds, shikimic acid pathway, alkaloids.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox. , Worth Publishing

References:

- Harper's Biochemistry K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw Hill/ Appleton and Lange.
- Biochemistry (Fifth Edition), Lubert Stryer

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Basics of structures of Carbohydrates	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
2	Basics of structures of Carbohydrates	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
3	Basics of structures of Lipids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
4	Basics of structures of Lipids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
5	Basics of structures of Proteins	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
6	Basics of structures of Proteins	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
7	Basics of structures of Nucleic Acids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
8	Basics of structures of Nucleic Acids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
9	Anaerobic processes in generating metabolic energy	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
10	Glycolysis, fates of pyruvate: Lactate and ethanol metabolism	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
11	Glycolysis, fates of pyruvate: Lactate and ethanol metabolism	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
12	regulation of glycolysis, glycogen mobilization	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
13	glycogen breakdown	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
14	Oxidative processes: Pyruvate oxidation, coenzymes involved in pyruvate oxidation	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
15	citric acid cycle, action of PDH, Complex	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
16	Krebs Cycle, Regulation of PDH and Krebs Cycle, anaplerotic sequences	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
17	glyoxylate cycle, PPP, Human genetic disorder involving PPP enzymes.	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
18	ETC and OP: Electron carriers in respiratory chain, OP.	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
19	enzyme system for ATP synthesis, chemiosmotic coupling	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
20	Gluconeogenesis. Ethanol consumption and gluconeogenesis	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam

21	reciprocal regulation of glycolysis and gluconeogenesis, glycogen metabolism in humans	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
22	Photosynthesis	Lecture	MSB101.2	Mid Term, Quiz
				& End Sem Exam
23	Utilization and transport of fat and cholesterol	Lecture	MSB101.3	Mid Term, Quiz & End Sem Exam
24	lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain	Lecture	MSB101.3	Mid Term, Quiz & End Sem Exam
25	lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain	Lecture	MSB101.3	Quiz & End Sem Exam
26	control of fatty acid oxidation	Lecture	MSB101.3	Quiz & End Sem Exam
27	biosynthesis of fatty acids, fatty acid desaturation	Lecture	MSB101.3	Quiz & End Sem Exam
28	control of fatty acid synthesis	Lecture	MSB1013	Quiz & End Sem Exam
29	variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.	Lecture	MSB101.3	Quiz & End Sem Exam
30	variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.	Lecture	MSB101.3	Quiz & End Sem Exam
31	Utilization of ammonia, transamination	Lecture	MSB101.4	Quiz & End Sem Exam
32	Biosynthetic of amino acids, amino acids degradation	Lecture	MSB101.4	Quiz & End Sem Exam
33	detoxification and excretion of ammonia	Lecture	MSB101.4	Quiz & End Sem Exam
34	urea cycle, transport of ammonia to liver	Lecture	MSB101.4	Quiz & End Sem Exam
35	porphyrin and hememetabolism	Lecture	MSB101.4	Quiz & End Sem Exam
36	The succinate-glycine pathway, Biological Nitrogen fixation	Lecture	MSB101.4	Quiz & End Sem Exam
37	De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
38	De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides	Lecture	MSB101.5	Quiz & End Sem Exam

39	purine degradation and clinical disorders of purine metabolism (Gout, lesch – nyhan syndrome, immuno deficiency)	Lecture	MSB101.5	Quiz & End Sem Exam
40	pyrimidine breakdown, reduction of ribonucleotides to deoxyribonucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
41	pyrimidine breakdown, reduction of ribonucleotides to	Lecture	MSB101.5	Quiz & End Sem Exam
	deoxyribonucleotides			
42	thymidylate synthetase – a target enzyme for chemotheraphy	Lecture	MSB101.5	Quiz & End Sem Exam
43	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
44	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
45	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
46	Importance of secondary metabolites-terpenes, classification	Lecture	MSB101.7	Quiz & End Sem Exam
47	mevalonic acid pathway, phenolic compounds	Lecture	MSB101.7	Quiz & End Sem Exam
48	shikimic acid pathway, alkaloids	Lecture	MSB101.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB101.1.	Understand the basics of structures of biopolymers.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.2 .	Learn carbohydrate metabolism in detail by analyzing all the pathways.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1

MSB101.3.	Learn the various aspects of lipid metabolism and their regulation.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.4.	Understand the metabolism of Nitrogen and excretion of urea from body.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.5 .	Learn Nucleotide metabolism and clinical disorders of purine metabolism.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.6 **.**	Develop advanced knowledge of action of major hormones.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.7 **.**	Understand the principles and application of primary and secondary metabolites.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –I) 2021-22						
Class: M.Sc. Biotechnology I Semester						
Subject Name: MSB 101 ADVANCED BIOCHEMISTRY		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biomolecules with examples.	3
CO1	Q.2a	What do you understand by phosphorylation?	3
	Q.2b	Discuss secondary metabolites in brief.	3
CO1	Q.3	Give an account of lipid transport in body.	6
CO2	Q.4	Explain the significance of urea cycle in clinics.	3
CO2	Q.5a	What are the factors favoring nucleic acid synthesis?	3
	Q.5b	Discuss the different factors affecting cholesterol synthesis.	3
CO2	Q 6	Phosphofructokinase I is the pace maker of glycolysis. Why?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Biochemistry**/Course code **MSB-101** is level **3** for the academic year 2019-20.

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Advanced Microbial Technology
Course Code : MSB102, Credits : 03, Session : 2019-20(Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To acquaint the students to understand the basic concept of microbiology and role of various microorganisms in different biotechnological applications, various techniques for their cultivation and control.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB102.1. Study morphology, classification, forms, of bacteria, archaebacteria, mycoplasma and PPLO. Different types of media & their preparations. Isolation of pure cultures, maintenance and preservation. Culture characteristics and Bacterial growth, growth curve, batch and continuous cultures di auxic and synchronous growth enumeration of cells by direct and indirect methods.

MSB102.2. Able to understand the Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals, antiviral etc.

MSB102.3. Know about the Molecular classification of microbes, microbial genetics, prokaryotic gene organization, DNA, replication, transcription and translation. Microbial regulation of gene expression: trp and lac operon. Gene Transfer and Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics and Reproductive cycles of bacteriophage, T4 phage and lambda.

MSB102.4. Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms. Applications of microbiology in effective diagnosis, treatment and prevention of infectious disease.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate the most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need for professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize students to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist,

advanced molecular biology, advances in genetic engineering, bioprocess technology,

advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Introduction to Microbiology: Bacteria Morphology and classification. Abnormal forms of bacteria, archaebacteria, mycoplasma and PPLO, cultivation of bacteria nutritional requirements of microorganism, physical requirements, different types of media & their preparations. Isolation of pure cultures, maintenance and preservation of the pure cultures. Culture characteristics Bacterial growth Growth curve, batch and continuous cultures di-auxic and synchronous growth enumeration of cells by direct and indirect methods.

Module II: Control of Microorganisms: Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals, antiviral etc.

Module III: Microbial Genetics: Molecular classification of microbes, The Basics of microbial genetics, prokaryotic gene organization. The basic principles of microbial DNA, replication, transcription and translation. Microbial regulation of gene expression: the trp and lac operon. Gene Transfer Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics Reproductive cycles of bacteriophage, T4 and lambda.

Module IV: Medical Microbiology: Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms (bacteria, fungi, parasites, and viruses), applications of the basic principles of microbiology in effective diagnosis, treatment and prevention of infectious disease.

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill
- General Microbiology, R.Y. Stanier, J.L. Ingraham, M. L. Wheelis and P.R. Painter, Macmillian

- Principles of Microbiology, R.M. Atlas, Wm C. Brown Publisher.
- The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing Benjamin Cummings.
- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin& Cummings.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction to Microbiology	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
2	Discovery of Microbial World	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
3	Spontaneous Generation	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
4	Role of microbes in disease causation	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
5	Development of Pure Culture	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
6	Methods in Microbiology	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
7	Principle of Microbial Nutrition	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
8	Culture Media Types	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
9	Theory of Sterilization	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
10	Practice of Sterilization	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
11	Concept of Sterilization	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam

12	Disinfection	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
13	Methods of Control	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
14	Chemotherapeutics	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
15	Mode of Action of Antibiotics	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
16	Penicillin and Ampicillin	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
17	Sulfonamide and Vanomycin	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
18	Streptomycin and Tatracycline	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
19	Chloramphenicol	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
20	Antifungals and Antivirals	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
21	Basics of Microbial Genetics and Prokaryotic gene organization	Lecture	MSB 102.3	Quiz & End Sem Exam
22	Principles of Microbial DNA	Lecture	MSB 102.3	Quiz & End Sem Exam
23	Replication, Transcription, Translation	Lecture	MSB 102.3	Quiz & End Sem Exam
24	Regulation of Gene Expression: Trp and Lac Operon	Lecture	MSB 102.3	Quiz & End Sem Exam
25	Transformation, Transduction, Conjugation	Lecture	MSB 102.3	Quiz & End Sem Exam
26	Plasmids and Transposons	Lecture	MSB 102.3	Quiz & End Sem Exam
27	Viral Genetics	Lecture	MSB 102.3	Quiz & End Sem Exam

28	Reproductive Cycles of Bacteriophage, T4 and Lambda	Lecture	MSB 102.3	Quiz & End Sem Exam
29	Normal Microflora of Host	Lecture	MSB 102.4	Quiz & End Sem Exam
30	Host Parasite Interactions	Lecture	MSB 102.4	Quiz & End Sem Exam
31	Mechanisms of Pathogenesis	Lecture	MSB 102.4	Quiz & End Sem Exam
32	Clinical manifestations associated to medically important pathogens	Lecture	MSB 102.4	Quiz & End Sem Exam
33	Applications of Microbiology	Lecture	MSB 102.4	Quiz & End Sem Exam
34	Diagnosis of Diseases	Lecture	MSB 102.4	Quiz & End Sem Exam
35	Treatment of different microbial diseases	Lecture	MSB 102.4	Quiz & End Sem Exam
36	Prevention of different microbial diseases	Lecture	MSB 102.4	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4

MSB 102.1	Study morphology, classification, forms of bacteria, archaebacteria, mycoplasma and PPLO. Different types of media & their preparations. Isolation of pure cultures, maintenance and preservation. Culture characteristics and Bacterial growth, growth curve, batch and continuous cultures di auxic and synchronous growth Eneumeration of	3	2	2	2	2	2	2	2	2	1	3	2	2	2
	cells by direct and indirect methods.														
MSB 102.2	Able to understand the Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals antiviral	3	2	2	2	2	2	2	2	2	1	3	2	2	2

MSB 102.3	Know about the Molecular classification of microbes, microbial genetics, prokaryotic gene organization, DNA, replication, transcription and translation. Microbial regulation of gene expression: trp and lac operon. Gene Transfer and Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics and Reproductive cycles of bacteriophage, T4 phage and lambda.	3	2	2	2	2	2	2	2	2	1	3	2	2	2
MSB 102.4	Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms (bacteria, fungi, parasites, and viruses),	3	2	2	2	2	2	2	2	2	1	3	2	2	2
	applications of the basic principles of microbiology in effective diagnosis, treatment and prevention of infectious disease.														

<u>Sample Question Paper</u>

Amity Institute of Biotechnology MID-SEMESTER 2019-20
Class: M.Sc. (Biotech) I Semester

Subject Name: MSB 102 Advanced Microbial Technology		Time: 2 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to

CO1: List the broad perspective of microbiology and microbial technology.

CO2: Apply the knowledge to different types of microbes

(Bacteria, Virus, Algae, Fungus and Protozoa).

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the microbial nutritional requirement.	3
CO1	Q.2a	What are different sterilization techniques?	3
	Q.2b	How the mode of action of Penicillin and chloramphenicol are different from each other?	3
CO1	Q.3	How Lactose Operon works in presence and absence of Lactose as a positive or negative regulation?	6
CO2	Q.4	Explain the application of microbiology in effective diagnosis, treatment and prevention of infectious diseases.	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Microbial Technology/MSB 102** is **level 3** for the academic year 2019-20.

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MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MSB120	3	3	3	3	-	1	2	-	2	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY LAB
Course Code : MSB 120, Credits: 02, Session :2021-22 (Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend advanced understanding of the qualitative and quantitative estimation of proteins and nucleic acids.

B. Course Outcomes: At the end of the course, students will be able to:

MSB120.1. Understand the practical based learning of estimation of proteins.
MSB120.2. Understand the practical based learning of enzyme activity.
MSB120.3. Understand the practical based learning of estimation of DNA & RNA.
MSB120.4. Understand the practical based learning of estimation of carbohydrate.
MSB120.5. Understand the practical based learning of estimation of lipid.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Proteins
Identification of protein by Biuret test.
Quantization of protein by Bradford method
Separation of proteins by SDS-PAGE
Module II: Enzyme
Enzyme activity study of serum alkaline phosphates.
Module III: Nucleic Acid
Biochemical estimation of DNA
Biochemical estimation of RNA
Separation of DNA on Agarose gel.
Module IV: Carbohydrate
Biochemical estimation of blood sugar
Module V: Lipids
Blood Cholesterol estimation.

G. Examination Scheme:

IA	EE

Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
4	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
5	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
6	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
7	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
8	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
9	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
10	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
11	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
12	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
13	Biochemical estimation of DNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
14	Biochemical estimation of DNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
15	Biochemical estimation of RNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam

16	Biochemical estimation of RNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
17	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
18	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
19	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
20	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
21	Biochemical estimation of blood sugar	Practical	MSB120.4	Class Test (Practical Based) & End Sem Exam
22	Biochemical estimation of blood sugar	Practical	MSB120.4	Class Test (Practical Based) & End Sem Exam
23	Blood Cholesterol estimation	Practical	MSB120.5	Class Test (Practical Based) & End Sem Exam
24	Blood Cholesterol estimation	Practical	MSB120.5	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB120.1.	Understand the practical based learning of estimation of proteins.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.2.	Understand the practical based learning of enzyme activity.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.3.	Understand the practical based learning of estimation of DNA & RNA.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.4.	Understand the practical based learning of estimation of carbohydrate.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.5.	Understand the practical based learning of estimation of lipid.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Biochemistry Lab**/Course code **MSB-120** is level **3** for the academic year 2019-20.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

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PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess

technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MSB201	3	3	2	3	1	3	2	2	2	1

AMITY UNIVERSITY
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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED MOLECULAR BIOLOGY
Course Code : MSB 201, Credits: 04, Session :2021-22 (Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The objective of the course is to provide a clear understanding of DNA (genetic material) so that they can manipulate it and understand basic tools and techniques involved in its manipulation. Strong foundation in molecular biology enables the students to familiarize themselves with Genetic engineering technology.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB201.1. Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes.

MSB201.2. Learn the advanced mechanism of transcription in prokaryotes and eukaryotes.

MSB201.3. Develop understanding of various post-transcriptional processes in cell.

MSB201.4. Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes.

MSB201.5. Understand about the advances of gene expression regulation.

MSB201.6. Develop advanced knowledge of various mechanisms of gene silencing.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

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PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: DNA replication and repair

DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork; termination of replication DNA repair, photo reaction, base excision repair, nucleotide excision repair, transcription coupled repair, mismatch repair , error pone repair recombinational repair.

Module II: Transcription of DNA

Transcription in prokaryotes and eukaryotes, RNA polymerase – Composition and function; transcription mechanism; transcription factor and their role, inhibition of RNA synthesis.

Module III: Processing of RNA

Procession of ribosomal and transfer RNA"s processing of mRNA-5'cap formation; 3' polyadenylation ; RNA splicing , RNA editing , RNA degradation.

Module IV: Translation

Translation mechanism in prokaryotes and eukaryotes; ribosomes, initiation of translation, elongation, termination, amino acid activation; translational recoding inhibitors, post translation modification of protein.

Module V: Regulation of gene expression

Regulation in prokaryotes – repressors and negative control, positive control, role of c AMP, Ampreceptor protein, lac, tryp, His and ara operons, Regulation in Eukaryotes=promoters and enhancers, transcriptional regulatory protein, transcriptional activators,

eukaryotic repressor.

Module VI: Gene Silencing

RNAi (SiRNA and MiRNA) molecular mechanism and current application in gene silencing, Antisense RNA technology, Biochemistry of ribozyme, Hammer head, hairpin ribozymes. Application of antisense and ribozymes in genetic engineering.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education

References:

- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Biology of the Cell by Alberts Bruce, Bray Demos, and Watson James D.
- Gene VIII, Benjamin Lewin 2005, Oxford University Press
- Molecular Cell Biology, H. Lodish, A. Berk, S. Zipursky, P Matsundaira, D. Baltimore and J.E. Barnell, W.H. Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing.

Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley and Sons Inc.

I. **Lecture Plan**

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
2	DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
3	termination of replication DNA repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
4	photo reaction	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
5	base excision repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
6	nucleotide excision repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
7	transcription coupled repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
8	mismatch repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
9	error pone repair, recombinational repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
10	Transcription in prokaryotes and eukaryotes	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
11	Transcription in prokaryotes and eukaryotes	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
12	RNA polymerase – Composition and function	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
13	transcription mechanism	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
14	transcription mechanism	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
15	transcription factor and their role	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
16	inhibition of RNA synthesis	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
17	Procession of ribosomal and transfer RNA	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
18	Procession of ribosomal and transfer RNA	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam

19	processing of mRNA-5'cap formation	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
20	3' polyadenylation	Lecture	MSB201.3	Mid Term, Quiz
				& End Sem Exam
21	RNA splicing	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
22	RNA editing	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
23	RNA degradation	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
24	Translation mechanism in prokaryotes and eukaryotes	Lecture	MSB201.4	Mid Term, Quiz & End Sem Exam
25	Translation mechanism in prokaryotes and eukaryotes	Lecture	MSB201.4	Quiz & End Sem Exam
26	ribosomes, initiation of translation	Lecture	MSB201.4	Quiz & End Sem Exam
27	Elongation	Lecture	MSB201.4	Quiz & End Sem Exam
28	termination	Lecture	MSB2014	Quiz & End Sem Exam
29	amino acid activation	Lecture	MSB201.4	Quiz & End Sem Exam
30	inhibitors, post translation modification of protein	Lecture	MSB201.4	Quiz & End Sem Exam
31	Regulation in prokaryotes	Lecture	MSB201.5	Quiz & End Sem Exam
32	repressors and negative control	Lecture	MSB201.5	Quiz & End Sem Exam
33	positive control, role of cAMP	Lecture	MSB201.5	Quiz & End Sem Exam
34	Ampreceptor protein	Lecture	MSB201.5	Quiz & End Sem Exam
35	Lac operon	Lecture	MSB201.5	Quiz & End Sem Exam
36	Tryp operon	Lecture	MSB201.5	Quiz & End Sem Exam
37	His operon	Lecture	MSB201.5	Quiz & End Sem Exam
38	His operon	Lecture	MSB201.5	Quiz & End Sem Exam
39	Regulation in Eukaryotes=promoters and enhancers	Lecture	MSB201.5	Quiz & End Sem Exam

40	transcriptional regulatory protein	Lecture	MSB201.5	Quiz & End Sem Exam
41	transcriptional activators, eukaryotic repressor	Lecture	MSB201.5	Quiz & End Sem Exam
42	RNAi (SiRNA and MiRNA)	Lecture	MSB201.6	Quiz & End Sem
				Exam
43	RNAi (SiRNA and MiRNA)	Lecture	MSB201.6	Quiz & End Sem Exam
44	molecular mechanism and current application in gene silencing	Lecture	MSB201.6	Quiz & End Sem Exam
45	Antisense RNA technology, Biochemistry of ribozyme	Lecture	MSB201.6	Quiz & End Sem Exam
46	Hammer head and hairpin ribozymes	Lecture	MSB201.6	Quiz & End Sem Exam
47	Application of antisense and ribozymes in genetic engineering	Lecture	MSB201.6	Quiz & End Sem Exam
48	Application of antisense and ribozymes in genetic engineering	Lecture	MSB201.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB201.1.	Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.2.	Learn the advanced mechanism of transcription in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.3.	Develop understanding of various post-transcriptional processes in cell.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.4.	Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.5.	Understand about the advances of gene expression regulation.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.6 .	Develop advanced knowledge of various mechanisms of gene silencing.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
I MID-SEMESTER (SEM –II) 2021-22</td></tr>
<tr><td colspan="7">Class: M.Sc. Biotechnology II Semester</td></tr>
<tr><td colspan="2">Subject Name:
MSB 101 ADVANCED MOLECULAR BIOLOGY</td><td colspan="3">Time: 1.5 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4</td><td>Q.2,3</td><td>Q.4</td><td>Q.2,5,6</td><td></td><td></td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the types of nucleic acids with examples.	3
CO1	Q.2	What do you understand by semi conservative mode of DNA replication?	6
CO1	Q.3	Give an account of transcription termination in *E. coli*.	6
CO2	Q.4	Explain the significance of poly A tail in RNA.	3
CO2	Q.5a	tRNA acts as an adapter molecule in translation. Discuss.	3
	Q.5b	Discuss the different mechanisms of antisense technology.	3
CO2	Q 6	How does post-translation modification ensure the functionality of a protein? Discuss.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Molecular Biology** /Course code **MSB-201** is level **3** for the academic year 2019-20.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess

technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MSB220	3	3	2	3	1	3	2	2	2	3

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED MOLECULAR BIOLOGY LAB
Course Code : MSB 220, Credits: 02, Session :2021-22 (Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend the advanced understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. Course Outcomes: At the end of the course, students will be able to:

MSB220.1. Understand the practical based learning of isolation of nucleic acids and DNA protein interaction.

MSB220.2. Understand the practical based learning in-vitro transcription, translation and repair mechanism.

MSB220.3. Understand the practical based learning of PCR and Gradient PCR.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. **Programme Specific Outcomes:**

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. **Assessment Plan:**

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

1. Isolation of genomic DNA from prokaryotic and Eukaryotes.
2. Isolation of plasmid.
3. Study of DNA protein interaction.
4. Study of in vitro transcription.
5. Study of DNA methylation.
6. Study of DNA repair mechanism.
7. Invitro study of translation
8. Isolation of RNA
9. PCR and Gradient PCR

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:

Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of genomic DNA from prokaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
2	Isolation of genomic DNA from prokaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of genomic DNA from eukaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
4	Isolation of genomic DNA from eukaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
5	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
6	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
7	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
8	Study of DNA protein interaction	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
9	Study of DNA protein interaction	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
10	Study of in vitro transcription	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
11	Study of in vitro transcription	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
12	Study of DNA methylation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
13	Study of DNA methylation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
14	Study of DNA repair mechanism	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
15	Study of DNA repair mechanism	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam

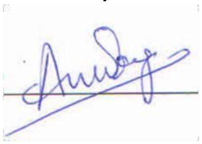
16	Invitro study of translation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
17	Invitro study of translation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
18	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
19	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
20	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
21	PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
22	PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
23	Gradient PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
24	Gradient PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam

J. **Course Articulation Matrix (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB220.1.	Understand the practical based learning of isolation of nucleic acids and DNA protein interaction.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB220.2.	Understand the practical based learning in-vitro transcription, translation and repair mechanism.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB220.3.	Understand the practical based learning of PCR and Gradient PCR.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology Lab**/Course code **MSB-220** is level **3** for the academic year 2019-20.



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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

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PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
III SEM	MSB302	3	3	2	3	1	3	2	2	2	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENZYME TECHNOLOGY
Course Code : MSB 302, Credits: 03, Session :2021-22 (Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The course aims to provide an understanding of the principles and application of proteins, secondary metabolites and enzyme biochemistry in therapeutic applications and clinical diagnosis. The theoretical understanding of biochemical systems would certainly help to interpret the results of laboratory experiments.

B. Course Outcomes: At the end of the course, students will be able to:

MSB302.1. Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action.

MSB302.2. Understand about various modes of inhibition of enzyme actions with examples.

MSB302.3. Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc.

MSB302.4. Learn enzyme reactors and various parameters for bio-process design.

MSB302.5. Learn about the concepts of bio-process design.

MSB302.6. Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Enzymes

Introduction and scope, Nomenclature, Mechanism of Catalysis, enzyme catalysis in organic media, Industrial applications.

Module II: Enzyme Kinetics

Single substrate steady state kinetics; King-Altman's method; Inhibitors and activators; Multi-substrate systems; Effect of pH and temperature; Allosteric enzymes. Thermodynamic explanation for transition complex formation, limitations of Michaelis – Menten equation, LB plot method to study enzyme kinetics, effect of pH

And temperature on kinetics,allosteric enzyme kinetics,models as WMC, KNF with examples of ACTase and Hb.

Module III: Immobilization of Enzymes

Advantages, Carriers, adsorption, covalent coupling, cross-linking and entrapment methods, Micro-environmental effects

Module IV: Enzyme Reactors

Reactors for batch/continuous enzymatic processing, Choice ot reactor type: idealized enzyme reactor systems; Mass Transfer in Enzyme Reactors: Steady state analysis of mass transfer and biochemical reaction in enzyme reactors.

Module V: Bio-process Design

Physical parameters, reactor operational stability; Immobilized cells.

Module VI: Challenges and future trends

Catalytic antibodies and Non-protein biomolecules as catalysts, Biocatalysts from Extreme Thermoph!lic and Hyperthermophilic Archaea and Bacteria.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Enzyme Technology, M.F. Chaplin and C. Bucke, Cambridge University Press.

References:

- Biotechnological Innovations in Chemical Synthesis, R.C.B. Currell, V.D. Mieras, Biotol Partners Staff, Butterworth Heinemann.
- Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis, R.A. Copeland, John Wiley and Sons Inc.
- Enzymes Biochemistry, Biotechnology, Clinical Chemistry, Trevor Palner
- Enzyme Kinetics: Behaviour and Analysis of Rapid Equilibrium and Steady State Enzyme Systems, I.H. Segel, Wiley-Interscience
- Industrial Enzymes & their applications, H. Uhlig, John Wiley and Sons Inc

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction and scope	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
2	Nomenclature	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
3	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
4	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
5	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
6	enzyme catalysis in organic media	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
7	Industrial applications	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
8	Single substrate steady state kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
9	Single substrate steady state kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
10	King-Altman's method	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
11	Inhibitors and activators	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
12	Multi-substrate systems	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
13	Effect of pH and temperature	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam

14	Allosteric enzymes	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
15	Thermodynamic explanation for transition complex formation	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
16	limitations of Michaelis – Menten equation	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
17	LB plot method to study enzyme kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
18	effect of pH and temperature on kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
19	allosteric enzyme kinetics	Lecture	MSB302.2	Quiz & End Sem Exam
20	models as WMC, KNF with examples of ACTase and Hb	Lecture	MSB302.2	Quiz & End Sem Exam
21	models as WMC, KNF with examples of ACTase and Hb	Lecture	MSB302.2	Quiz & End Sem Exam
22	Advantages, Carriers, adsorption	Lecture	MSB302.3	Quiz & End Sem Exam
23	covalent coupling, cross-linking and entrapment methods	Lecture	MSB302.3	Quiz & End Sem Exam
24	covalent coupling, cross-linking and entrapment methods	Lecture	MSB302.3	Quiz & End Sem Exam
25	Micro-environmental effects	Lecture	MSB302.3	Quiz & End Sem Exam
26	Reactors for batch/continuous enzymatic processing	Lecture	MSB302.4	Quiz & End Sem Exam
27	Choice of reactor type: idealized enzyme reactor systems	Lecture	MSB302.4	Quiz & End Sem Exam
28	Mass Transfer in Enzyme Reactors	Lecture	MSB302.4	Quiz & End Sem Exam
29	Steady state analysis of mass transfer	Lecture	MSB302.4	Quiz & End Sem Exam
30	biochemical reaction in enzyme reactors	Lecture	MSB302.4	Quiz & End Sem Exam
31	Physical parameters	Lecture	MSB302.5	Quiz & End Sem Exam
32	reactor operational stability	Lecture	MSB302.5	Quiz & End Sem Exam
33	Immobilized cells	Lecture	MSB302.5	Quiz & End Sem Exam
34	Catalytic antibodies and Non-protein biomolecules as catalysts	Lecture	MSB302.6	Quiz & End Sem Exam
35	Biocatalysts from Extreme Thermophilic bacteria	Lecture	MSB302.6	Quiz & End Sem Exam
36	Hyperthermophilic Archaea and Bacteria	Lecture	MSB302.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB302.1.	Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.2.	Understand about various modes of inhibition of enzyme actions with examples.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.3.	Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.4.	Learn enzyme reactors and various parameters for bio-process design.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.5.	Learn about the concepts of bio-process design.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.6.	Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

Sample Question Paper

Amity Institute of Biotechnology
I MID-SEMESTER (SEM –III) 2021-22

Class: M.Sc. Biotechnology III Semester

Subject Name: MSB 302 ENZYME TECHNOLOGY	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss in brief about the nomenclature of Enzymes.	3
CO1	Q.2	Explain the Lineweaver Burk plot & its significance.	6
CO1	Q.3	Give a brief account on enzyme kinetics.	6
CO2	Q.4	Briefly discuss the properties of an inhibitor.	3
CO2	Q.5a	Discuss the acid-base catalysis in brief.	3
	Q.5b	What is reversible inhibition? Discuss in brief.	3
CO2	Q 6	Discuss the Michaelis-Menten equation. Derive the double reciprocal plot with this equation.	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Enzyme Technology**/Course code **MSB-302** is level **3** for the academic year 2019-20.

AMITY UNIVERSITY
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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
III SEM	MSB321	3	3	2	3	1	3	2	2	2	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENZYME TECHNOLOGY LAB
Course Code : MSB 321, Credits: 01, Session :2021-22 (Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend advanced understanding of isolation, recovery, and immobilization of enzymes.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB321.1. Understand the practical based learning of Isolation of industrially important microorganisms and growth curve.

MSB321.2. Understand the practical based learning ethanol production, production of antibiotics and fermentation.

MSB321.3. Understand the practical based learning of downstream processing.

MSB321.4. Understand the practical based learning of enzyme assay, enzyme purification and kinetics.

MSB321.5. Understand the practical based learning of enzyme production and immobilization.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their

workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. **Programme Specific Outcomes:**

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. **Assessment Plan:**

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. **Syllabus**

Module I
Isolation of industrially important microorganisms for microbial processes.
Determination of Thermal Death Point and Thermal death time of microorganisms for design of a sterilizer
Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.
Module II
Comparative studied of ethanol production using different substrates.
Microbial production of antibiotics (Penicillin)
Production and estimation of alkaline protease
Sauer Krant fermentation
Module III: Downstream processing
Conventional filtration
Protein precipitation and recovery
Aqueous two-phase separation
Ion exchange chromatography
Gel filtration
Membrane based filtration i.e. Micro filtration and cross filtration in cross flow Modules.

Module IV
Isolation of Enzymes from plant and microbial sources.
Enzyme assay; activity and specific activity – determination of amylase, nitrate reductase, cellulose, protease.

Purification of Enzyme by ammonium sulphate fractionation.
Enzyme Kinetics: Effect of varying substrate concentration on enzyme activity
Effect of Temperature and pH on enzyme activity.

Module V

Production of enzyme on industrial scale using solid and state fermentation
Enzyme immobilization

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of industrially important microorganisms for microbial processes.	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
2	Determination of Thermal Death Point and Thermal death time of microorganisms for design of a sterilizer	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
3	Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
4	Comparative studied of ethanol production using different substrates. Microbial production of antibiotics (Penicillin)	Practical	MSB321.2	Class Test (Practical Based) & End Sem Exam
5	Production and estimation of alkaline protease Sauer Krant fermentation	Practical	MSB321.2	Class Test (Practical Based) & End Sem Exam

6	Conventional filtration Protein precipitation and recovery	Practical	MSB321.3	Class Test (Practical Based) & End Sem Exam
7	Aqueous two-phase separation	Practical	MSB321.3	Class Test
	Ion exchange chromatography Gel filtration			(Practical Based) & End Sem Exam
8	Membrane based filtration i.e. Micro filtration and cross filtration in cross flow Modules.	Practical	MSB321.3	Class Test (Practical Based) & End Sem Exam
9	Isolation of Enzymes from plant and microbial sources. Enzyme assay; activity and specific activity – determination of amylase, nitrate reductase, cellulose, protease.	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
10	Purification of Enzyme by ammonium sulphate fractionation. Enzyme Kinetics: Effect of varying substrate concentration on enzyme activity	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
11	Effect of Temperature and pH on enzyme activity	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
12	Production of enzyme on industrial scale using solid and state fermentation Enzyme immobilization	Practical	MSB321.5	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB321.1.	Understand the practical based learning of Isolation of industrially important microorganisms and growth curve.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.2.	Understand the practical based learning ethanol production, production of antibiotics and fermentation.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.3.	Understand the practical based learning of downstream processing.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.4.	Understand the practical based learning of enzyme assay, enzyme purification and kinetics.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.5.	Understand the practical based learning of enzyme production and immobilization.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Enzyme Technology Lab**/Course code **MSB-321** is level **3** for the academic year 2019-20.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
I	MTB 123	3	3	3	1	1	-	-	1	2	1	3	2	1	1

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOINFORMATICS LAB
Course Code : MTB 123, Crédits : 01, Session :2019-20 (Odd Sem.), Class : M.Tech 1st Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to demonstrate the techniques and software's used for sequence analysis, alignment, structure prediction of the proteins and other compounds, docking and finding the phylogenetic relationships.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MTB 123.1. Understand about Retrieving of nucleotide and protein sequence through NCBI database.

MTB 123.2. Understand the nucleotide and protein sequence alignment methods through different types of algorithm and able to make phylogenetic tree.

MTB 123.3. Experimental understanding of different structure of protein.

MTB 123.4. Experimental prediction of the databases related to Phylogenetic.

MTB 123.5. Describe the molecular docking and visualization of structure.

MTB 123.6. Experimental demonstration of finding of transcription regulatory signals.

c. **Programme Outcomes:**

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.
PO8: Ability to communicate effectively and develop scientific writing.
PO9. Inculcation of ability to think independently for problem solving.
PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.
PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**
Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%

Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Basics of sequence analysis Retrieving a sequence-nucleic acid/Protein
Module II
Local and Global Alignment- concepts Pair wise sequence alignment, multiple sequence alignment
Dynamic Programming – Smith Watermann Algorithm Needleman Wunsch Algorithm
Module III
Motif and pattern searching, Structure prediction, Protein structure classification resources, Structure superposition tools, Energy minimization and simulated annealing
Module IV
Phylogenetic prediction and analysis
Module V
Docking small molecules/peptides in active site of protein. Use of automated docking procedures. Free energy calculation.
Module VI
Finding transcription regulatory signals

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;
A: Attendance

H. Suggested Text/Reference Books:

Text:

- Essentials of Genomics and Bioinformaticsby C.W. Sensen, John Wiley and Sons
- Bioinformatics: Sequence and Genome Analysis by D.W. Mount, Cold Spring Harbor Laboratory Press.
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by A.D. Baxevanis and B.F.F Ouellette, Wiley – interscience.

References:

- Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology by D. Gusfield, Cambridge University Press

- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by G. Von Heijne and G. Von Heijne, Academic Press.
- Computational Molecular Biology: An Algorithmic Approach by P.A. Pevzner, MIT Press
- Computer Methods for Macromolecular Sequence Analysis by R.F. Doolittle, J.N, Abelson, M.I. Simon, Academic press
- Essentials of Genomics and Bioinformatics C.W. Sensen, John Wiley and Sons Inc.
- Introduction to Computational Biology: Maps, Sequences and Genomes by M. Waterman, Chapman and Hall
- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by G. V. Heijne and G.V. Heijne, Academic Press

I. Lecture Plan

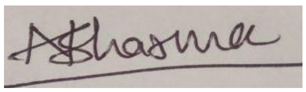
Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Basics of sequence analysis Retrieving a sequence- Protein	Practical	MTB 123.1	Mid Term-1, Quiz & End Sem Exam
2	Basics of sequence analysis Retrieving a sequence-nucleic acid	Practical	MTB 123.1	Mid Term-1, Quiz & End Sem Exam
3	Local Alignment	Practical	MTB 123.2	Mid Term-1, Quiz & End Sem Exam
4	Global Alignment	Practical	MTB 123.2	Mid Term-1, Quiz & End Sem Exam
5	Pair wise sequence alignment	Practical	MTB 123.2	Mid Term-1, Quiz & End Sem Exam
6	Multiple sequence alignment	Practical	MTB 123.2	End Sem Exam
7	Motif and pattern searching	Practical	MTB 123.3	End Sem Exam
8	Structure prediction, Protein structure classification resources	Practical	MTB 123.3	End Sem Exam
9	Structure superposition tools, Energy minimization and simulated annealing	Practical	MTB 123.3	End Sem Exam
10	Phylogenetic prediction and analysis	Practical	MTB 123.4	End Sem Exam
11	Docking	Practical	MTB 123.3	End Sem Exam
12	Finding transcription regulatory signals	Practical	MTB 123.3	End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 123.1.	Understand about Retrieving of nucleotide and protein sequence through NCBI database.	3	3	1	3	1				2	1	3	2	1	1
MTB 123.2.	Understand the nucleotide and protein sequence alignment methods through different types of algorithm and able to make phylogenetic tree.	3	3	1	3	1				2	1	3	2	1	1
MTB 123.3.	Experimental understanding of different structure of protein.	3	3	1	3	1				1	1	3	2	1	1
MTB 123.4.	Experimental prediction of the databases related to Phylogenetic	3	3	2	3	2				1	1	3	2	1	1
MTB 123.5.	Describe the molecular docking and visualization of structure.	2	3	1	2	3				2	1	3	2	1	1
MTB 123.6.	Experimental demonstration of finding of transcription regulatory signals.	2	3	1	2	3				2	1	3	2	1	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course *Advanced Immunology lab*/Course code *MTB 320* is level 3 for the academic year 2019-20.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
I	MTB 104	3	3	3	1	1	-	-	1	2	1	3	2	1	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOINFORMATICS
Course Code : MTB 104, Crédits : 04, Session :2019-20(Odd Sem.), Class : M.Tech 1st Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: The objective is to describe data models and database management systems with an emphasis on biologically important techniques to store various data on DNA sequencing structures, genetic mapping, phylogenetic analysis. Multiple sequence alignment, protein structure prediction, and comparative genome analysis.

B. Course Outcomes: After successful completion of the course student will be able to:

MTB 104.1. Understand about nucleotide and protein sequence retrieval, submission through NCBI database.

MTB 104.2. Understand the nucleotide and protein sequence alignment methods through different types of algorithm used.

MTB 104.3. Predict the phylogenetic tree and evolutionary relationship.

MTB 104.4. Predict the databases related to functional gene sequences and their analysis through identification and classification

MTB 104.5. Describe the molecular modeling using protein databank, docking and visualization of structure.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular

biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with

detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9. Inculcation of ability to think independently for problem solving.

PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction and overview

The NCBI, sequence databases, sequence retrieval, sequence file formats, submitting DNA, protein sequences and sequence assembly.

Module II

Exact string matching -classical comparison based methods, semi numerical string matching, suffix trees -construction and application, Databases and rapid sequence analysis –Blast and Fasta , sequence comparison by statistical content; Dynamic programming alignment -The number of alignments, shortest and longest paths in a network, global distance and similarity alignments, Fitting one sequence onto the other, trace backs, parametric sequence comparison

Module III

Global and local alignments, scoring matrices-pam and blosum and gap penalties, filtering, position specific scoring matrices, internet resources , uses of multiple sequence alignment programs and methods pattern searching programs, family and superfamily representation & profit analysis.

Module IV

Trees-representation of sequences, tree interpretation, Distance – additive, ultrameric and nonadditive distances, tree building methods, phylogenetic analysis, parsimony, Bootstrap, maximum likelihood trees , estimating the rate of change, likelihood and trees; analysis software.

Module V

Annotation, ESTs – databases, comparative genome analysis clustering, gene discovery, protein identification, physical properties, motifs and patterns, structure, folding classes, structure classification; Structure databases– PDB and MMDB, visualizing structural information, Docking of Molecules, structure prediction in proteins, prediction of buried residues in proteins, RNA secondary structure –minimum free-energy structures, Genome analysis, genome rearrangements with inversions, gene identification, gene expression, expression analysis, gene identification and functional classification.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Essentials of Genomics and Bioinformaticsby C.W. Sensen, John Wiley and Sons
- Bioinformatics: Sequence and Genome Analysis by D.W. Mount, Cold Spring Harbor Laboratory Press.
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by A.D. Baxevanis and B.F.F Ouellette, Wiley – interscience.

References:

- Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology by D. Gusfield, Cambridge University Press
- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by G. Von Heijne and G. Von Heijne, Academic Press.
- Computational Molecular Biology: An Algorithmic Approach by P.A. Pevzner, MIT Press
- Computer Methods for Macromolecular Sequence Analysis by R.F. Doolittle, J.N, Abelson, M.I. Simon, Academic press
- Essentials of Genomics and Bioinformatics C.W. Sensen, John Wiley and Sons Inc.
- Introduction to Computational Biology: Maps, Sequences and Genomes by M. Waterman, Chapman and Hall
- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by G. V. Heijne and G.V. Heijne, Academic Press

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	The NCBI, sequence databases, sequence retrieval, sequence file formats	Lecture	MTB 104.1.	Mid Term-1, Quiz & End Sem Exam
2	Submitting DNA, protein sequences and sequence assembly.	Lecture	MTB 104.1.	Mid Term-1, Quiz & End Sem Exam
3	Exact string matching - classical comparison based methods, semi numerical string matching, suffix trees - construction and application	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
4	Databases and rapid sequence analysis –Blast and Fasta	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
5	Sequence comparison by statistical content;	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
6	Dynamic programming alignment -The number of alignments, shortest and longest paths in a network, global distance and similarity alignments,	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
7	Fitting one sequence onto the other, trace backs, parametric sequence comparison	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
8	Global and local alignments	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam
9	Scoring matrices-pam and blosum	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam
10	Gap penalties, filtering, position specific scoring matrices,	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam
11	Internet resources,	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam

12	Uses of multiple sequence alignment programs and methods pattern searching programs, family and superfamily	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam
	representation & profit analysis.			
13	Trees-representation of sequences	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
14	Tree interpretation, Distance – additive, ultrameric and nonadditive distances, tree building methods,	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
15	Phylogenetic analysis, parsimony,	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
16	Phylogenetic analysis, parsimony,	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
17	Bootstrap, maximum likelihood trees , estimating the rate of change, likelihood and trees;	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
18	Bootstrap, maximum likelihood trees , estimating the rate of change, likelihood and trees;	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
19	Analysis software	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
20	Analysis software	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
21	Annotation, ESTs – databases,	Lecture	MTB 104.5	Mid Term-2, Quiz & End Sem Exam
22	comparative genome	Lecture	MTB 104.5	Mid Term-2, Quiz & End Sem Exam
23	analysis clustering,	Lecture	MTB 104.5	Mid Term-2, Quiz & End Sem Exam
24	gene discovery,	Lecture	MTB 104.5	Quiz & End Sem Exam

25	protein identification,	Lecture	MTB 104.5	Quiz & End Sem Exam
26	Physical properties,	Lecture	MTB 104.5	Quiz & End Sem Exam
27	Motifs and patterns,	Lecture	MTB 104.5	Quiz & End Sem Exam
28	Structure, folding classes,	Lecture	MTB 104.5	Quiz & End
				Sem Exam
29	structure classification; Structure databases– PDB and MMDB,	Lecture	MTB 104.5	Quiz & End Sem Exam
30	Visualizing structural information,	Lecture	MTB 104.5	Quiz & End Sem Exam
31	Docking of Molecules,	Lecture	MTB 104.5	Quiz & End Sem Exam
32	Structure prediction in proteins,	Lecture	MTB 104.5	Quiz & End Sem Exam
33	Prediction of buried residues in proteins,	Lecture	MTB 104.5	Quiz & End Sem Exam
34	RNA secondary structure –	Lecture	MTB 104.5	Quiz & End Sem Exam
35	minimum free	Lecture	MTB 104.5	Quiz & End Sem Exam
36	minimum free	Lecture	MTB 104.5	Quiz & End Sem Exam
37	Genome analysis	Lecture	MTB 104.5	Quiz & End Sem Exam
38	Genome analysis	Lecture	MTB 104.5	Quiz & End Sem Exam
39	Genome rearrangements with inversions	Lecture	MTB 104.5	Quiz & End Sem Exam
40	Genome rearrangements with inversions	Lecture	MTB 104.5	Quiz & End Sem Exam
41	Gene identification,	Lecture	MTB 104.5	Quiz & End Sem Exam
42	Gene identification,	Lecture	MTB 104.5	Quiz & End Sem Exam
43	Gene expression,	Lecture	MTB 104.5	Quiz & End Sem Exam
44	Gene expression	Lecture	MTB 104.5	Quiz & End Sem Exam
45	Gene expression	Lecture	MTB 104.5	Quiz & End Sem Exam
45	Expression analysis,	Lecture	MTB 104.5	Quiz & End Sem Exam
46	Expression analysis,	Lecture	MTB 104.5	Quiz & End Sem Exam

47	Gene identification and functional classification.	Lecture	MTB 104.5	Quiz & End Sem Exam
48	Gene identification and functional classification.	Lecture	MTB 104.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 104.1	Understand about nucleotide and protein sequence retrieval, submission through NCBI database.	3	3	1	3	1				2	1	3	2	1	1
MTB 104.2	Understand the nucleotide and protein sequence alignment methods through different types of algorithm used.	3	3	1	3	1				2	1	3	2	1	1
MTB 104.3	Predict the phylogenetic tree and evolutionary relationship.	3	3	1	3	1				1	1	3	2	1	1
MTB 104.4	Predict the databases related to functional gene sequences and their analysis through identification and classification	3	3	2	3	2				1	1	3	2	1	1
MTB 104.5	Describe the molecular modeling using protein databank, docking and visualization of structure.	2	3	1	2	3				2	1	3	2	1	1


AMITY INSTITUTE OF BIOTECHNOLOGY
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Sample Question Paper

Amity Institute Biotechnology 2019-20						
Class: M.Tech. Biotechnology I Semester						
Subject Name: Computational Biology		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand and explain the development of computational biology.
- Describe the fundamentals of bioinformatics databases and their application.
- Understand and explain the use of various computational methods for phylogentic studies.
- Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling.
- Explain the applications of computational biology in different fields of sciences.

CO Map	Question No.	Question	Marks
CO1	Q.1	Bioinformatics is the integrated field of science" Explain this statement with suitable examples.	6
CO2	Q.2	What is a primary sequence database? Give any five examples of primary databases with features.	6
	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	Compare the Global and Local alignment methods with suitable example of matrix.	6
CO4	Q.5	Give the description of commonly used secondary databases of nucleic acid and protein.	6
CO3	Q.6	Write any five applications of bioinformatics in biological sciences and agriculture.	6
	Q.7	BLAST is a popular program for exploring protein family relationship. Discuss the types and applications of BLAST program.	10

CO4	Q.8	What is Neighbor-joining and UPGMA method? How it is useful in constructing phylogenetic tree.	10
CO3	Q.9	What is sequence alignment? Write the difference between pairwise and multiple sequence alignment.	10
CO3	Q.10	A. Consider the following multiple sequence alignment: A.TCGGTAGGCT B. ACCGTTCCAT C. ACCCAAGGCT D. ATGGTAGGCT How many rooted and un-rooted phylogenies can you construct out of the taxa shown in the alignment? Explain any one method to construct a phylogenetic tree. B. Explain dendogram, cladogram and phylogram. How many different unrooted and rooted trees topologies are possible for 3, 4 and 5 species?	20

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioinformatics***/Course code ***MTB 104*** is level **3** for the academic year 2019-20.

ASharma

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	MTB 301	3	3	3	1	1	-	-	1	2	1	3	2	1	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY
Course Code : MTB 301, Crédits : 03, Session :2019-20(Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The aim to teach immunology and immuno technology to the students for their better understanding of immune system, types and mechanism of immunity, immune responses, their tolerance and suppression as well as tools and techniques involved in diagnosis and identification of immune related diseases.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MTB 301.1. Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.

MTB 301.2. Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.

MTB 301.3. Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.

MTB 301.4. the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9. Inculcation of ability to think independently for problem solving.

PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Types of immunity - innate, aquired, passive and active physiology of immune response – MI and CMI specificity and memory. Antigen, antibody reactions. Antigens types Hapten, immunoglobuin structure, distribution and function

Module II

Molecular biology of Ig synthesis, Lymphoid tissues – ontogeny and physiology of immuno system - origin and development, differentiation of lymphocytes. Lymphocyte subpopulation of mouse and man. Structure and function of class I and II molecules antigen distribution in population – HLA in human health and diseases. Transplantation immunity – organ transplantation and HLA tissue typing.

Module III

Cell mediated cytotoxicity. Hypersensitivity reactions, cellular interaction in immune response. Antigen recognition. T.B. cell receptors, MHC restriction, Lymphocyte activation clonal proliferation, differentiation. Interleukins and their roles. The complement systems mode of activation, classical and alternate pathway biological functions.

Module IV

Introduction to tumor immunology, autoimmune disorders and immunology of infectious diseases. Antigen antibody reactions in vitro methods agglutination precipitation, complement fixation, immunofluorescence, immunoelectrophoresis, ELISA, Radio immuno assays, In vitro methods, skin tests and immune complex tissue demonstrations. Applications of these methods in diagnosis of microbial infections, Vaccines

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;

A: Attendance

H. Suggested Text/Reference Books:

Text:

- Kuby Immunology, R.A. Goldsby, T.J. Kindt and B.A. Obsorne, Freeman
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company

References:

- Immunology (Sixth Edition), Roitt, Brostoff, Male, Panima Publication
- Fundamentals of Immunology, W. Paul, Lippincot Williams and Wilkins
- Immunology, W.L. Anderson, Frence Creek Publishing (Blackwell)
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.
- Immunology, Poitt, Mosby – Yearbook Inc.
- Perkin Elmer Antibody Manual
- Production of Monoclonal Antibodies – Detailed Protocol, G.K. Lewis, University of Maryland

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Type of immunity	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
2	Antigen and haptens	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
3	Antibody : function and structure	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
4	Types of antibody and their functions	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
5	Synthesis of Ig molecule	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
6	Light Chain gene rearrangement	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
7	Heavy Chain gene rearrangement	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
8	Antibody Diversity	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
9	Primary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
10	Primary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
11	Secondary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
12	Secondary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam

13	MHC I: Structure, types and function	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam

14	MHC II: Structure, types and function	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
15	Transplantation Immunology	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
16	Cell mediated cytotoxicity	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
17	Hypersensitivity : Types and function.	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
18	Hypersensitivity : Types and function.	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
19	Complement system: Types and importance	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
20	Complement system: Types and importance and Regulation	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
21	Lymphocyte activation and clonal proliferation	Lecture	MTB 301.3	Mid Term-2, Quiz & End Sem Exam
22	Antigen recognition and T.B. cell receptor	Lecture	MTB 301.3	Mid Term-2, Quiz & End Sem Exam
23	Revision of module I and II	Lecture	MTB 301.3	Mid Term-2, Quiz & End Sem Exam
24	Introduction of tumor immunology	Lecture	MTB 301.3	Quiz & End Sem Exam
25	Tumor immunology	Lecture	MTB 301.4	Quiz & End Sem Exam
26	Autoimmune disorder: Organ specific	Lecture	MTB 301.4	Quiz & End Sem Exam
27	Autoimmune disorder: systemic	Lecture	MTB 301.4	Quiz & End Sem Exam
28	Autoimmunity : mechanism and regulation	Lecture	MTB 301.4	Quiz & End Sem Exam
29	Agglutination reaction	Lecture	MTB 301.4	Quiz & End Sem Exam
30	Precipitation reaction	Lecture	MTB 301.4	Quiz & End Sem Exam
31	Complement fixation	Lecture	MTB 301.4	Quiz & End Sem Exam
32	Immunofluorescence and immunoelectrophoresis	Lecture	MTB 301.4	Quiz & End Sem Exam
33	ELISA and RIA	Lecture	MTB 301.4	Quiz & End Sem Exam
34	Skin test and immune complex tissue demonstration	Lecture	MTB 301.4	Quiz & End Sem Exam
35	Application of these methods in diagnosis of microbial infection, Vaccines	Lecture	MTB 301.4	Quiz & End Sem Exam

36	Immunofluorescence and immunoelectrophoresis	Lecture	MTB 301.4	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 301.1	Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.	3	3	3	1	1	-	-	1	2	1	3	2	1	1
MTB 301.2	Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MTB 301.3	Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

MTB 301.4	the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer,	3	3	3	1	1	-	-	1	2	1	3	1	3	1

	including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.														

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2019-20</td></tr>
<tr><td colspan="7">Class: M.Tech. Biotechnology
IIISemester</td></tr>
<tr><td colspan="2">Subject Name: ADVANCED IMMUNOLOGY</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.7</td><td>Q. 8, 9,</td><td>Q. 10</td></tr>
</table>

Student will be able to:

- Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
- Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
- Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
- the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

CO Map	Question No.	Question	Marks
CO1	Q.1	Specific immunity exhibits four characteristic attributes, which are mediated by lymphocytes. List these four attributes and briefly explain how they arise.	6
CO2	Q.2	Draw a schematic diagram of a typical IgG molecule and label each of the following parts: H chains, L chains, inter-chain disulfide bonds, intra-chain disulfide bonds, hinge, Fab, Fc, and all the domains. Indicate which domains are involved in antigen binding.	6

	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	What is antigen? Discuss about the typing procedures for HLA antigens.	6
CO4	Q.5	Describe one advantage and one disadvantage of N-nucleotide addition during the rearrangement of immunoglobulin heavy-chain gene segments.	6
CO3	Q.6	Explain why NK cells from a given host will kill many types of virus-infected cells but do not kill normal cells from that host.	6
	Q.7	Discuss about that the role of cell-Mediated Immunity is Important for Viral Control and Clearance.	10
CO4	Q.8	What is the mechanism of tumor generation and how does normal cells are differentiated from transformed cells?	10
CO3	Q.9	Describe the main stages of leukocyte migration from the blood to a site of inflammation.	10
CO3	Q.10	What are the hallmark features of adaptive immunity? An individual has a mutation severely inhibiting the natural function of the transporter associated with antigen processing (TAP). Which antigen processing pathway would be rendered inefficient? What classes of agents would the individual have a problem attacking and why?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advanced Immunology***/Course code ***MTB 301*** is level **3** for the academic year 2019-20.

AMITY UNIVERSITY
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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY LAB
Course Code : MTB 320, Crédits : 01, Session :2019-20(Odd Sem.), Class : M.Tech. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe the immunological questions through experimentation. The aim is also to explain the antigen antibody interaction patterns through various experiments.

B. Course Outcomes: After successful completion of the course student will be able to:

MTB 320.1. Demonstrate detailed knowledge of purification of immunologlobulin, cells and antigen antibody interaction.

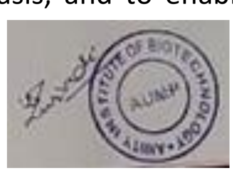
MTB 320.2. Apply knowledge and incorporate experimental understanding of the agglutination mechanism.

MTB 320.3. Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized



knowledge and understanding of selected aspects by means of a lecture series and a research

project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9. Inculcation of ability to think independently for problem solving.

PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			100%

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Course Contents:
1. Purification of immunoglobin G.
2. Study of antigen- antibody pattern (ODD).
3. Study of sandwich ELISA.
4. Study of haemeagglutination.
5. Study of immunoelectrophoresis.
6. Isolation and identification of rosette cells.
7. Antigen capture ELISA

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;
A: Attendance

H. Suggested Text/Reference Books:

- Manual of Molecular and Clinical Laboratory Immunology, 8th Edition Barbara Detrick (Editor), John L. Schmitz (Editor), Robert G. Hamilton (Editor) ISBN: 978-1-555-81871-5 May 2016 ASM Press
- Immunology Laboratory Manual Published by LAP LAMBERT Academic Publishing (2018) ISBN 10: 6138386175 ISBN 13: 9786138386179

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Purification of Immunoglobulin G	Lecture	MTB 320.1	Mid Term-1, Quiz & End Sem Exam
2	Radial Immuno Diffusion Test	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam
3	Double Immuno Diffusion Test	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam
4	Study of sandwich ELISA	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam
5	Study of DOT ELISA	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam

6	Study of heamagglutination (Blood group)	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
7	Rh factor determination	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
8	Study of heamagglutination (Widal test)	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
9	Study of immunoelectrophoresis	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
10	Study of rocket immunoelectrophoresis	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
11	Isolation and identification of rostte cells	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
12	Revision and discussion	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 320.1	Demonstrate detailed knowledge of purification of immunoglobulin, cells and antigen antibody interaction.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MTB 320.2	Apply knowledge and incorporate experimental understanding of the agglutination mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MTB 320.3	Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

Amity Institute Biotechnology 2019-20						
Class: M.Tech. Biotechnology III Semester						
Subject Name: Advanced Immunology Lab		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.3 & Q.4	Q.1		Q.2		

Student will be able to:

- Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
- Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
- Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
- the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

CO Map	Question No.	Question	Marks
CO1	Q.1	Perform Dot Elisa for detection of antigen-antibody interaction.	35
CO2	Q.2	Perform hemagglutination (Blood group) test.	15
	Q.3	*Viva-voce*	10
CO 3	Q.4	Record	10

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course *Advanced Immunology lab*/Course code *MTB 320* is level 3 for the academic year 2019-20.

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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Technology (M. Tech.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M. Tech. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and

immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MTB101	3	3	3	3	3	1	2	2	2	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY AND METABOLIC REGULATION
Course Code : MTB 101, Credits: 04, Session :2021-22 (Odd Sem.), Class : M.Tech. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The objectives of the Metabolic Biochemistry course are to provide a comprehensive understanding of human metabolism in areas of enzymology and protein structure and function; energy releasing and energy consuming metabolic processes; the regulation of synthesis and breakdown of sugars, lipids, nucleic acids, and amino acids which is necessary for further work in the biochemical/biomedical and biotechnology areas.

B. Course Outcomes: At the end of the course, students will be able to:

MTB101.1. Learn and understand the structure of biomolecules from their monomers to polymers.

MTB101.2. Learn the metabolism of biomolecules at advanced level and they will be able to interconnect these pathways.

MTB101.3. Learn about different levels of regulation of enzymes in metabolic pathways.

MTB101.4. Learn regulation of various metabolic pathways and diseases due to mis regulation of metabolic pathways.

C. Programme Outcomes:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Structure of Biomolecules, Metabolism of Carbohydrates, Lipids, Proteins, Amino acids and Nucleic acids.

Module II
Photosynthesis in Microorganisms; Role of chlorophylls, carotenoids and phycobilins; Calvin cycle; Chemolithotrophy; hydrogen - iron-nitrite-oxidizing bacteria; nitrate and sulfate reduction; methanogenesis and acetogenesis; Bacterial fermentations.

Module III:Modes of Regulation
Different levels of regulation - protein synthesis/degradation, allosteric regulation, reversible covalent modification, proteolytic processing, Requirements for ATP in synthesis and degradation cycle, Reversibility of the different methods of regulation, Consequences of misregulation

Module IV: Regulation of metabolic pathways
Glycolysis/glycogenolysis, Phosphogluconate/Citric Acid Cycle, Oxidative Phosphorylation, Fatty acid oxidation, Fatty Acid Biosynthesis, Amino Acid Oxidation, Regulation of Metabolism for the production of Primary and Secondary Metabolites with cas e

studies

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Principles of Biochemistry by A. Lehninger revised by Nelson and Cox.
- Biochemistry by Mathews, Van Holde and Ahern. IIIrd Edition.

References:

- “Biochemistry” by White, Handler and R.B. Smith 7th Ed. 1983
- Biochemistry” by L.Stryer Third Edition.
- Biochemistry by Voet and Voet.
- Fundamentals of Biochemistry by Conn and Stumph.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Structure of Biomolecules	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
2	Structure of Biomolecules	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
3	Structure of Biomolecules	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
4	Metabolism of Carbohydrates	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
5	Metabolism of Carbohydrates	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
6	Metabolism of Carbohydrates	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
7	Metabolism of Lipids	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
8	Metabolism of Lipids	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
9	Metabolism of Proteins	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
10	Metabolism of Proteins	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
11	Metabolism of Amino acids	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
12	Metabolism of Nucleic acids	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam

13	Metabolism of Nucleic acids	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
14	Photosynthesis in Microorganisms	Lecture	MTB101.2	Mid Term, Quiz
				& End Sem Exam
15	Photosynthesis in Microorganisms	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
16	Role of chlorophylls	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
17	carotenoids and phycobilins	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
18	Calvin cycle	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
19	Chemolithotrophy; hydrogen- iron-nitrite-oxidizing bacteria	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
20	Chemolithotrophy; hydrogen- iron-nitrite-oxidizing bacteria	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
21	nitrate and sulfate reduction	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
22	methanogenesis and acetogenesis	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
23	Bacterial fermentations	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
24	Different levels of regulation	Lecture	MTB101.3	Mid Term, Quiz & End Sem Exam
25	protein synthesis/degradation	Lecture	MTB101.3	Quiz & End Sem Exam
26	protein synthesis/degradation	Lecture	MTB101.3	Quiz & End Sem Exam
27	allosteric regulation	Lecture	MTB101.3	Quiz & End Sem Exam
28	reversible covalent modification	Lecture	MTB101.3	Quiz & End Sem Exam
29	proteolytic processing	Lecture	MTB101.3	Quiz & End Sem Exam
30	Requirements for ATP in synthesis and degradation cycle	Lecture	MTB101.3	Quiz & End Sem Exam
31	Requirements for ATP in synthesis and degradation cycle	Lecture	MTB101.3	Quiz & End Sem Exam
32	Requirements for ATP in synthesis and degradation cycle	Lecture	MTB101.3	Quiz & End Sem Exam
33	Requirements for ATP in synthesis and degradation cycle	Lecture	MTB101.3	Quiz & End Sem Exam
34	Consequences of misregulation	Lecture	MTB101.3	Quiz & End Sem Exam
35	Glycolysis	Lecture	MTB101.4	Quiz & End Sem Exam
36	Glycogenolysis	Lecture	MTB101.4	Quiz & End Sem Exam

37	Phosphogluconate	Lecture	MTB101.4	Quiz & End Sem Exam
38	Citric Acid Cycle	Lecture	MTB101.4	Quiz & End Sem Exam
39	Oxidative Phosphorylation	Lecture	MTB101.4	Quiz & End Sem
				Exam
40	Oxidative Phosphorylation	Lecture	MTB101.4	Quiz & End Sem Exam
41	Fatty acid oxidation	Lecture	MTB101.4	Quiz & End Sem Exam
42	Fatty Acid Biosynthesis	Lecture	MTB101.4	Quiz & End Sem Exam
43	Amino Acid Oxidation	Lecture	MTB101.4	Quiz & End Sem Exam
44	Amino Acid Oxidation	Lecture	MTB101.4	Quiz & End Sem Exam
45	regulation of Metabolism for the production of Primary and Secondary Metabolites	Lecture	MTB101.4	Quiz & End Sem Exam
46	regulation of Metabolism for the production of Primary and Secondary Metabolites	Lecture	MTB101.4	Quiz & End Sem Exam
47	regulation of Metabolism for the production of Primary and Secondary Metabolites	Lecture	MTB101.4	Quiz & End Sem Exam
48	Discussion/Revision	Lecture	MTB101.4	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MTB101.1.	Learn and understand the structure of biomolecules from their monomers to polymers.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB101.2.	Learn the metabolism of biomolecules at advanced level and they will be able to interconnect these pathways.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB101.3.	Learn about different levels of regulation of enzymes in metabolic pathways.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB101.4.	Learn regulation of various metabolic pathways and diseases due to mis regulation of metabolic pathways.	3	3	2	3	-	-	1	2	3	-			3	2	1	1

Amity Institute of Biotechnology
I MID-SEMESTER (SEM –I) 2021-22

Class: M.Tech. Biotechnology I Semester

Subject Name: MTB 101 BIOCHEMISTRY AND METABOLIC REGULATION	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biomolecules with examples.	3
CO1	Q.2a	What do you understand by phosphorylation?	3
	Q.2b	Discuss secondary metabolites in brief.	3
CO1	Q.3	Give an account of lipid transport in body.	6
CO2	Q.4	Explain the significance of urea cycle in clinics.	3
CO2	Q.5a	What are the factors favoring nucleic acid synthesis?	3
	Q.5b	Discuss the different factors affecting cholesterol synthesis.	3
CO2	Q 6	Phosphofructokinase I is the pacemaker of glycolysis. Why?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry and Metabolic Regulation**/Course code **MTB-101** is level **3** for the academic year 2019-20.

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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Technology (M. Tech.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M. Tech. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and

immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MTB120	3	3	3	3	3	1	2	2	2	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY AND METABOLIC REGULATION
Course Code : MTB 120, Credits: 02, Session :2021-22 (Odd Sem.), Class : M.Tech. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend advanced understanding of the qualitative and quantitative estimation of carbohydrates, proteins, lipids and nucleic acids.

B. **Course Outcomes:** At the end of the course, students will be able to:
MTB120.1. Understand the practical based learning of estimation of proteins.
MTB120.2. Understand the practical based learning of enzyme activity.
MTB120.3. Understand the practical based learning of estimation of DNA & RNA.
MTB120.4. Understand the practical based learning of estimation of carbohydrate.
MTB120.5. Understand the practical based learning of estimation of lipid.

C. **Programme Outcomes:**

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Proteins

Identification of protein by Biuret test, quantitation of protein by Bradford method, Separation of proteins by SDS-PAGE, Enzyme: Determination of serum alkaline phosphatase activity

Module II: Nucleic Acid

Biochemical estimation of DNA, RNA. Separation of DNA samples on Agarose gel.

Carbohydrate: Colour reactions of different type of carbohydrates, Biochemical estimation of blood sugar

Lipids: Blood Cholesterol estimation.

G. Examination Scheme:

IA			**EE**			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**

15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Biuret test	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Biuret test	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
4	quantitation of protein by Bradford method	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
5	quantitation of protein by Bradford method	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
6	quantitation of protein by Bradford method	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
7	Separation of proteins by SDS-PAGE	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
8	Separation of proteins by SDS-PAGE	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
9	Separation of proteins by SDS-PAGE	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
10	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MTB120.2	Class Test (Practical Based) & End Sem Exam
11	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MTB120.2	Class Test (Practical Based) & End Sem Exam
12	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MTB120.2	Class Test (Practical Based) & End Sem Exam

13	Biochemical estimation of DNA	Practical	MTB120.3	Class Test (Practical Based)
				& End Sem Exam
14	Biochemical estimation of DNA	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
15	Biochemical estimation of RNA	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
16	Biochemical estimation of RNA	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
17	Separation of DNA samples on Agarose gel	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
18	Separation of DNA samples on Agarose gel	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
19	Separation of DNA samples on Agarose gel	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
20	Separation of DNA samples on Agarose gel	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
21	Colour reactions of different type of carbohydrates	Practical	MTB120.4	Class Test (Practical Based) & End Sem Exam
22	Colour reactions of different type of carbohydrates	Practical	MTB120.4	Class Test (Practical Based) & End Sem Exam
23	Biochemical estimation of blood sugar	Practical	MTB120.5	Class Test (Practical Based) & End Sem Exam
24	Blood Cholesterol estimation	Practical	MTB120.5	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MTB120.1.	Understand the practical based learning of estimation of proteins.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB120.2.	Understand the practical based learning of enzyme activity.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB120.3.	Understand the practical based learning of estimation of DNA & RNA.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB120.4.	Understand the practical based learning of estimation of carbohydrate.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB120.5.	Understand the practical based learning of estimation of lipid.	3	3	3	3	-	1	2	-	2	2			3	3	2	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry and Metabolic Regulation Lab**/Course code **MTB-120** is level **3** for the academic year 2019-20.

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Technology (M. Tech.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M. Tech. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and

immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MTB201	3	3	3	3	3	1	2	2	2	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : CELL AND MOLECULAR BIOLOGY
Course Code : MTB 201, Credits: 04, Session :2021-22 (Even Sem.), Class : M.Tech. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The object of the present course is to develop basic knowledge and skills in cell and molecular biology and to understand the structure and function of the cellular and sub cellular components of cells and tissues with the help of recent techniques. This course will help students to get an understanding of cell function at the molecular level including the fundamentals of DNA They will become aware of the complexity and harmony of the cell. Applications of cellular and molecular biology in Biotechnology will also be presented.

B. **Course Outcomes:** At the end of the course, students will be able to:

MTB201.1. Learn various aspects of protein targeting and transportation of small molecules across the membrane by different means.

MTB201.2. Learn and understand the cell cycle with check points.

MTB201.3. Learn and understand intracellular signaling mechanisms.

MTB201.4. Learn the mechanism of replication of DNA both in prokaryotes and eukaryotes and repair mechanisms processed by the cell.

MTB201.5. Learn in detail about the mechanism of transcription and post-transcriptional processes in prokaryotes and eukaryotes.

MTB201.6. Learn and understand the mechanism translation, gene expression regulation in prokaryotes and eukaryotes as well as gene silencing.

C. **Programme Outcomes:**

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and

molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal	Mid Term	CT	15%

Evaluation	Seminar/Viva-	S/V/Q/HA	10%
	Voce/Quiz/Home Assignment		
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Protein targeting - Chemical and physical properties of cell membranes and their major components, significance of these properties to membrane structure, integral and peripheral membrane proteins, biosynthesis of membrane and secreted proteins; targeting of proteins to membranes.
Module II
Membrane transport/Cell Cycle - Mechanisms for transport of small molecules across the membrane, including simple diffusion, facilitative diffusion, primary and secondary active transport, action of ionophores. Cell cycle and the events associated with each stage, control of the cell cycle and the proteins involved; know the role of the cyclins and cyclin-dependent kinases, cell cycle checkpoints, methods for synchronizing the cell cycle in cell populations.
Module III
Intracellular Signaling I - define growth, growth factor, growth factor receptor, mitogen, receptor, effector, second messenger, action of hormones and other biologically active agents that act via receptors in the nucleus and/or cytoplasm. Intracellular Signaling II - the intracellular signaling cascades triggered by hormone binding to these receptor, G proteins signalling, the action of Ca 2+ and diacylglycerol as second messengers.
Module IV: Replication
Replication of DNA, Role of DNA polymerases & proteins involved in DNA replication, Compare and contrast eukaryote and prokaryote DNA replication, telomeres, telomerase and altered telomerase function in aging and disease.
Recombination & Repair: Mutations and types of site mutations: substitution, transition, transversion, insertion, deletion, tautomer, frameshift and nonsense mutation. Repair mechanisms: dimer repair, excision repair, mismatch repair, trans-lesion repair, and recombinational repair.
Module V
Transcription **-** RNA transcription and the proteins required for each step, maturation of the RNA transcript derived from a eukaryotic gene, structure of prokaryote and eukaryote promoter and the function of promoter sequences, inhibitors of prokaryote and eukaryote transcription and their mechanisms of action. Concept of operon, inducer, operator and polycistronic transcript, expression of the lac operon and trp operon in *E. coli,* catabolite repression, leader peptide and attenuator site, enhancer and transcription factors, four common DNA-binding motifs found in transcription factors, mRNA stability and alternative splicing in gene expression
Module VI: Translation
Genetic code and the concept of colinearity of the gene and protein, components required for translation, basic steps involved in initiation, elongation, and termination of protein translation, translational recoding, inhibitors

of protein translation. Compare and contrast the spatial and temporal differences in prokaryotic and eukaryotic transcription and translation

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Molecular Cell Biology by Bruce Albert
- Molecular Biology by Lodish Darnell and Baltimore
- Molecular Biology of the gene by Watson et al 4th ed.

References:

- Genes VIII by Benjamin Lewis
- Genetics by Ursula Goodenough
- Cytogenetics by l Garl P. Swanson, Mertz & Young
- Biochemistry by Stryer
- Genome by T.A. Brown, John Willey and Sons Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Protein targeting	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
2	Chemical and physical properties of cell membranes and their major components	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
3	Chemical and physical properties of cell membranes and their major components	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
4	significance of these properties to membrane structure	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
5	integral and peripheral membrane proteins	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
6	biosynthesis of membrane and secreted proteins	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
7	biosynthesis of membrane and secreted proteins	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
8	targeting of proteins to membranes	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
9	Membrane transport	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
10	Mechanisms for transport of small molecules across the membrane	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam

11	including simple diffusion, facilitative diffusion, primary and secondary active transport,	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
	action of ionophores			
12	including simple diffusion, facilitative diffusion, primary and secondary active transport, action of ionophores	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
13	Cell cycle and the events associated with each stage	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
14	control of the cell cycle and the proteins involved	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
15	know the role of the cyclins and cyclin-dependent kinases	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
16	cell cycle checkpoints	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
17	methods for synchronizing the cell cycle in cell populations	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
18	Intracellular Signaling I	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
19	define growth, growth factor, growth factor receptor, mitogen, receptor, effector, second messenger	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
20	define growth, growth factor, growth factor receptor, mitogen, receptor, effector, second messenger	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
21	action of hormones and other biologically active agents that act via receptors in the nucleus and/or cytoplasm	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
22	action of hormones and other biologically active agents that act via receptors in the nucleus and/or cytoplasm	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
23	Intracellular Signaling II - the intracellular signaling cascades triggered by hormone binding to these receptor	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
24	Intracellular Signaling II - the intracellular signaling cascades triggered by hormone binding to these receptor	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
25	G proteins signalling	Lecture	MTB201.3	Quiz & End Sem Exam

26	the action of Ca^{2+} and diacylglycerol as second messengers	Lecture	MTB201.3	Quiz & End Sem Exam
27	Replication of DNA	Lecture	MTB201.4	Quiz & End Sem Exam
28	Role of DNA polymerases & proteins involved in DNA replication	Lecture	MTB201.4	Quiz & End Sem Exam
29	Compare and contrast eukaryote and prokaryote DNA replication	Lecture	MTB201.4	Quiz & End Sem Exam
30	telomeres, telomerase and altered telomerase function in aging and disease	Lecture	MTB201.4	Quiz & End Sem Exam
31	Recombination & Repair: Mutations and types of site mutations: substitution, transition, transversion, insertion, deletion, tautomer, frameshift and nonsense mutation.	Lecture	MTB201.4	Quiz & End Sem Exam
32	Recombination & Repair: Mutations and types of site mutations: substitution, transition, transversion, insertion, deletion, tautomer, frameshift and nonsense mutation.	Lecture	MTB201.4	Quiz & End Sem Exam
33	Repair mechanisms: dimer repair, excision repair, mismatch repair, trans-lesion repair, and recombinational repair.	Lecture	MTB201.4	Quiz & End Sem Exam
34	Repair mechanisms: dimer repair, excision repair, mismatch repair, trans-lesion repair, and recombinational repair.	Lecture	MTB201.4	Quiz & End Sem Exam
35	Transcription - RNA transcription and the proteins required for each step, maturation of the RNA transcript	Lecture	MTB201.5	Quiz & End Sem Exam
36	Transcription - RNA transcription and the proteins required for each step, maturation of the RNA transcript	Lecture	MTB201.5	Quiz & End Sem Exam

37	structure of prokaryote and eukaryote promoter and the function of promoter sequences, inhibitors of prokaryote and eukaryote transcription and their mechanisms of action	Lecture	MTB201.5	Quiz & End Sem Exam
38	Concept of operon, inducer, operator and polycistronic transcript, expression of the lac operon and trp operon in *E. coli*	Lecture	MTB201.5	Quiz & End Sem Exam
39	Concept of operon, inducer, operator and polycistronic transcript, expression of the lac operon and trp operon in *E. coli*	Lecture	MTB201.5	Quiz & End Sem Exam
40	catabolite repression, leader peptide and attenuator site, enhancer and transcription factors	Lecture	MTB201.5	Quiz & End Sem Exam
41	four common DNA-binding motifs found in transcription factors, mRNA stability and alternative splicing in gene expression	Lecture	MTB201.5	Quiz & End Sem Exam
42	four common DNA-binding motifs found in transcription factors, mRNA stability and alternative splicing in gene expression	Lecture	MTB201.5	Quiz & End Sem Exam
43	Genetic code and the concept of colinearity of the gene and protein	Lecture	MTB201.6	Quiz & End Sem Exam
44	components required for translation, basic steps involved in initiation	Lecture	MTB201.6	Quiz & End Sem Exam
45	elongation, and termination of protein translation	Lecture	MTB201.6	Quiz & End Sem Exam
46	translational recoding, inhibitors of protein translation	Lecture	MTB201.6	Quiz & End Sem Exam
47	Compare and contrast the spatial and temporal differences in prokaryotic and eukaryotic transcription and translation	Lecture	MTB201.6	Quiz & End Sem Exam
48	Compare and contrast the spatial and temporal differences in prokaryotic and eukaryotic transcription and translation	Lecture	MTB201.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MTB201.1.	Learn various aspects of protein targeting and transportation of small molecules across the membrane by different means.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB201.2.	Learn and understand the cell cycle with check points.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB201.3.	Learn and understand intracellular signaling mechanisms.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB201.4.	Learn the mechanism of replication of DNA both in prokaryotes and eukaryotes and repair mechanisms processed by the cell.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB201.5.	Learn in detail about the mechanism of transcription and post-transcriptional processes in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	1	1

MTB201.6.	Learn and understand the mechanism translation, gene expression regulation in prokaryotes and eukaryotes as well as gene silencing.	3	3	2	3	-	-	1	2	3	-			3	2	1	1

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –II) 2021-22						
Class: M.Tech. Biotechnology II Semester						
Subject Name: MTB 101 CELL AND MOLECULAR BIOLOGY		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the types of nucleic acids with examples.	3
CO1	Q.2	What do you understand by semi conservative mode of DNA replication?	6
CO1	Q.3	Give an account of transcription termination in *E. coli*.	6
CO2	Q.4	Explain the significance of poly A tail in RNA.	3
CO2	Q.5a	tRNA acts as an adapter molecule in translation. Discuss.	3
	Q.5b	Discuss the different mechanisms of antisense technology.	3
CO2	Q 6	How does post-translation modification ensure the functionality of a protein? Discuss.	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Cell and Molecular Biology**/Course code **MTB-201** is level **3** for the academic year 2019-20.

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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Technology (M. Tech.) Biotechnology, Academic Year – 2019-20

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M. Tech. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and

immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MTB220	3	3	3	3	3	1	2	2	2	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : CELL AND MOLECULAR BIOLOGY LAB
Course Code : MTB 220, Credits: 02, Session :2021-22 (Even Sem.), Class : M.Sc. 1^{st} Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend advanced understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:

MTB220.1. Understand the practical based learning of isolation of nucleic acids and study of apoptosis.

MTB220.2. Understand the practical based learning of cell organelle isolation, in-vitro transcription, translation and repair mechanism.

MTB220.3. Understand the practical based learning of site-directed mutagenesis and RNA isolation.

C. **Programme Outcomes:**

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

1. Isolation of genomic DNA from prokaryotic and Eukaryotes
2. Isolation of plasmid.
3. Study of apoptosis by TUNEL method
4. Isolation of cell organelles by ultracentrifugation.
5. Study of in vitro transcription.
6. Study of DNA repair mechanism
7. Site-directed mutagenesis
8. Isolation of RNA

G. Examination Scheme:

IA			**EE**			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A:

Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:

Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of genomic DNA from prokaryotic and Eukaryotes	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
2	Isolation of genomic DNA from prokaryotic and Eukaryotes	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of genomic DNA from prokaryotic and Eukaryotes	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
4	Isolation of plasmid	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
5	Isolation of plasmid	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
6	Isolation of plasmid	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
7	Study of apoptosis by TUNEL method	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
8	Study of apoptosis by TUNEL method	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
9	Study of apoptosis by TUNEL method	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
10	Isolation of cell organelles by ultracentrifugation	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
11	Isolation of cell organelles by ultracentrifugation	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
12	Isolation of cell organelles by ultracentrifugation	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam

13	Study of in vitro transcription	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
14	Study of in vitro transcription	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
15	Study of in vitro transcription	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
16	Study of DNA repair mechanism	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
17	Study of DNA repair mechanism	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
18	Study of DNA repair mechanism	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
19	Site-directed mutagenesis	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam
20	Site-directed mutagenesis	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam
21	Site-directed mutagenesis	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam
22	Isolation of RNA	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam
23	Isolation of RNA	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam
24	Isolation of RNA	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MTB220.1.	Understand the practical based learning of isolation of nucleic acids and study of apoptosis.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB220.2.	Understand the practical based learning of cell organelle isolation, in-vitro transcription, translation and repair mechanism.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB220.3.	Understand the practical based learning of site-directed mutagenesis and RNA isolation.	3	3	3	3	-	1	2	-	2	2			3	3	2	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Cell and Molecular Biology Lab**/Course code **MTB-220** is level **3** for the academic year 2019-20.

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science/Master of Science (B.Sc.-M.Sc. Dual Degree)

Academic Year – 2020-21

Programme Outcomes:

PROGRAM OUTCOMES OF B.Sc.-M.Sc Biotechnology-Dual Degree BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and

comprehend effectively in person and other means and being able to

write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of basic and applied cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
II SEM	BMB 202	3	2	2	3	-	-	-	1	2	1			3	2	-

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOANALYTICAL TECHNIQUES
Course Code : BMB 202, Crédits : 03, Session :2020-21 (Even Sem.), Class : B.Sc.-M.Sc. (Dual) 1st Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques in Bioanalytical techniques The student will be exposed to principles, instrumentation & application of various instruments & techniques used in biological research.

B. Course Outcomes: At the end of the course, students will be able to:

BMB 202.1. Develop deep theoretical understanding of analytical instruments and their practical use in the laboratory, it includes the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc.
BMB 202.2. Understand principles of Chromatographic techniques and their types.
BMB 202.3. Principle and applications of electrophoresis i.e., PAGE (Native and SDS), Immunoelectrophoresis etc.
BMB 202.4. Understand about radioisotope and tracer techniques in life sciences.

C. Programme Outcomes:

On completion of the course, students are able to understand about:
PO1. Knowledge: Dealing with developing knowledge and effective

implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of basic and applied cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation,

environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. **Syllabus**

Module I: Instruments, basic principles and usage

pH meter, absorption and emission spectroscopy, Principle and law of absorption, fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), polarography, centrifugation, atomic absorption, NMR, X-ray crystallography, Circular Dichorism.

Module II: Chromatography techniques

Paper chromatography, thin layer chromatography, affinity chromatography, column chromatography, HPLC, gas chromatography, gel filtration and ion exchange chromatography,

Module III: Electrophoresis

Agarose gel electrophoresis, SDS polyacrylamide electrophoresis, immunoelectrophoresis, Isoelectric focussing.

Module IV: Radioisotope tracer techniques and autoradiography

G. **Examination Scheme:**

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. **Suggested Text/Reference Books:**

- Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
- Bioinstrumentation, Webster
- Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
- Crystal Structure Analysis, J.P. Glusker and K.N. Trueblood, Oxford University Press
- Modern Spectroscopy, J.M. Hollas, John Wiley and Son Ltd.
- NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry, H. Gunther, John Wiley and Sons Ltd.
- Principles of Physical Biochemistry, K.E. Van Holde, Prentice Hall.
- Principles and Practice of Bioanalysis, Richard F. Venn
- Microscopic Techniques in Biotechnology, Michael Hoppert
- Principles of Fermentation Technology, P.F. Stanbury, A. Whitaker, S.J. Hall

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Introduction of instrumentation	Lecture	BMB 202.1.	Mid Term-1, Quiz & End Sem Exam
2	pH meter,	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Absorption and emission spectroscopy,	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Absorption and emission spectroscopy,	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Principle and law of absorption,	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Principal and applications fluorimetry,	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Principal and applications Colorimetry	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Principal and applications spectrophotometry (visible, UV, infra-red),	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Principal and applications Polorography	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Principal and applications Centrifugation	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Principal and applications NMR	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Principal and applications X-ray Crystellography	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Principal and applications Circular Dichorism.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Principal and applications of Paper Chramatography	Lecture	BMB 202.2.	Mid Term-1, Quiz & End Sem Exam
15	Principal and applications thin layer chromatography	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Principal and applications Column Chromatography	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Principal and applications Column Chromatography	Lecture		Quiz & End Sem Exam
18	Principal and applications Affinity chromatography	Lecture		Quiz & End Sem Exam

19	Principal and applications gel filtration Chromatography	Lecture		Quiz & End Sem Exam
20	Principal and applications ion exchange	Lecture		Quiz & End Sem Exam

	Chromatography			
21	Principal and applications Gas Chromatography	Lecture		Quiz & End Sem Exam
22	Principal and applications of HPLC	Lecture		Quiz & End Sem Exam
23	Agarose gel electrophoresis,	Lecture	BMB 202.3.	Quiz & End Sem Exam
24	Agarose gel electrophoresis,	Lecture		Quiz & End Sem Exam
25	Native polyacrylamide electrophoresis (PAGE)	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Native polyacrylamide electrophoresis (PAGE)	Lecture		Quiz & End Sem Exam
27	SDS polyacrylamide electrophoresis (SDS-PAGE)	Lecture		Quiz & End Sem Exam
28	SDS polyacrylamide electrophoresis (SDS-PAGE)	Lecture		Quiz & End Sem Exam
29	Immunoelectrophoresis	Lecture		Quiz & End Sem Exam
30	Imunoelectrophoresis	Lecture		Quiz & End Sem Exam
31	Isoelectric focussing.	Lecture	BMB 202.4.	Quiz & End Sem Exam
32	Radioisotopes in life sciences	Lecture		Quiz & End Sem Exam
33	Radioisotope tracer techniques	Lecture		Quiz & End Sem Exam
34	Radioisotope tracer techniques	Lecture		Quiz & End Sem Exam
35	Autoradiography	Lecture		Quiz & End Sem Exam
36	Autoradiography	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 1	P O 1	P O 1	P S O	P S O	P S O

											0	1	2	1	2	3
BMB 202.1.	Develop deep theoretical understanding of analytical instruments and their practical use in the laboratory, it includes the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**
BMB 202.2.	Understand basic instrumentation of chromatographic techniques and their types.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**
BMB 202.3.	Principle and applications of electrophoresis i.e., PAGE (Native and SDS), Immunoelectrophoresis etc.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**
BMB 202.4.	Understand about radioisotope and tracer techniques in life sciences.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**

Sample Question Paper

Amity Institute Biotechnology 2021-22						
Class: B.Sc.-M.Sc. (Dual Degree) Biotechnology II Semester						
Subject Name: BIOANALYTICAL TECHNIQUES		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.2, 10	Q. 7, 8, 9,	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	Write the standard definition of pH? How does pH meter measures the pH?	6
CO2	Q.2	Differentiate between Ascending and Descending paper chromatography.	6
	Q.3	Write short note on of counter-current imunoelectrophoresis.	6
CO4	Q.4	Define radioisotopes tracer technique and its applications in biological research.	6
CO4	Q.5	Write a short note on autoradiography and its applications in biological research.	6
CO3	Q.6	Define retention factor (Rf) value, write its significance.	6
	Q.7	Discuss polyacrylamide gel electrophoresis, Why low molecular weight proteins are separated on high el percentage in PAGE? How PAGE offers advantage over Agarose gel electrophoresis?	10
CO1	Q.8	Explain the principle and instrumentation of UV/Vis spectrophotometer. Draw its block diagramme and enlist its applications.	10
CO3	Q.9	Explain the working principle and methodology of Thin Layer Chromatography (TLC). Enlist its applications.	10

CO3	Q.10	.	20

		A Design the affinity column to separate the eukaryotic mRNA from mixture of different types of RNAs (rRNA, t-RNA, mRNA, and other snRNA)? Write the detailed description.	

Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioanalytical techniques***/Course code ***BMB 202*** is level **3** for the academic year ***2020-21***.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
III	BMB 302	3	3	3	3	1	-	-	2	2	1	3	1	-

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MICROBIOLOGY
Course Code : BMB 302, Crédits : 04, Session :2020-21 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The course imparts the knowledge of different types of microorganisms that are invisible to our naked eyes. Discovery origin and evaluation of different forms of bacteria, fungi, protozoa and viruses constitute the basics of biotechnology.

B. **Course Outcomes:** After successful completion of the course student will be able to:
BMB 302.1. Understand the microbiological techniques for the isolation and characterization of microbes.
BMB 302.2. Understand the mechanism of different metabolic processes.
BMB 302.3. Know the physiology and survival mechanism of extremophilic bacteria.
BMB 302.4. Know the concept of virus lytic and lysogenic cycle is quite clear to students.
BMB 302.5. Understand the epidemiology and microbial pathogenesis.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.
PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.
PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting

commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/ HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the

causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization,

Module II

Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, continuous culture, culture collection and maintenance of cultures.

Module III

Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV

Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archaea

Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles Viruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI

Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII

Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill
  Microbiology by Prescott

- The microbes – An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

References:

- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin & Cummings
- Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
- Industrial Microbiology, Casida, New Age International
- Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC. Brown Publisher.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
2	Role of microorganisms in transformation of organic matter and in the causation of diseases,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
3	Development of pure culture methods.	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
4	Methods in Microbiology -Principles of microbial nutrition,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
5	Culture media,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
6	Culture media,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam

7	Physical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
8	Physical Sterilization	Lecture	BMB 302.1.	Mid Term-

				1, Quiz & End Sem Exam
9	Chemical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
10	Chemical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
11	Prokaryotic structure and function	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
12	Cell wall	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
13	Cell cytoplasmic membrane	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
14	Capsule	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
15	Surface appendages	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
16	Cytoplasm and cytoplasmic inclusion	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
17	Bacterial growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam

18	Mathematical expression of growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam

19	Growth curve	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
20	Measurement of growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
21	Synchronous growth,	Lecture	BMB 302.2	Quiz & End Sem Exam
22	Continuous culture,	Lecture	BMB 302.2	Quiz & End Sem Exam
23	Culture collection and maintenance of cultures.	Lecture	BMB 302.2	Quiz & End Sem Exam
24	Systematics and taxonomy - new approaches to bacterial taxonomy,	Lecture	BMB 302.2	Quiz & End Sem Exam
25	Classification including ribotyping, ribosomal RNA sequencing,	Lecture	BMB 302.2	Quiz & End Sem Exam
26	Characteristics of primary domains, taxonomy, nomenclature and Bergey's manual	Lecture	BMB 302.2	Quiz & End Sem Exam
27	Metabolic Diversity among microorganisms- photosynthesis in microorganisms	Lecture	BMB 302.2	Quiz & End Sem Exam
28	Role of bacteriochlorophylls	Lecture	BMB 302.2	Quiz & End Sem Exam
29	carotenoids and phycobilins	Lecture	BMB 302.2	Quiz & End Sem Exam
30	Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria,	Lecture	BMB 302.2	Quiz & End Sem Exam
31	nitrate and sulphate reduction,	Lecture	BMB 302.2	Quiz & End Sem Exam
32	methanogenesis and acetogenesis,	Lecture	BMB 302.2	Quiz & End Sem Exam
33	Fermentations,	Lecture	BMB 302.2	Quiz & End Sem Exam
34	Nitrogen fixation,	Lecture	BMB 302.2	Quiz & End Sem Exam
35	Plant microbe interactions	Lecture	BMB 302.2	Quiz & End Sem Exam

36	Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BMB 302.3	Quiz & End Sem Exam
37	*Viruses: Bacterial, animal;*	Lecture	BMB	Quiz & End Sem

	structure of viruses;		302.4	Exam
38	*Reproduction and life cycle of RNA and DNA viruses; Viroids and prions.*	Lecture	BMB 302.4	Quiz & End Sem Exam
39	*Algae: Classification and Reproduction.*	Lecture	BMB 302.4	Quiz & End Sem Exam
40	*Fungi: Classification and Reproduction.*	Lecture	BMB 302.4	Quiz & End Sem Exam
41	Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract,	Lecture	BMB 302.5	Quiz & End Sem Exam
42	Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo) and their mode of actions,	Lecture	BMB 302.5	Quiz & End Sem Exam
43	Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission;	Lecture	BMB 302.5	Quiz & End Sem Exam
44	Sexually transmitted disease including AIDS, Food and water-borne diseases; pathogenic fungi.	Lecture	BMB 302.5	Quiz & End Sem Exam
45	Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins,	Lecture	BMB 302.5	Quiz & End Sem Exam
45	Broad spectrum antibiotics	Lecture	BMB 302.5	Quiz & End Sem Exam
46	Antifungal antibiotics	Lecture	BMB 302.5	Quiz & End Sem Exam
47	Antibiotics mode of action.	Lecture	BMB 302.5	Quiz & End Sem Exam
48	Antibiotics mode of action.	Lecture	BMB 302.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 302.1	Understand the microbiological techniques for the isolation and characterization of microbes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.2	Understand the mechanism of different metabolic processes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.3	Know the physiology and survival mechanism of extremophilic bacteria.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.4	Learn structure and function of the cell cytoskeleton, cilia and flagella.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.5	Understand the epidemiology and microbial pathogenesis	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

Amity Institute Biotechnology 2020-21						
Class: B.Sc.-M.Sc. (Dual Degree) Biotechnology III Semester						
Subject Name: Microbiology		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand the microbiological techniques for the isolation and characterization of microbes.
- Understand the mechanism of different metabolic processes.
- Know the physiology and survival mechanism of extremophilic bacteria.
- Know the concept of virus lytic and lysogenic cycle is quite clear to students.
- Understand the epidemiology and microbial pathogenesis.

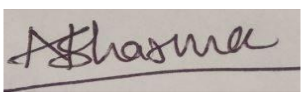
CO Map	Question No.	Question	Marks
CO1	Q.1	Write the historical contributions of Louis Pasteur and Robert Koch in the field of microbiology.	6
CO2	Q.2	Write down the steps involved in Gram's staining procedure. Differentiate between Gram positive and gram negative bacteria.	6
	Q.3	Explain the importance of extracellular appendages present in bacteria.	6
CO4	Q.4	Describe polyphasic taxonomy and discuss some of its advantages	6
CO4	Q.5	Discuss about the mechanism of photo-phosphorylation in bacterial system.	6
CO3	Q.6	Give an outline the nitrogen fixation, and explain the roles of microorganisms in this cycle	6
	Q.7	What are the archaea? Briefly describe the major ways in which they differ from bacteria and eucaryotes.	10

CO4	Q.8	Write a note on viroids and prions with suitable example of disease.	10

CO3	Q.9	Discuss about normal microbiota present on different body region with suitable features	10
CO3	Q.10	What is penicillinase? Explain the role of penicillin against the synthesis of bacterial cell wall. How does a low concentration of penicillin G select for penicillin-resistant bacteria?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Microbiology***/Course code ***BMB 302*** is level **2** for the academic year 2020-21.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BMB 401	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **Bioinformatics**
Course Code : BMB 401, Crédits : 3, Session :2020-21 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The course involves a basic understanding of computer and bioinformatics tools and skills in the field of biology

B. **Course Outcomes:** After successful completion of the course student will be able to:

BMB 401.1. Understand and explain the structural organization and characteristics of computers and its parts

BMB 401.2. Describe the concept of use of internet in bioinformatics.

BMB 401.3. Explain the concept and organization of biological databases..

BMB 401.4. Understand and explain the structure and functions of the phylogenetic analytic tools.

BMB 401.5. Interrogate major database sources and be able to integrate this information with clinical data.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting

commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Computers
General introduction (characteristics, capabilities, generations), software, hardware : organization of hardware (input devices, memory, control unit arithmetic logic unit, output devices); software : (System software; application software, languages -low level, high level), interpreter, compiler, data processing; batch, on-line, real-time (examples from bioindustries; e.g. application of computers in co-ordination of solute concentration, ph, temperature, etc., of a fermenter in operation); internet application.

Module II: Basic Bioinformatics

Introduction to Internet, Search Engines (Google, Yahoo, Entrez etc)

Module III: Biological Databases
Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL), Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc), Cluster databases-An Introduction, Specialised databases (KEGG, etc), Database technologies (Flat-file), Structural databases (PDB)

Module IV: Phylogenetic Analysis
Trees-splits and metrices on trees, tree interpretation, Distance – additive, ultrameric and nonadditive distances,tree building methods, phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains, estimating the rate of change, likelihood and trees; analysis software.

Module V: Genome analysis
Annotation, comparison of different methods; ESTs – databases, clustering, gene discovery and identification, and functional classification. Reconstruction of metabolic pathways; Genome analysis, genome anatomy, genome rearrangements with inversions, signed inversions, gene identification, gene expression, expression analysis, gene identification and functional classification

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
• Computer Science, J.G. Brookshear, Pearson, Addison Wesley
• Introduction to Bioinformation – T.Attawood
References:
• A book on C by Kelley : Programming in C, Addison-Wesley Publishing
• Introduction to C++ for Engineers and Scientists, Prentice-Hall
• Schaum's Outline of Introduction of Computer Science, P. Cushman and R. Mata-Toledo, McGraw Hill
Trade
• Bioinformatics – Managing Scientific Data, Zoe' Lacroix and Terence Critchlow
• Bioinformatics – Sequence, Structure and Databanks, Des Higgins & Willie Taylor
• Structural Bioinformatics, Philip E. Bourne, Helge Weissig 2003
• Statistical Methods in Bioinformatics: An Introduction, G.R. Grant, W.J. Ewens, Springer Verlag

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	General introduction (characteristics, capabilities, generations),	Lecture	**BMB 401.1**.	Mid Term-1, Quiz & End Sem Exam

2	software, hardware : organization of hardware (input devices, memory, control unit	Lecture	**BMB 401.1**.	Mid Term-1, Quiz & End Sem Exam

	arithmetic logic unit, output devices),			
3	organization of hardware	Lecture	**BMB 401.2**.	Mid Term-1, Quiz & End Sem Exam
4	*organization of software*	Lecture	**BMB 401.2**.	Mid Term-1, Quiz & End Sem Exam
5	Interpreter, compiler, data processing; batch, on-line, real-time	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
6	Introduction and application of Internet	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
7	Search Engines (Google, Yahoo, Entrez etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
8	Revision	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
9	Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
10	Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
11	Cluster data bases-An Introduction. Specialized databases (KEGG, etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
12	Database technologies (Flat-file)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
13	Revision	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
14	Introduction of phylogenetics analysis	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
15	Trees-splits and metrices on trees, tree interpretation	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
16	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
17	phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
18	Estimating the rate of change, likelihood and trees; analysis software	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
19	Annotation, comparison of different methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam

20	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
21	Revision	Lecture	**BMB 401.4**	Quiz & End Sem

				Exam
22	ESTs – databases, clustering	Lecture	**BMB 401.4**	Quiz & End Sem Exam
23	Gene discovery	Lecture	**BMB 401.4**	Mid Term-2, Quiz & End Sem Exam
24	Identification and classification	Lecture	**BMB 401.5**	Quiz & End Sem Exam
25	Revision	Lecture	**BMB 401.5**	Quiz & End Sem Exam
26	Reconstruction of metabolic pathways	Lecture	**BMB 401.5**	Quiz & End Sem Exam
27	Genome analysis, genome anatomy	Lecture	**BMB 401.4**	Quiz & End Sem Exam
28	Genome rearrangements with inversions	Lecture	**BMB 401.4**	Quiz & End Sem Exam
29	signed inversions, gene identification	Lecture	**BMB 401.4**	Quiz & End Sem Exam
30	Reconstruction of metabolic pathways	Lecture	**BMB 401.4**	Quiz & End Sem Exam
31	Genome analysis, genome anatomy	Lecture	**BMB 401.4**	Quiz & End Sem Exam
32	Gene expression	Lecture	**BMB 401.4**	Quiz & End Sem Exam
33	Gene expression analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
34	Gene identification methods	Lecture	**BMB 401.1**	Quiz & End Sem Exam
35	Functional classification	Lecture	**BMB 401.1**	Quiz & End Sem Exam
36	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
37	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
38	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam
39	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam
40	Gene expression	Lecture	**BMB 401.1**	Quiz & End Sem Exam
41	Gene expression analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
42	Gene identification methods	Lecture	**BMB 401.1**	Quiz & End Sem Exam
43	Functional classification	Lecture	**BMB 401.1**	Quiz & End Sem Exam
44	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
45	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
45	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 401.1	Understand and explain the structural organization and characteristics of computers and its parts	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.2	Describe the concept of use of internet in bioinformatics.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.3	Explain the concept and organization of biological databases	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.4	Understand and explain the structure and functions of the phylogenetic analytic tools.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.5	Interrogate major database sources and be able to integrate this information with clinical data.	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

Amity Institute Biotechnology 2020-21						
Class: B.Sc. Biotechnology IV Semester						
Subject Name: **Bioinformatics**		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand the basic knowledge of computer hardware and software.
- Understand the advanced techniques of bioinformatics.
- Understand the application of bioinformatics in different area.
- Understand the role of computational biology in drug designing.
- Understand the importance of phylogenetic analysis in species development.

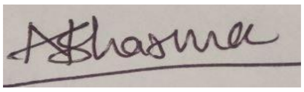
CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about the importance of input and output device of computer. Also differentiate between input and output devices.	6
CO2	Q.2	Discuss about the anatomy of E. mail and www.	6
	Q.3	Explain about the different databases present in NCBI. Give a comparison between protein databases and nucleotide databases with examples.	6
CO4	Q.4	Discuss about the different terminology used in phylogenetic tree with the suitable diagram.	6
CO4	Q.5	Write about the genome of between prokaryotic and eukaryotic organism.	6
CO3	Q.6	Discuss a general classification of computer generations with suitable examples, merits and demerits	6
	Q.7	What is topology of computer networking? Write advantages and disadvantages of different topology networking.	10
CO4	Q.8	Write a detail note on RCSB, Genbank, and DDBJ with advantages.	10
CO3	Q.9	What is sequence similarity? Explain about the different quantitative methods of sequence similarity	10

CO3	Q.10	. A. Explain the different methods used for gene prediction. Discuss one of the methods in detail with suitable diagram. B. By writing the corresponding match states into columns we get the following alignment: ATGA AGTA	20

		What is its score under the following scoring scheme? Match +2, Mismatch -1 and Gap +1.Explain with global alignment algorithm.	

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Bioinformatics** /Course code ***BMB 401*** is level **2** for the academic year 2020-21.

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MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science/ Master of Science (B.Sc. -M.Sc Dual Degree)

Academic Year – 2020-21

Programme Outcomes:

B.Sc.-M.Sc Biotechnology-Dual Degree (Ten Semesters)

PROGRAM OUTCOMES OF B.Sc.- M.Sc Biotechnology-Dual Degree BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere

to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of basic and applied cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	BMB 402	3	2	3	3	1	-	1	-	1	1			3	2	1
IV SEM																

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR CELL BIOLOGY
Course Code : BMB 402, Crédits : 03, Session :2020-21 (Odd Sem.), Class : B.Sc. M.Sc (Dual degree) 2nd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in Molecular Cell Biology, further to extend understanding of the molecular mechanisms via which genetic information's are stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:

BMB 402.1. Develop deep understanding of DNA/ RNA structure, and mechanism of DNA replication.
BMB 402.2. Understand Genetic Codes and Transposable elements
BMB 402.3. Understand mechanism of transcription and translation in prokaryotes and eukaryotes.
BMB 402.4. Enhance fine molecular understanding of operon gene regulation ion in prokaryotes.
BMB402.5. Understand the mechanism of Oncogenes and Tumor suppressor genes.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents,

make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of basic and applied cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%

End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction to Moleculer Biology,
Structure and composition of DNA, RNA structure and its types, Basic techniques in molecular biology (Agarose gel electrophoresis, PCR etc.) and its applications.
Molecular basis of life:DNA replication in prokaryotes and eukaryotes; DNA recombination molecular mechanisms.

Module II: Insertion elements, transposons and retrotransposons
Mobile genetic elements and its types in both prokaryotes and eukaryotes and their applications.
Application of genetic engineering, Organisation of genetic material: Split genes; overlapping genes; pseudogenes; cryptic genes
Genetic Code: Properties of genetic code, codon assignment, chain termination codons, wobble hypothesis.

Module III: Structure of prokaryotic and eukaryotic genes
Transcription mechanism in prokaryotes and eukaryotes. Translation: Translation mechanisms in prokaryotes and eukaryotes.

Module IV: Gene Expression in prokaryotes
Operon concept, Positive and Negative control of operon (Lac, Tryptophan and Arabinose operon)

Module V: Eukaryotic geneExpression
Overview of gene expression, polyadenylation, cap formation, RNA degradation.

Module VI: Oncogenes and Tumor Suppressor genes
Oncogenes, tumorsuppressor genes in humans, role of genes in cancer development.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Gene VIII, Benjamin Lewin 2005, Oxford University Press
- Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing.

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education
- Genome, T.A. Brown, John Willey & Sons Inc.

- Molecular Cell Biology, H. Lodish, A.Berk, S. Zipursky, P Matsundaira, D.Baltimore and J.E. Barnell,W. H Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing
- .Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley and Sons Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Structure and composition of DNA, RNA structure and its types	Lecture	BMB 402.1.	Mid Term-1, Quiz & End Sem Exam
2	Structure and composition of DNA, RNA structure and its types	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Structure and composition of DNA, RNA structure and its types	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Structure and composition of DNA, RNA structure and its types	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Basic techniques in molecular biology: PCR etc.) and its applications.	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Basic techniques in molecular biology (Agarose gel electrophoresis, and its applications.	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Mobile genetic elements and its types in prokaryotes	Lecture	BMB 402.2.	Mid Term-1, Quiz & End Sem Exam
8	Mobile genetic elements and its types in prokaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Mobile genetic elements and its types in eukaryotes	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Organisation of genetic material: Split genes; overlapping genes; pseudogenes; cryptic genes	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Application of genetic engineering,	Lecture		Mid Term-1, Quiz & End Sem Exam

12	Genetic Code: Properties of genetic code, codon assignment, chain	Lecture		Mid Term-1, Quiz & End Sem Exam

	termination codons,			
13	, wobble hypothesis.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Structure of prokaryotic and eukaryotic genes	Lecture	BMB 402.3.	Mid Term-1, Quiz & End Sem Exam
15	Transcription mechanism in prokaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Transcription mechanism in eukaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Translation :Translation mechanisms in prokaryotes	Lecture		Quiz & End Sem Exam
18	Translation :Translation mechanisms in prokaryotes	Lecture		Quiz & End Sem Exam
19	Translation :Translation mechanisms in eukaryotes.	Lecture		Quiz & End Sem Exam
20	Operon concept, Positive and Negative control of operon	Lecture	BMB 402.4.	Quiz & End Sem Exam
21	Operon concept, Positive and Negative control of operon Lac Operon	Lecture		Quiz & End Sem Exam
22	Operon concept, Positive and Negative control of operon Lac Operon	Lecture		Quiz & End Sem Exam
23	Operon concept, Positive and Negative control of operon Trp operon	Lecture		Quiz & End Sem Exam
24	Operon concept, Positive and Negative control of operon Trp operon	Lecture		Quiz & End Sem Exam
25	Operon concept, Positive and Negative control of operon Ara Operon	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Overview of Eukaryotic gene expression,	Lecture	BMB 402.5.	Quiz & End Sem Exam
27	Mechanism of polyadenylation,	Lecture		Quiz & End Sem Exam
28	Mechanism of cap formation.	Lecture		Quiz & End Sem Exam
29	Mechanism of RNA degradation.	Lecture		Quiz & End Sem Exam
30	Oncogene in humans,	Lecture	BMB 402.6.	Quiz & End Sem Exam
31	Oncogenes in humans,	Lecture		Quiz & End Sem Exam

32	Tumorsuppressor genes in humans.	Lecture		Quiz & End Sem Exam

33		Lecture		Quiz & End Sem Exam
34	Tumorsuppressor genes in humans.	Lecture		Quiz & End Sem Exam
35	Role of genes in cancer	Lecture		Quiz & End Sem Exam
36	Role of genes in cancer	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BMB 402.1.	Develop deep understanding of DNA/ RNA structure, and mechanism of DNA replication.	3	3	**1**	**1**	2	-	-	-	-	1			3	2	-
BMB 402.2.	Understand Genetic Codes and Transposable elements	3	3	**1**	**1**	2	-	-	-	-	1			3	2	-
BMB 402.3	Understand mechanism of transcription and translation in prokaryotes and eukaryotes.	3	3	**1**	**1**	2	-	-	-	-	1			3	2	-
BMB 402.4	Enhance fine molecular understanding of operon gene regulation ion in prokaryotes	3	3	**1**	**1**	2	-	-	-	-	1			3	2	-

BMB 402.5.	Understand the mechanism of Oncogenes and Tumor suppressor genes.	3	3	**1**	**1**	2	-	-	-	-	1			3	2	1

Sample Question Paper

Amity Institute Biotechnology 2021-22						
Class: B.Sc.-M.Sc. (Dual Degree) Biotechnology IV Semester						
Subject Name: MOLECULAR CELL BIOLOGY		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,6,2	Q.4,3	Q.7,6	Q.5,8	Q. 8, 9, 10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	What is melting temperature (Tm). How Tm varies with increasing GC content and pH?	6
CO1	Q.2	Write a note on the bacterial insertion elements (IS).	6
	Q.3	Write the functions of the following. (i) Carboxyl terminal domain (CTD) (ii) Primosome (iii) Sigma (σ) Factor	6
CO2	Q.4	Define degeneracy of genetic codes and its significance.	6
CO1	Q.5	Write the function of the following proteins (i) Helicase (ii) Gyrase (iii) Primase	6
CO3	Q.6	Write short note on 5'Cap in eukaryotic mRNA.	6
	Q.7	Design the experiment to proof that DNA replication is (i) Semiconservative (ii) Bidirectional.	10

CO4	Q.8	Explain the structure and function of *Lac* operon in *E.coli*. Discuss the mechanism of *Lac* operon expression regulation under following conditions (I) When lactose sugar present in growth medium (ii) When lactose sugar absent in growth medium.	10

CO5	Q.9	Define Oncogenes, discuss the different classes andproperties of oncogenes. How Proto-oncogenes converted into oncogenes?	10
CO3	Q.10	Explain the basic mechanism of PCR and explain the following variants of PCR and their advantages (i) RT- PCR (ii) Touch Down PCR (iii) Hot start PCR.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Molecular cell Biology***/Course code ***BMB 402*** is level **3** for the academic year ***2020-21***.


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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BMB 403	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **IMMUNOLOGY & IMMUNOTECHNOLOGY**
Course Code : BMB 403, Crédits : 04, Session :2020-21 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. Course Outcomes: After successful completion of the course student will be able to:

BMB 403.1. Understand and explain the phylogeny of immune system, types of immunity, immune response.
BMB 403.2. Describe the concept of clonal selection theory, humoral and cell mediated immunity.
BMB 403.3. Understand and explain the structure and functions of the organs and cells of the immune system.
BMB 403.4. Understand the mechanism of antigen-antibody interaction.
BMB 403.5. Describe the structure of antibodies, their types and functions in immunity.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.
PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy

flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I :
Descriptors/Topics
Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.

Module II:
Descriptors/Topics

The organs and cells of the immune system.

Module III :

Descriptors/Topics
Histocompatibility: structure of MHC class I, II & III antigens & their mode of antigen presentation, MHC restriction; Antigens & antigenicity;

Module IV :
Descriptors/Topics
Antibody structure in relation to function and antigen-binding; Types of antibodies and their structures: isotypes, allotypes, idiotypes. Antibodies in targeting therapeutic agents. Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application

Module V :
Descriptors/Topics
Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.

Module VI :
Descriptors/Topics
Measurement of antigen – antibody interaction: agglutination, precipitation immunodiffusion, immuno-electrophoresis, ELISA, RIE

Module VII :
Descriptors/Topics
Tissue and organ transplantation

Module VIIII :
Descriptors/Topics
Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.
Autoimmunity and autoimmune diseases: Hashimoto’s thyroiditis; Myasthenia gravis; Rheumatoid Arthritis, Pernicious anemia, Asthma.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Freeman

References:
- Immunology, Roitt, Mosby – Yearbook Inc.
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.1**.	Mid Term-1, Quiz & End Sem Exam
2	Innate and specific immunity. Humoral immunity,	Lecture	**BMB 403.1**.	Mid Term-1, Quiz & End Sem Exam
3	Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.2**.	Mid Term-1, Quiz & End Sem Exam
4	Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.2**.	Mid Term-1, Quiz & End Sem Exam
5	The organs of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
6	The organs of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
7	The cells of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
8	The cells of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
9	Histocompatibility: structure of MHC class I, II & III	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
10	Histocompatibility: structure of MHC class I, II & III	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
11	Antigens	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
12	Mode of antigen presentation,	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
13	MHC restriction; Antigens & antigenicity	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam

14	MHC restriction; Antigens & antigenicity	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
15	Antibody structure in relation to	Lecture	**BMB 403.4**	Mid Term-1,

	function and antigen-binding			Quiz & End Sem Exam
16	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
17	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
18	Antibodies in targeting therapeutic agents.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
19	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
20	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
21	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application,	Lecture	**BMB 403.4**	Quiz & End Sem Exam
22	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Quiz & End Sem Exam
23	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.4**	Mid Term-2, Quiz & End Sem Exam
24	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam
25	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam
26	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam
27	Measurement of antigen – antibody interaction: agglutination,	Lecture	**BMB 403.5**	Quiz & End Sem Exam

28	Precipitation	Lecture	**BMB 403.5**	Quiz & End Sem Exam
29	immunodiffusion,	Lecture	**BMB 403.5**	Quiz & End Sem

				Exam
30	immuno-electrophoresis,	Lecture	**BMB 403.5**	Quiz & End Sem Exam
31	ELISA,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
32	RIE,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
33	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
34	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
35	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
36	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
37	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
38	Autoimmunity	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
39	Autoimmunity	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
40	Autoimmune diseases: Hashimoto’s thyroiditis;	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
41	Myasthenia gravis;	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
42	Rheumatoid Arthritis,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
43	Pernicious anemia,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
44	Pernicious anemia,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
45	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
45	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
46	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
47	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
48	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 403.1	Understand and explain the phylogeny of immune system, types of immunity, immune response.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.2	Describe the concept of clonal selection theory, humoral and cell mediated immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.3	Understand and explain the structure and functions of the organs and cells of the immune system	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.4	Understand the mechanism of antigen-antibody interaction	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.5	Describe the structure of antibodies, their types and functions in immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

Amity Institute Biotechnology 2020-21		
Class: B.Sc.-M.Sc. (Dual Degree) Biotechnology IV Semester		
Subject Name: **Immunology & Immunotechnology**	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand and explain the phylogeny of immune system, types of immunity, immune response.
- Describe the concept of clonal selection theory, humoral and cell mediated immunity.
- Understand and explain the structure and functions of the organs and cells of the immune system.
- Understand the mechanism of antigen-antibody interaction.
- Describe the structure of antibodies, their types and functions in immunity.

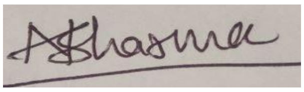
CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about innate and adaptive immunity. Discuss about the different types of innate immunity with characters.	6
CO2	Q.2	Write a note on different phases of cytotoxic cell mediated targeting killing mechanism.	6
	Q.3	Write a general organization of class I and class II MHC molecules with suitable diagram.	6
CO4	Q.4	Discuss the role of IgG immunoglobulin in immune system.	6
CO4	Q.5	What is antibody diversity? Discuss the role of light chain gene rearrangement in antibody diversity.	6
CO3	Q.6	Draw a well labeled diagram of hybridoma technology with production of monoclonal antibody.	6
	Q.7	Discuss the role of innate and adaptive immunity in tissue grafting. Explain with suitable example.	10
CO4	Q.8	Give a comparison between all type of vaccine with examples and applications.	10
CO3	Q.9	Discuss about features of any two primary lymphoid organs with suitable diagram	10

CO3	Q.10	A. Although all lymphocytes are formed in bone marrow. Explain how these cells get differentiated into B cell and T cell. B Where the CDR regions located on an antibody molecule and what are	20

		are their functions? Discuss the ELISA method on the basis of antigen and antibody interaction.	

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Immunology and immunotechnology**/Course code ***BMB 403*** is level **2** for the academic year 2020-21.

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science/ Master of Science (B.Sc. -M.Sc Dual Degree)Academic Year – 2020-21

B.Sc.-M.Sc Biotechnology-Dual Degree (Ten Semesters)

Programme Outcomes:

PROGRAM OUTCOMES OF B.Sc.- M.Sc Biotechnology-Dual Degree BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of basic and applied cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

ROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	BMB 502	3	2	3	3	-	1	2	1	1	-			3	2	1
														-	-	-
V SEM														-	-	-
														-	-	-
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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ANIMAL BIOTECHNOLOGY
Course Code : BMB 502, Crédits : 03, Session :2020-21 (Odd Sem.), Class : B.Sc._M.Sc (Dual) 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in animal biotechnology like in vitro fertilization, animal cell and tissue culture, hormone vaccine and important enzyme production through animal biotechnology.

B. **Course Outcomes:** At the end of the course, students will be able to:

BMB 502.1. Understand theory of animal cell culture, culture media, methods to develop cell lines. and their maintenance for commercial applications.
BMB 502.2. Understand scale up production of monoclonal antibodies and hybridoma technology.
BMB 502.3. Understand the structure and function of variety of hormones and growth factors.
BMB 502.4. Understand the technology and concepts of invitro fertilization and embryo transfer, and development of superior live stocks.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:
PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.
PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.
PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.
PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of basic and applied cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. **Syllabus**

Module I:

Introduction of animal cell culture substrate, culture media, preservation and maintenance of cell lines

Module II:

Production of monoclonal antibodies. Bioreactors for large scale culture of cells

Module III:

Growth factors promoting proliferation of animal cells (EGF, FGF, PDGF, IL-1, IL-2, NGF,erythropoietin).

Module IV:

Transgenic animals. In vitro fertilization and embryo transfer.

G. **Examination Scheme:**

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. **Suggested Text/Reference Books:**

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss. References:
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford.
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag.
- Cell Culture LabFax, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press.
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

I. **Lecture Plan**

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Animal Cell Culture: Overview	Lecture	BMB 502.1.	Mid Term-1, Quiz & End Sem Exam
2	Animal Cell culture substrates for attachment	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Broad outline of Animal Cell culture Media	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Animal Cell Culture Media: Natural media	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Animal Cell Culture Media: Artificial media	Lecture		Mid Term-1, Quiz & End Sem Exam

6	Advantages and limitations of natural and artificial media.	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Methods of Initiation of Cell culture	Lecture		Mid Term-1, Quiz & End Sem Exam

8	Methods of Initiation of Cell culture	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Preversation and maintenance of cell culture.	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Monoclonal antibodies:	Lecture	BMB 502.2.	Mid Term-1, Quiz & End Sem Exam
11	Methods of somatic cell fusion	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Hybridoma technology for MAbs production	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Hybridoma technology for MAbs production	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Bioreactors	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Bioreactors	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Applications of bioreactoras and Mabs	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Growth factors: epidermal growth factor (EGF), receptor, structure and functions.	Lecture	BMB 502.3.	Quiz & End Sem Exam
18	Growth Factors:Fibroblast growth factor (FGF), receptor, structure and functions FGF.	Lecture		Quiz & End Sem Exam
19	Growth Factors: Platelates derived growth factor (PDGF), receptor, structure and functions PDGF.	Lecture		Quiz & End Sem Exam
20	Growth Factors:Neural growth factor (NGF), receptor, structure and functions NGF.	Lecture		Quiz & End Sem Exam
21	Growth Factors:Interleukins IL1 and IL2 structure and functions.	Lecture		Quiz & End Sem Exam
22	Growth Factors: erythropoiten (EP) structure and functions.	Lecture		Quiz & End Sem Exam
23	Applications of growth factors.	Lecture		Quiz & End Sem Exam
24	Transgenic Animals: overview	Lecture	BMB 502.4.	Quiz & End Sem Exam
25	Vectors for transgene transfer	Lecture		Mid Term-2, Quiz & End Sem Exam

26	Methods of transgenic animal production	Lecture		Quiz & End Sem Exam
27	Application of transgenic	Lecture		Quiz & End Sem

	animals			Exam
28	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
29	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
30	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
31	Embryo transfer technique	Lecture		Quiz & End Sem Exam
32	Embryo transfer technique	Lecture		Quiz & End Sem Exam
33	Embryo transfer technique	Lecture		Quiz & End Sem Exam
34	Embryo transfer technique	Lecture		Quiz & End Sem Exam
35	Application of embryo transfer technique	Lecture		Quiz & End Sem Exam
36	Application of embryo transfer technique	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BMB 502.1.	Understand theory of animal cell culture, culture media, methods to develop cell lines. and their maintenance for commercial applications.	3	2	3	3	-	1	-	1	1	-	**-**	**-**	**3**	**2**	**1**
BMB 502.2.	Understand scale up production of monoclonal antibodies and hybridoma technology.	3	2	3	3	-	1	-	1	1	-			**3**	**2**	**1**

BMB 502.3	Understand the structure and function of variety of	3	2	3	3	-	2	-	-	1	-			**3**	**2**	**1**

	hormones and growth factors.															
BMB 502.4	Understand the technology and concepts of *invitro* fertilization and embryo transfer, and development of superior live stocks.	3	2	3	3	-	2	3	-	1	-			**3**	**2**	**1**

Sample Question Paper

Amity Institute Biotechnology 2020-21						
Class: B.Sc.-M.Sc. (Dual Degree) Biotechnology V Semester						
Subject Name: ANIMAL BIOTECHNOLOGY		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4,6	Q.2,5,3	Q.7,8	Q.9	Q. 10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	Write a short note on primary cell culture including its advantages and limitations.	6
CO1	Q.2	Write a short note on reporter genes used during cloning in animal cells.	6
	Q.3	Briefly discuss moist heat sterilization method including its advantages and limitations.	6
CO2	Q.4	Write a short note on Stirred tanked bioreactor.	6

CO2	Q.5	Explain the selection method of hybridoma cells for vaccine production.	6
	Q.6	Define bioethics? Enlist the initiatives of CSIRO’s animal ethics committee.	6

CO1	Q.7	Explain various methods of cell separation from animal tissue, clearly indicating their merits and demerits. How is cell culture maintained in the laboratory?	10
CO3	Q.8	Explain the following- (a) Method of selection of myeloma cells form bone marrow. (b) Recombinant erythropoietin (EPO) and its commercial applications.	10
CO4	Q.9	Discuss the principal and steps involved in Intra-cytoplasmic Sperm Injection (ICSI) with suitable diagramme during IVF for genetically superior livestock development. Enlist the risks associated with IVF.	10
CO4	Q.10	Discuss the following in detail (a) Various selection criteria for grading best embryos for embryo transfer technology (ETT). (b) Natural animal cell culture media.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Animal Biotechnology***/Course code ***BMB 502*** is level **3** for the academic year ***2020-21***.


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MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2020-21

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant

and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

	PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
	BSB 202	3	2	2	3	-	-	-	1	2	1			3	2	-	
														-	-	-	
														-	-	-	
II SEM														-	-	-	
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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOANALYTICAL TECHNIQUES
Course Code : BSB 202, Crédits : 03, Session :2020-21 (Even Sem.), Class : B.Sc. 1st Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in Bioanalytical techniques The student will be exposed to principles, instrumentation & application of various instruments & techniques used in biological research.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 202.1. Develop deep theoretical understanding of analytical instruments and their practical use in the laboratory, it includes the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc.
BSB 202.2. Understand principle instrumentation of chromatographic techniques and their types.
BSB 202.3. Principle and applications of electrophoresis i.e., PAGE (Native and SDS), Immunoelectrophoresis etc.
BSB 202.4. Understand about radioisotope and tracer techniques in life sciences.

C. **Programme Outcomes:**

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.
PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. **Syllabus**

Module I: Instruments, basic principles and usage
pH meter, absorption and emission spectroscopy, Principle and law of absorption, fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), polarography, centrifugation, atomic absorption, NMR, X-ray crystallography, Circular Dichorism.

Module II: Chromatography techniques
Paper chromatography, thin layer chromatography, affinity chromatography, column chromatography, HPLC, gas chromatography, gel filtration and ion exchange chromatography,

Module III: Electrophoresis
Agarose gel electrophoresis, SDS polyacrylamide electrophoresis, immunoelectrophoresis, Isoelectric focussing.

Module IV: Radioisotope tracer techniques and autoradiography

G. **Examination Scheme:**

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. **Suggested Text/Reference Books:**

- Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
- Bioinstrumentation, Webster
- Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
- Crystal Structure Analysis, J.P. Glusker and K.N. Trueblood, Oxford University Press
- Modern Spectroscopy, J.M. Hollas, John Wiley and Son Ltd.
- NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry, H. Gunther, John Wiley and Sons Ltd.
- Principles of Physical Biochemistry, K.E. Van Holde, Prentice Hall.
- Principles and Practice of Bioanalysis, Richard F. Venn
- Microscopic Techniques in Biotechnology, Michael Hoppert
- Principles of Fermentation Technology, P.F. Stanbury, A. Whitaker, S.J. Hall

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction of instrumentation	Lecture	BSB 202.1.	Mid Term-1, Quiz & End Sem Exam
2	pH meter,	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Absorption and emission spectroscopy,	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Absorption and emission spectroscopy,	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Principle and law of absorption,	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Principal and applications fluorimetry,	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Principal and applications Colorimetry	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Principal and applications spectrophotometry (visible, UV, infra-red),	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Principal and applications Polorography	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Principal and applications Centrifugation	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Principal and applications NMR	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Principal and applications X-ray Crystellography	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Principal and applications Circular Dichorism.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Principal and applications of Paper Chramatography	Lecture	BSB 202.2.	Mid Term-1, Quiz & End Sem Exam
15	Principal and applications thin layer chromatography	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Principal and applications Column Chromatography	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Principal and applications Column Chromatography	Lecture		Quiz & End Sem Exam
18	Principal and applications Affinity chromatography	Lecture		Quiz & End Sem Exam
19	Principal and applications gel filtration Chromatography	Lecture		Quiz & End Sem Exam

20	Principal and applications ion exchange Chromatography	Lecture		Quiz & End Sem Exam
21	Principal and applications	Lecture		Quiz & End Sem

	Gas Chromatography			Exam
22	Principal and applications of HPLC	Lecture		Quiz & End Sem Exam
23	Agarose gel electrophoresis,	Lecture	BSB 202.3.	Quiz & End Sem Exam
24	Agarose gel electrophoresis,	Lecture		Quiz & End Sem Exam
25	Native polyacrylamide electrophoresis (PAGE)	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Native polyacrylamide electrophoresis (PAGE)	Lecture		Quiz & End Sem Exam
27	SDS polyacrylamide electrophoresis (SDS-PAGE)	Lecture		Quiz & End Sem Exam
28	SDS polyacrylamide electrophoresis (SDS-PAGE)	Lecture		Quiz & End Sem Exam
29	Immunoelectrophoresis	Lecture		Quiz & End Sem Exam
30	Imunoelectrophoresis	Lecture		Quiz & End Sem Exam
31	Isoelectric focussing.	Lecture	BSB 202.4.	Quiz & End Sem Exam
32	Radioisotopes in life sciences	Lecture		Quiz & End Sem Exam
33	Radioisotope tracer techniques	Lecture		Quiz & End Sem Exam
34	Radioisotope tracer techniques	Lecture		Quiz & End Sem Exam
35	Autoradiography	Lecture		Quiz & End Sem Exam
36	Autoradiography	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3

BSB 202.1.	Develop deep theoretical understanding of analytical instruments and their practical use	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**

	in the laboratory, it includes the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc.															
BSB 202.2.	Understand basic instrumentation of chromatographic techniques and their types.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**
BSB 202.3	Principle and applications of electrophoresis i.e., PAGE (Native and SDS), Immunoelectrophoresis etc.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**			**3**	**1**	**-**
BSB 202.4	Understand about radioisotope and tracer techniques in life sciences.	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**2**	**2**	**1**			**3**	**1**	**-**

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2021-22</td></tr>
<tr><td colspan="7">Class: B.Sc. (H) Biotechnology
II Semester</td></tr>
<tr><td colspan="2">Subject Name:
BIOANALYTICAL TECHNIQUES</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.2, 10</td><td>Q. 7, 8, 9,</td><td></td></tr>
</table>

Student will be able to:

CO Map	Question No.	Question	Marks

CO1	Q.1	Write the standard definition of pH? How does pH meter measures the pH?	6
CO2	Q.2	Differentiate between Ascending and Descending paper chromatography.	6
	Q.3	Write short note on of counter-current imunoelectrophoresis.	6
CO4	Q.4	Define radioisotopes tracer technique and its applications in biological research.	6
CO4	Q.5	Write a short note on autoradiography and its applications in biological research.	6
CO3	Q.6	Define retention factor (Rf) value, write its significance.	6
	Q.7	Discuss polyacrylamide gel electrophoresis, Why low molecular weight proteins are separated on high el percentage in PAGE? How PAGE offers advantage over Agarose gel electrophoresis?	10
CO1	Q.8	Explain the principle and instrumentation of UV/Vis spectrophotometer. Draw its block diagramme and enlist its applications.	10
CO3	Q.9	Explain the working principle and methodology of Thin Layer Chromatography (TLC). Enlist its applications.	10
CO3	Q.10	. A Design the affinity column to separate the eukaryotic mRNA from mixture of different types of RNAs (rRNA, t-RNA, mRNA, and other snRNA)? Write the detailed description.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioanalytical techniques***/Course code ***BSB 202*** is level **3** for the academic year ***2020-21***.


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Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Genetics
Course Code : BSB301, Credits : 03, Session : 2021-22 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : Dr. Manish Kumar

A. Introduction : To acquaint the students to understand the basic concept of genetics incorporating the concepts of classical, molecular genetics. Students will learn about Mendelian Laws, Extension of Mendels Law, Multiple allele and isoallele, etc. Mutation, Mutagen, Chromosomal Aberrations, Human Genetic Disorders. Knowledge of methods of sex determination, Chromosomal non-disjunction, Chromosomal theory of inheritance, Sex linked, Sex limited and Sex limited Inheritance, Extra-chromosomal inheritance. Understanding of Population Genetics, Hardy-Weinberg Equilibrium, Gene and Genotype Frequencies.

B. Course Outcomes: At the end of the course, students will be able to:

BSB301.1. Students will develop an understanding of History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance.

BSB301.2. Understanding the pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation.

BSB301.3. To study the classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage.

BSB301.4. Students will develop a basic understanding of Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders.

BSB301.5. Knowledge of Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance.

BSB301.6. Students will learn about extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA.

BSB301.7. Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies.

C. Programme Outcomes:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution,

morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course

also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Program Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Brief history, scope and significance of Genetics. Mendelian law of inheritance. Lethality and interaction of gene. Multiple allele and isoallele. Penetrance and Expressivity. Linkage and crossing over. Mapping of genes. interference and coincidence.

Module II: Basic microbial genetics, Conjugation, transformation, transduction and their use in genetic mapping.

Module III: Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over and complementation test, Benzers work on rII locus in T4 Bacteriophage.

Module IV: Mutation; spontaneous and induced, Mutagen;chemical and physical. Chromosomal aberrations; structural and numerical. Economic importance of mutation. Genetic disorders in human; Kleinefelter, Turner, Cri-du-Chat and Down syndrome.

Module V: Sex determination in plant and animal. Non disjunction as a proof of chromosomal theory of inheritance. Sex linked, sex influenced and sex limited inheritance.

Module VI: Extra chromosomal inheritance; cytoplasmic inheritance, Mitochondrial and Chloroplast genetic system.

Module VII: Population genetics; Hardy-Weinberg equilibrium law, Gene and genotype frequencies.

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

Principles of Genetics, E. J. Gardner, John Wiley & Sons Inc.

Genetics, P.K. Gupta, Rastogi Publication.

Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, Pearson Education.

Genetics, M.W. Strickberger, Prentice Hall College Division.

Genetics, P.J. Russell, Benjamin/Cummings.

Genetics, R. Goodenough, International Thomson Publishing.

Introduction to Genetic Analysis, A.J. F. Griffiths, W.H. Freeman and Company.

Principles of Genetics, D.P. Snustad& M.J. Simmons, John Wiley and Sons Inc.

Molecular Biology of the Gene (Fifth Edition), J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison Wiesley Publishing.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Brief history, scope and significance of Genetics	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
2	Mendelian law of inheritance	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
3	Lethality and interaction of gene. Multiple allele and isoallele.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
4	Penetrance and Expressivity. Linkage and crossing over.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
5	Mapping of genes. Interference and coincidence.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
6	Basic microbial genetics	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam

7	Conjugation	Lecture	BSB301.2	Mid Term, Quiz & End

				Sem Exam
8	Transformation	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
9	Transduction	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
10	Genetic Mapping	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
11	Classical and modern concept of gene	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
12	Pseudoallelism, position effect	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
13	Intragenic crossing over	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
14	Mapping of genes	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
15	Interference and coincidence	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
16	Mutation; spontaneous and induced	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
17	Mutagen; chemical and physical	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
18	Chromosomal aberrations	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
19	Structural and numerical Aberration	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
20	Economic importance of mutation	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
21	Genetic disorders in human	Lecture	BSB301.4	Quiz & End Sem Exam
22	Sex determination in plant	Lecture	BSB301.5	Quiz & End Sem Exam

23	Sex determination in animal	Lecture	BSB301.5	Quiz & End Sem Exam

24	Non disjunction	Lecture	BSB301.5	Quiz & End Sem Exam
25	Non disjunction as a proof of chromosomal theory of inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
26	Sex linked inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
27	Sex influenced and sex limited inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
28	Extra chromosomal inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
29	Cytoplasmic inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
30	Mitochondrial DNA	Lecture	BSB301.6	Quiz & End Sem Exam
31	Chloroplast genetic system	Lecture	BSB301.6	Quiz & End Sem Exam
32	Significance of Extra chromosomal inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
33	Significance of cytoplasmic inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
34	Population genetics	Lecture	BSB301.7	Quiz & End Sem Exam
35	Hardy-Weinberg equilibrium law	Lecture	BSB301.7	Quiz & End Sem Exam
36	Gene and genotype frequencies	Lecture	BSB301.7	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3

BSB301.1	History and scope of Genetics, Linkage, Crossing Over,	3	2	2	2	2	2	2	2	2	2	3	2	2

	Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance													
BSB301.2	Pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB301.3	Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage	3	2	2	2	2	2	2	2	3	3	3	2	2
BSB301.4	Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders	3	3	2	3	2	2	2	2	2	2	3	2	2
BSB301.5	Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance	3	2	3	2	2	3	2	2	2	2	3	2	2

BSB301.6	Extra-chromosomal inheritance, cytoplasmic inheritance,	3	3	2	3	2	2	2	2	2	2	3	2	2

	Mitochondrial and Chloroplast DNA													
BSB301.7	Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies	3	2	2	3	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

Amity Institute of Biotechnology MID-SEMESTER 2021-22		
Class: B.Sc. (Biotech) III Semester		
Subject Name: BSB 301 GENETICS	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzin g	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to
CO1: History and scope of Genetics
CO2: Understanding the pre Mendelian genetic concepts

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the scope and significance of genetics.	3
CO1	Q.2a	What are different steps involved in genetic mapping ?	3
	Q.2b	How is mechanism of conjugation is different from transformation ?	3
CO1	Q.3	How classical concept of gene is different from modern concept of gene ?	6
CO2	Q.4	Explain the significance of extra-chromosomal inheritance and cytoplasmic inheritance.	3

Attainments	**Rubric**

Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **GENETICS/BSB 301** is **level 3** for the academic year 2021-22.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
III	BSB 302	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MICROBIOLOGY
Course Code : BSB 302, Crédits : 04, Session :2020-21 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The course imparts the knowledge of different types of microorganisms that are invisible to our naked eyes. Discovery origin and evaluation of different forms of bacteria, fungi, protozoa and viruses constitute the basics of biotechnology.

B. **Course Outcomes:** After successful completion of the course student will be able to:

BSB 302.1. Understand the microbiological techniques for the isolation and characterization of microbes.
BSB 302.2. Understand the mechanism of different metabolic processes.
BSB 302.3. Know the physiology and survival mechanism of extremophilic bacteria.
BSB 302.4. Know the concept of virus lytic and lysogenic cycle is quite clear to students.
BSB 302.5. Understand the epidemiology and microbial pathogenesis.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.
PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.
PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting

commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.
PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/ HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the

causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization,

Module II

Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, continuous culture, culture collection and maintenance of cultures.

Module III

Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV

Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archaea

Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles Viruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI

Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII

Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill
  Microbiology by Prescott

- The microbes – An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

References:

- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin & Cummings
- Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
- Industrial Microbiology, Casida, New Age International
- Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC. Brown Publisher.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
2	Role of microorganisms in transformation of organic matter and in the causation of diseases,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
3	Development of pure culture methods.	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
4	Methods in Microbiology -Principles of microbial nutrition,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
5	Culture media,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam

6	Culture media,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem

				Exam
7	Physical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
8	Physical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
9	Chemical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
10	Chemical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
11	Prokaryotic structure and function	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
12	Cell wall	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
13	Cell cytoplasmic membrane	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
14	Capsule	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam

15	Surface appendages	Lecture	BSB 302.2	Mid Term-1,

				Quiz & End Sem Exam
16	Cytoplasm and cytoplasmic inclusion	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
17	Bacterial growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
18	Mathematical expression of growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
19	Growth curve	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
20	Measurement of growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
21	Synchronous growth,	Lecture	BSB 302.2	Quiz & End Sem Exam
22	Continuous culture,	Lecture	BSB 302.2	Quiz & End Sem Exam
23	Culture collection and maintenance of cultures.	Lecture	BSB 302.2	Quiz & End Sem Exam
24	Systematics and taxonomy - new approaches to bacterial taxonomy,	Lecture	BSB 302.2	Quiz & End Sem Exam

25	Classification including ribotyping, ribosomal RNA sequencing,	Lecture	BSB 302.2	Quiz & End Sem Exam

26	Characteristics of primary domains, taxonomy, nomenclature and Bergey's manual	Lecture	BSB 302.2	Quiz & End Sem Exam
27	Metabolic Diversity among microorganisms- photosynthesis in microorganisms	Lecture	BSB 302.2	Quiz & End Sem Exam
28	Role of bacteriochlorophylls	Lecture	BSB 302.2	Quiz & End Sem Exam
29	carotenoids and phycobilins	Lecture	BSB 302.2	Quiz & End Sem Exam
30	Chemolithotrophy, hydrogrn- iron-nitrite-oxidizing bacteria,	Lecture	BSB 302.2	Quiz & End Sem Exam
31	nitrate and sulphate reduction,	Lecture	BSB 302.2	Quiz & End Sem Exam
32	methanogenesis and acetogenesis,	Lecture	BSB 302.2	Quiz & End Sem Exam
33	Fermentations,	Lecture	BSB 302.2	Quiz & End Sem Exam
34	Nitrogen fixation,	Lecture	BSB 302.2	Quiz & End Sem Exam
35	Plant microbe interactions	Lecture	BSB 302.2	Quiz & End Sem Exam
36	Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BSB 302.3	Quiz & End Sem Exam
37	*Viruses: Bacterial, animal; structure of viruses;*	Lecture	BSB 302.4	Quiz & End Sem Exam
38	*Reproduction and life cycle of RNA and DNA viruses; Viroids and prions.*	Lecture	BSB 302.4	Quiz & End Sem Exam

39	*Algae: Classification and Reproduction.*	Lecture	BSB 302.4	Quiz & End Sem Exam

40	*Fungi: Classification and Reproduction.*	Lecture	BSB 302.4	Quiz & End Sem Exam
41	Host-parasite relationship - Normal micro flora of skin, oral cavity, gastrointestinal tract,	Lecture	BSB 302.5	Quiz & End Sem Exam
42	Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo) and their mode of actions,	Lecture	BSB 302.5	Quiz & End Sem Exam
43	Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission;	Lecture	BSB 302.5	Quiz & End Sem Exam
44	Sexually transmitted disease including AIDS, Food and water-borne diseases; pathogenic fungi.	Lecture	BSB 302.5	Quiz & End Sem Exam
45	Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins,	Lecture	BSB 302.5	Quiz & End Sem Exam
45	Broad spectrum antibiotics	Lecture	BSB 302.5	Quiz & End Sem Exam
46	Antifungal antibiotics;	Lecture	BSB 302.5	Quiz & End Sem Exam
47	Antibiotics mode of action.	Lecture	BSB 302.5	Quiz & End Sem Exam
48	Antibiotics mode of action.	Lecture	BSB 302.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB 302.1	Understand the microbiological techniques for the isolation and characterization of microbes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.2	Understand the mechanism of different metabolic processes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.3	Know the physiology and survival mechanism of extremophilic bacteria.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.4	Learn structure and function of the cell cytoskeleton, cilia and flagella.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.5	Understand the epidemiology and microbial pathogenesis	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2020-21</td></tr>
<tr><td colspan="7">Class: B.Sc. Biotechnology
III Semester</td></tr>
<tr><td colspan="2">Subject Name: Microbiology</td><td colspan="2">Time: 3 Hrs</td><td colspan="3">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1, 5,3</td><td>Q.2,6</td><td>Q.,4,5</td><td>Q.7</td><td>Q. 8, 9,</td><td>Q. 10</td></tr>
<tr><td colspan="7">Student will be able to:
• Understand the microbiological techniques for the isolation and characterization of microbes.
• Understand the mechanism of different metabolic processes.
• Know the physiology and survival mechanism of extremophilic bacteria.
• Know the concept of virus lytic and lysogenic cycle is quite clear to students.
• Understand the epidemiology and microbial pathogenesis.</td></tr>
</table>

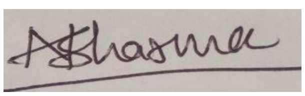
CO Map	Question No.	Question	Marks
CO1	Q.1	Write the historical contributions of Louis Pasteur and Robert Koch in the field of microbiology.	6
CO2	Q.2	Write down the steps involved in Gram's staining procedure. Differentiate between Gram positive and gram negative bacteria.	6
	Q.3	Explain the importance of extracellular appendages present in bacteria.	6
CO4	Q.4	Describe polyphasic taxonomy and discuss some of its advantages	6
CO4	Q.5	Discuss about the mechanism of photo-phosphorylation in bacterial system.	6
CO3	Q.6	Give an outline the nitrogen fixation, and explain the roles of microorganisms in this cycle	6
	Q.7	What are the archaea? Briefly describe the major ways in which they differ from bacteria and eucaryotes.	10

CO4	Q.8	Write a note on viroids and prions with suitable example of disease.	10

CO3	Q.9	Discuss about normal microbiota present on different body region with suitable features	10
CO3	Q.10	What is penicillinase? Explain the role of penicillin against the synthesis of bacterial cell wall. How does a low concentration of penicillin G select for penicillin-resistant bacteria?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Microbiology***/Course code ***BSB 302*** is level **3** for the academic year 2020-21.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BSB 401	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **Bioinformatics**
Course Code : BSB 401, Crédits : 3, Session :2020-21 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The course involves a basic understanding of computer and bioinformatics tools and skills in the field of biology

B. **Course Outcomes:** After successful completion of the course student will be able to:

BMB 401.1. Understand and explain the structural organization and characteristics of computers and its parts

BMB 401.2. Describe the concept of use of internet in bioinformatics.

BMB 401.3. Explain the concept and organization of biological databases..

BMB 401.4. Understand and explain the structure and functions of the phylogenetic analytic tools.

BMB 401.5. Interrogate major database sources and be able to integrate this information with clinical data.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting

commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Computers
General introduction (characteristics, capabilities, generations), software, hardware : organization of hardware (input devices, memory, control unit arithmetic logic unit, output devices); software : (System software; application software, languages -low level, high level), interpreter, compiler, data processing; batch, on-line, real-time (examples from bioindustries; e.g. application of computers in co-ordination of solute concentration, ph, temperature, etc., of a fermenter in operation); internet application.

Module II: Basic Bioinformatics

Introduction to Internet, Search Engines (Google, Yahoo, Entrez etc)

Module III: Biological Databases

Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL), Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc), Cluster databases-An Introduction, Specialised databases (KEGG, etc), Database technologies (Flat-file), Structural databases (PDB)

Module IV: Phylogenetic Analysis

Trees-splits and metrices on trees, tree interpretation, Distance – additive, ultrameric and nonadditive distances,tree building methods, phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains, estimating the rate of change, likelihood and trees; analysis software.

Module V: Genome analysis

Annotation, comparison of different methods; ESTs – databases, clustering, gene discovery and identification, and functional classification. Reconstruction of metabolic pathways; Genome analysis, genome anatomy, genome rearrangements with inversions, signed inversions, gene identification, gene expression, expression analysis, gene identification and functional classification

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

• Computer Science, J.G. Brookshear, Pearson, Addison Wesley
• Introduction to Bioinformation – T.Attawood

References:

• A book on C by Kelley : Programming in C, Addison-Wesley Publishing
• Introduction to C++ for Engineers and Scientists, Prentice-Hall
• Schaum's Outline of Introduction of Computer Science, P. Cushman and R. Mata-Toledo, McGraw Hill

Trade

• Bioinformatics – Managing Scientific Data, Zoe' Lacroix and Terence Critchlow
• Bioinformatics – Sequence, Structure and Databanks, Des Higgins & Willie Taylor
• Structural Bioinformatics, Philip E. Bourne, Helge Weissig 2003
• Statistical Methods in Bioinformatics: An Introduction, G.R. Grant, W.J. Ewens, Springer Verlag

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**
1	General introduction (characteristics, capabilities, generations),	Lecture	**BSB 401.1**.	Mid Term-1, Quiz & End Sem Exam

2	software, hardware : organization of hardware (input devices, memory, control unit	Lecture	**BSB 401.1**.	Mid Term-1, Quiz & End Sem Exam

	arithmetic logic unit, output devices),			
3	organization of hardware	Lecture	**BSB 401.2**.	Mid Term-1, Quiz & End Sem Exam
4	*organization of software*	Lecture	**BSB 401.2**.	Mid Term-1, Quiz & End Sem Exam
5	Interpreter, compiler, data processing; batch, on-line, real-time	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
6	Introduction and application of Internet	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
7	Search Engines (Google, Yahoo, Entrez etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
8	Revision	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
9	Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
10	Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
11	Cluster data bases-An Introduction. Specialized databases (KEGG, etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
12	Database technologies (Flat-file)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
13	Revision	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
14	Introduction of phylogenetics analysis	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
15	Trees-splits and metrices on trees, tree interpretation	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
16	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
17	phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
18	Estimating the rate of change, likelihood and trees; analysis software	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
19	Annotation, comparison of different methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam

20	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
21	Revision	Lecture	**BSB 401.4**	Quiz & End Sem

				Exam
22	ESTs – databases, clustering	Lecture	**BSB 401.4**	Quiz & End Sem Exam
23	Gene discovery	Lecture	**BSB 401.4**	Mid Term-2, Quiz & End Sem Exam
24	Identification and classification	Lecture	**BSB 401.5**	Quiz & End Sem Exam
25	Revision	Lecture	**BSB 401.5**	Quiz & End Sem Exam
26	Reconstruction of metabolic pathways	Lecture	**BSB 401.5**	Quiz & End Sem Exam
27	Genome analysis, genome anatomy	Lecture	**BSB 401.4**	Quiz & End Sem Exam
28	Genome rearrangements with inversions	Lecture	**BSB 401.4**	Quiz & End Sem Exam
29	signed inversions, gene identification	Lecture	**BSB 401.4**	Quiz & End Sem Exam
30	Reconstruction of metabolic pathways	Lecture	**BSB 401.4**	Quiz & End Sem Exam
31	Genome analysis, genome anatomy	Lecture	**BSB 401.4**	Quiz & End Sem Exam
32	Gene expression	Lecture	**BSB 401.4**	Quiz & End Sem Exam
33	Gene expression analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
34	Gene identification methods	Lecture	**BSB 401.1**	Quiz & End Sem Exam
35	Functional classification	Lecture	**BSB 401.1**	Quiz & End Sem Exam
36	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
37	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
38	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam
39	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam
40	Gene expression	Lecture	**BSB 401.1**	Quiz & End Sem Exam
41	Gene expression analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
42	Gene identification methods	Lecture	**BSB 401.1**	Quiz & End Sem Exam
43	Functional classification	Lecture	**BSB 401.1**	Quiz & End Sem Exam
44	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
45	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
45	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB 401.1	Understand and explain the structural organization and characteristics of computers and its parts	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.2	Describe the concept of use of internet in bioinformatics.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.3	Explain the concept and organization of biological databases	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.4	Understand and explain the structure and functions of the phylogenetic analytic tools.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.5	Interrogate major database sources and be able to integrate this information with clinical data.	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

Amity Institute Biotechnology 2020-21						
Class: B.Sc. Biotechnology IV Semester						
Subject Name: **Bioinformatics**		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand the basic knowledge of computer hardware and software.
- Understand the advanced techniques of bioinformatics.
- Understand the application of bioinformatics in different area.
- Understand the role of computational biology in drug designing.
- Understand the importance of phylogenetic analysis in species development.

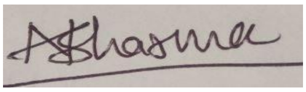
CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about the importance of input and output device of computer. Also differentiate between input and output devices.	6
CO2	Q.2	Discuss about the anatomy of E. mail and www.	6
	Q.3	Explain about the different databases present in NCBI. Give a comparison between protein databases and nucleotide databases with examples.	6
CO4	Q.4	Discuss about the different terminology used in phylogenetic tree with the suitable diagram.	6
CO4	Q.5	Write about the genome of between prokaryotic and eukaryotic organism.	6
CO3	Q.6	Discuss a general classification of computer generations with suitable examples, merits and demerits	6
	Q.7	What is topology of computer networking? Write advantages and disadvantages of different topology networking.	10
CO4	Q.8	Write a detail note on RCSB, Genbank, and DDBJ with advantages.	10
CO3	Q.9	What is sequence similarity? Explain about the different quantitative methods of sequence similarity	10

CO3	Q.10	. A. Explain the different methods used for gene prediction. Discuss one of the methods in detail with suitable diagram. B. By writing the corresponding match states into columns we get the following alignment: ATGA AGTA	20

		What is its score under the following scoring scheme? Match +2, Mismatch -1 and Gap +1.Explain with global alignment algorithm.	

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Bioinformatics** /Course code ***BSB 401*** is level **2** for the academic year 2020-21.




INSTITUTE OF BIOTECHNOLOGY
AMITY

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR

AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2020-21

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
	BSB 402	3	2	3	3	1	-	-	-	1	1			3	2	1
IV SEM																

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR CELL BIOLOGY
Course Code : BSB 402, Crédits : 03, Session :2020-21 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques in Molecular Cell Biology, further to extend understanding of the molecular mechanisms via which genetic information's are stored, expressed and transmitted among generations.

B. Course Outcomes: At the end of the course, students will be able to:

BSB 402.1. Develop deep understanding of DNA/ RNA structure, and mechanism of DNA replication.
BSB 402.2. Understand Genetic Codes and Transposable elements
BSB 402.3. Understand mechanism of transcription and translation in prokaryotes and eukaryotes.
BSB 402.4. Enhance fine molecular understanding of operon gene regulation ion in prokaryotes.
BSB402.5. Understand the mechanism of Oncogenes and Tumor suppressor genes.

C. Programme Outcomes:

On completion of the course, students are able to understand about:
PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures,

isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and

recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction to Moleculer Biology,
Structure and composition of DNA, RNA structure and its types, Basic techniques in molecular biology (Agarose gel electrophoresis, PCR etc.) and its applications.
Molecular basis of life:DNA replication in prokaryotes and eukaryotes; DNA recombination molecular mechanisms.

Module II: Insertion elements, transposons and retrotransposons
Mobile genetic elements and its types in both prokaryotes and eukaryotes and their applications.
Application of genetic engineering, Organisation of genetic material: Split genes; overlapping genes; pseudogenes; cryptic genes
Genetic Code: Properties of genetic code, codon assignment, chain termination codons, wobble hypothesis.

Module III: Structure of prokaryotic and eukaryotic genes
Transcription mechanism in prokaryotes and eukaryotes. Translation: Translation mechanisms in prokaryotes and eukaryotes.

Module IV: Gene Expression in prokaryotes

Operon concept, Positive and Negative control of operon (Lac, Tryptophan and Arabinose operon)

Module V: Eukaryotic geneExpression
Overview of gene expression, polyadenylation, cap formation, RNA degradation.

Module VI: Oncogenes and Tumor Suppressor genes
Oncogenes, tumorsuppressor genes in humans, role of genes in cancer development.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Gene VIII, Benjamin Lewin 2005, Oxford University Press
- Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing.

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education
- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Cell Biology, H. Lodish, A.Berk, S. Zipursky, P Matsundaira, D.Baltimore and J.E. Barnell,W. H Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing
- .Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley and Sons Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Structure and composition of DNA, RNA structure and its types	Lecture	BSB 402.1.	Mid Term-1, Quiz & End Sem Exam
2	Structure and composition of DNA, RNA structure and	Lecture		Mid Term-1, Quiz & End Sem Exam

	its types			
3	Structure and composition of DNA, RNA structure and its types	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Structure and composition of DNA, RNA structure and its types	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Basic techniques in molecular biology: PCR etc.) and its applications.	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Basic techniques in molecular biology (Agarose gel electrophoresis, and its applications.	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Mobile genetic elements and its types in prokaryotes	Lecture	BSB 402.2.	Mid Term-1, Quiz & End Sem Exam
8	Mobile genetic elements and its types in prokaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Mobile genetic elements and its types in eukaryotes	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Organisation of genetic material: Split genes; overlapping genes; pseudogenes; cryptic genes	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Application of genetic engineering,	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Genetic Code: Properties of genetic code, codon assignment, chain termination codons,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	, wobble hypothesis.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Structure of prokaryotic and eukaryotic genes	Lecture	BSB 402.3.	Mid Term-1, Quiz & End Sem Exam
15	Transcription mechanism in prokaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Transcription mechanism in eukaryotes.	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Translation :Translation mechanisms in prokaryotes	Lecture		Quiz & End Sem Exam

18	Translation :Translation mechanisms in prokaryotes	Lecture		Quiz & End Sem Exam
19	Translation :Translation mechanisms in eukaryotes.	Lecture		Quiz & End Sem Exam
20	Operon concept, Positive and Negative control of operon	Lecture	BSB 402.4.	Quiz & End Sem Exam
21	Operon concept, Positive and Negative control of operon Lac Operon	Lecture		Quiz & End Sem Exam
22	Operon concept, Positive and Negative control of operon Lac Operon	Lecture		Quiz & End Sem Exam
23	Operon concept, Positive and Negative control of operon Trp operon	Lecture		Quiz & End Sem Exam
24	Operon concept, Positive and Negative control of operon Trp operon	Lecture		Quiz & End Sem Exam
25	Operon concept, Positive and Negative control of operon Ara Operon	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Overview of Eukaryotic gene expression,	Lecture	BSB 402.5.	Quiz & End Sem Exam
27	Mechanism of polyadenylation,	Lecture		Quiz & End Sem Exam
28	Mechanism of cap formation.	Lecture		Quiz & End Sem Exam
29	Mechanism of RNA degradation.	Lecture		Quiz & End Sem Exam
30	Oncogene in humans,	Lecture	BSB 402.6.	Quiz & End Sem Exam
31	Oncogenes in humans,	Lecture		Quiz & End Sem Exam
32	Tumorsuppressor genes in humans.	Lecture		Quiz & End Sem Exam
33		Lecture		Quiz & End Sem Exam
34	Tumorsuppressor genes in humans.	Lecture		Quiz & End Sem Exam
35	Role of genes in cancer	Lecture		Quiz & End Sem Exam
36	Role of genes in cancer	Lecture		Quiz & End Sem Exam

J. **Course Articulation Matrix (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
BSB 402.1.	Develop deep understanding of DNA/ RNA structure, and mechanism of DNA replication.	**3**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.2.	Understand Genetic Codes and Transposable elements	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.3	Understand mechanism of transcription and translation in prokaryotes and eukaryotes.	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.4	Enhance fine molecular understanding of operon gene regulation ion in prokaryotes	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**-**
BSB 402.5.	Understand the mechanism of Oncogenes and Tumor suppressor genes.	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**			**3**	**1**	**1**

Sample Question Paper

Amity Institute Biotechnology 2021-22						
Class: B.Sc.(H)Biotechnology IV Semester						
Subject Name: MOLECULAR CELL BIOLOGY		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,6,2	Q.4,3	Q.7,6	Q.5,8	Q. 9, 10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	What is melting temperature (Tm). How Tm varies with increasing GC content and pH?	6
CO1	Q.2	Write a note on the bacterial insertion elements (IS).	6
	Q.3	Write the functions of the following. (i) Carboxyl terminal domain (CTD) (ii) Primosome (iii) Sigma (σ) Factor	6
CO2	Q.4	Define degeneracy of genetic codes and its significance.	6
CO1	Q.5	Write the function of the following proteins (i) Helicase (ii) Gyrase (iii) Primase	6
CO3	Q.6	Write short note on 5'Cap in eukaryotic mRNA.	6
	Q.7	Design the experiment to proof that DNA replication is (i) Semiconservative (ii) Bidirectional.	10

CO4	Q.8	Explain the structure and function of *Lac* operon in *E.coli*. Discuss the mechanism of *Lac* operon expression regulation under following conditions (I) When lactose sugar present in growth medium (ii) When lactose sugar absent in growth medium.	10

CO5	Q.9	Define Oncogenes, discuss the different classes andproperties of oncogenes. How Proto-oncogenes converted into oncogenes?	10
CO3	Q.10	What is the basic mechanism of PCR? and explain the following variants of PCR and their advantages (i) RT- PCR (ii) Touch Down PCR (iii) Hot start PCR.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Molecular cell Biology***/Course code ***BSB 402*** is level **3** for the academic year ***2020-21***.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BSB 403	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **IMMUNOLOGY & IMMUNOTECHNOLOGY**
Course Code : BSB 403, Crédits : 04, Session :2020-21(Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. Course Outcomes: After successful completion of the course student will be able to:

BSB 403.1. Understand and explain the phylogeny of immune system, types of immunity, immune response.

BSB 403.2. Describe the concept of clonal selection theory, humoral and cell mediated immunity.

BSB 403.3. Understand and explain the structure and functions of the organs and cells of the immune system.

BSB 403.4. Understand the mechanism of antigen-antibody interaction.

BSB 403.5. Describe the structure of antibodies, their types and functions in immunity.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy

flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I :
Descriptors/Topics
Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.

Module II:
Descriptors/Topics

The organs and cells of the immune system.

Module III :
Descriptors/Topics
Histocompatibility: structure of MHC class I, II & III antigens & their mode of antigen presentation, MHC restriction; Antigens & antigenicity;

Module IV :
Descriptors/Topics
Antibody structure in relation to function and antigen-binding; Types of antibodies and their structures: isotypes, allotypes, idiotypes. Antibodies in targeting therapeutic agents. Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application

Module V :
Descriptors/Topics
Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.

Module VI :
Descriptors/Topics
Measurement of antigen – antibody interaction: agglutination, precipitation immunodiffusion, immuno-electrophoresis, ELISA, RIE

Module VII :
Descriptors/Topics
Tissue and organ transplantation

Module VIIII :
Descriptors/Topics
Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.
Autoimmunity and autoimmune diseases: Hashimoto's thyroiditis; Myasthenia gravis; Rheumatoid Arthritis, Pernicious anemia, Asthma.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Freeman

References:
- Immunology, Roitt, Mosby – Yearbook Inc.
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.1**.	Mid Term-1, Quiz & End Sem Exam
2	Innate and specific immunity. Humoral immunity,	Lecture	**BSB 403.1**.	Mid Term-1, Quiz & End Sem Exam
3	Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.2**.	Mid Term-1, Quiz & End Sem Exam
4	Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.2**.	Mid Term-1, Quiz & End Sem Exam
5	The organs of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
6	The organs of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
7	The cells of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
8	The cells of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
9	Histocompatibility: structure of MHC class I, II & III	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
10	Histocompatibility: structure of MHC class I, II & III	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
11	Antigens	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
12	Mode of antigen presentation,	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam

13	MHC restriction; Antigens & antigenicity	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
14	MHC restriction; Antigens &	Lecture	**BSB 403.3**	Mid Term-1,

	antigenicity			Quiz & End Sem Exam
15	Antibody structure in relation to function and antigen-binding	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
16	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
17	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
18	Antibodies in targeting therapeutic agents.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
19	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
20	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
21	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
22	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Quiz & End Sem Exam
23	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.4**	Mid Term-2, Quiz & End Sem Exam
24	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam
25	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam
26	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam

27	Measurement of antigen – antibody interaction: agglutination,	Lecture	**BSB 403.4**	Quiz & End Sem Exam

28	Precipitation	Lecture	**BSB 403.4**	Quiz & End Sem Exam
29	immunodiffusion,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
30	immuno-electrophoresis,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
31	ELISA,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
32	RIE,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
33	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
34	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
35	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
36	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
37	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
38	Autoimmunity	Lecture	**BSB 403.1**	Quiz & End Sem Exam
39	Autoimmunity	Lecture	**BSB 403.1**	Quiz & End Sem Exam
40	Autoimmune diseases: Hashimoto's thyroiditis;	Lecture	**BSB 403.1**	Quiz & End Sem Exam
41	Myasthenia gravis;	Lecture	**BSB 403.1**	Quiz & End Sem Exam
42	Rheumatoid Arthritis,	Lecture	**BSB 403.1**	Quiz & End Sem Exam
43	Pernicious anemia,	Lecture	**BSB 403.1**	Quiz & End Sem Exam
44	Pernicious anemia,	Lecture	**BSB 403.1**	Quiz & End Sem Exam
45	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
45	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
46	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
47	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam

48	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 403.1	Understand and explain the phylogeny of immune system, types of immunity, immune response.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.2	Describe the concept of clonal selection theory, humoral and cell mediated immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.3	Understand and explain the structure and functions of the organs and cells of the immune system	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.4	Understand the mechanism of antigen-antibody interaction	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.5	Describe the structure of antibodies, their types and functions in immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-

Sample Question Paper

Amity Institute Biotechnology 2020-21						
Class: B.Sc. Biotechnology IV Semester						
Subject Name: **Immunology & Immunotechnology**		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

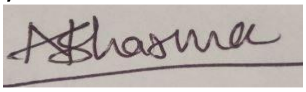
- Understand and explain the phylogeny of immune system, types of immunity, immune response.
- Describe the concept of clonal selection theory, humoral and cell mediated immunity.
- Understand and explain the structure and functions of the organs and cells of the immune system.
- Understand the mechanism of antigen-antibody interaction.
- Describe the structure of antibodies, their types and functions in immunity.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about innate and adaptive immunity. Discuss about the different types of innate immunity with characters.	6
CO2	Q.2	Write a note on different phases of cytotoxic cell mediated targeting killing mechanism.	6
	Q.3	Write a general organization of class I and class II MHC molecules with suitable diagram.	6
CO4	Q.4	Discuss the role of IgG immunoglobulin in immune system.	6
CO4	Q.5	What is antibody diversity? Discuss the role of light chain gene rearrangement in antibody diversity.	6
CO3	Q.6	Draw a well labeled diagram of hybridoma technology with production of monoclonal antibody.	6
	Q.7	Discuss the role of innate and adaptive immunity in tissue grafting. Explain with suitable example.	10
CO4	Q.8	Give a comparison between all type of vaccine with examples and applications.	10
CO3	Q.9	Discuss about features of any two primary lymphoid organs with suitable diagram	10

CO3	Q.10	A. Although all lymphocytes are formed in bone marrow. Explain how these cells get differentiated into B cell and T cell. B Where the CDR regions located on an antibody molecule and what are are their functions? Discuss the ELISA method on the basis of antigen and antibody interaction.	20

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Immunology and immunotechnology**/Course code ***BSB 403*** is level **2** for the academic year 2020-21.




AMITY INSTITUTE OF BIOTECHNOLOGY
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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2020-21

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business

leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
	BSB 502	3	2	3	3	-	1	2	1	1	-			3	2	1
														-	-	-
														-	-	-
V														-	-	-

SEM														-	-	-

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ANIMAL BIOTECHNOLOGY
Course Code : BSB 502, Crédits : 03, Session :2020-21 (Odd Sem.), Class : B.Sc. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in animal biotechnology like in vitro fertilization, animal cell and tissue culture, hormone vaccine and important enzyme production through animal biotechnology.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 502.1. Understand theory of animal cell culture, culture media, methods to develop cell lines. and their maintenance for commercial applications.
BSB 502.2. Understand scale up production of monoclonal antibodies and hybridoma technology.
BSB 502.3. Understand the structure and function of variety of hormones and growth factors.
BSB 502.4. Understand the technology and concepts of invitro fertilization and embryo transfer, and development of superior live stocks.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of

Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective

interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I:

Introduction of animal cell culture substrate, culture media, preservation and maintenance of cell lines

Module II:

Production of monoclonal antibodies. Bioreactors for large scale culture of cells

Module III:

Growth factors promoting proliferation of animal cells (EGF, FGF, PDGF, IL-1, IL-2, NGF,erythropoietin).

Module IV:

Transgenic animals. In vitro fertilization and embryo transfer.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE

Weightage (%)	5	15	10	70

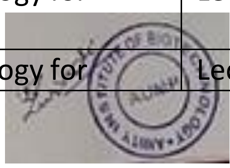
CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss. References:
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford.
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag.
- Cell Culture LabFax, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press.
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Animal Cell Culture: Overview	Lecture	BSB 502.1.	Mid Term-1, Quiz & End Sem Exam
2	Animal Cell culture substrates for attatchment	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Broad outline of Animal Cell culture Media	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Animal Cell Culture Media: Natural media	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Animal Cell Culture Media: Artificial media	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Advantages and limitations of natural and artificial media.	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Methods of Initiation of Cell culture	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Methods of Initiation of Cell culture	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Preversation and maintenance of cell culture.	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Monoclonal antibodies:	Lecture	BSB 502.2.	Mid Term-1, Quiz & End Sem Exam
11	Methods of somatic cell fusion	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Hybridoma technology for MAbs production	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Hybridoma technology for	Lecture		Mid Term-1, Quiz



	MAbs production			& End Sem Exam
14	Bioreactors	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Bioreactors	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Applications of bioreactoras and MAbs	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Growth factors: epidermal growth factor (EGF), receptor, structure and functions.	Lecture	BSB 502.3.	Quiz & End Sem Exam
18	Growth Factors:Fibroblast growth factor (FGF), receptor, structure and functions FGF.	Lecture		Quiz & End Sem Exam
19	Growth Factors: Platelates derived growth factor (PDGF), receptor, structure and functions PDGF.	Lecture		Quiz & End Sem Exam
20	Growth Factors:Neural growth factor (NGF), receptor, structure and functions NGF.	Lecture		Quiz & End Sem Exam
21	Growth Factors:Interleukins IL1 and IL2 structure and functions.	Lecture		Quiz & End Sem Exam
22	Growth Factors: erythropoiten (EP) structure and functions.	Lecture		Quiz & End Sem Exam
23	Applications of growth factors.	Lecture		Quiz & End Sem Exam
24	Transgenic Animals: overview	Lecture	BSB 502.4.	Quiz & End Sem Exam
25	Vectors for transgene transfer	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Methods of transgenic animal production	Lecture		Quiz & End Sem Exam
27	Application of transgenic animals	Lecture		Quiz & End Sem Exam
28	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
29	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
30	In-vitro fertilization technique	Lecture		Quiz & End Sem Exam
31	Embryo transfer technique	Lecture		Quiz & End Sem

				Exam
32	Embryo transfer technique	Lecture		Quiz & End Sem Exam
33	Embryo transfer technique	Lecture		Quiz & End Sem Exam
34	Embryo transfer technique	Lecture		Quiz & End Sem Exam
35	Application of embryo transfer technique	Lecture		Quiz & End Sem Exam
36	Application of embryo transfer technique	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
BSB 502.1.	Understand theory of animal cell culture, culture media, methods to develop cell lines. and their maintenance for commercial applications.	3	2	3	3	-	1	-	1	1	-			**3**	**2**	**1**
BSB 502.2.	Understand scale up production of monoclonal antibodies and hybridoma technology.	3	2	3	3	-	1	-	1	1	-			**3**	**2**	**1**
BSB 502.3	Understand the structure and function of variety of hormones and growth factors.	3	2	3	3	-	2	-	-	1	-			**3**	**2**	**1**

BSB 502.4	Understand the technology and concepts of *invitro* fertilization and embryo transfer, and development of superior live stocks.	3	2	3	3	-	2	3	-	1	-			**3**	**2**	**1**

<u>Sample Question Paper</u>

Amity Institute Biotechnology 2021-22						
Class: B.Sc.(H) Biotechnology V Semester						
Subject Name: ANIMAL BIOTECHNOLOGY	Time: 3 Hrs	Max.Marks:70				
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4,6	Q.2,5,3	Q.7,8	Q.9	Q. 10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	Write a short note on primary cell culture including its advantages and limitations.	6
CO1	Q.2	Write a short note on reporter genes used during cloning in animal cells.	6
	Q.3	Briefly discuss moist heat sterilization method including its advantages and limitations.	6
CO2	Q.4	Write a short note on Stirred tanked bioreactor.	6

CO2	Q.5	Explain the selection method of hybridoma cells for vaccine production.	6

CO1	Q.6	Define bioethics? Enlist the initiatives of CSIRO's animal ethics committee.	6
	Q.7	Explain various methods of cell separation from animal tissue, clearly indicating their merits and demerits. How is cell culture maintained in the laboratory?	10
CO3	Q.8	Explain the following- (a) Method of selection of myeloma cells form bone marrow. (b) Recombinant erythropoietin (EPO) and its commercial applications.	10
CO4	Q.9	Discuss the principal and steps involved in Intra-cytoplasmic Sperm Injection (ICSI) with suitable diagramme during IVF for genetically superior livestock development. Enlist the risks associated with IVF.	10
CO4	Q.10	Discuss the following in detail (a) Various selection criteria for grading best embryos for embryo transfer technology (ETT). (b) Natural animal cell culture media.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Animal Biotechnology***/Course code ***BSB 502*** is level **3** for the academic year ***2020-21***.

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B. Sc.) Academic Year – 2021-22

B.Sc. (H) Biotechnology (Six Semesters)

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context

of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3
	BSB 601	3	1	2	2	-	1	-	3	-	-	-		3	2	-
VII SEM																

AMITY UNIVERSITY

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL BIOTECHNOLOGY
Course Code : BSB 601, Crédits : 03, Session :2020-21 (Even Sem.), Class : B.Sc. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with different processes and use of microbial technology that can be employed for a cleaner environment. The course also aims to make the students aware of legislation and rules prevalent to control the degradation of our environment.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 601.1. Understand the delicate interrelationship of different components of environment.
BSB 601.2. Understand conventional fuels, their impact and concept of clean fuel technology.
BSB 601.3. Learn approaches and concepts behind bioremediation xenobiotic compounds, mechanism of microbial leaching and mining.
BSB 601.4. Learn the concept of municipal solid and liquid wastes management. environmental impact assessment (EIA) and assessment of environmental quality.
BSB 601.5. Learn the concept of biopesticides and biofertilizers and Bioassessment of assessment of environmental quality.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on

distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas

of cell and molecular biology, microbiology, genetics, biochemistry and metabolic

regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Environmental components, Environmental pollution and its types, Non-renewable and renewable energy resources.

Module II

Conventional fuels and their major impacts: Global warming and greenhouse effect, Global Ozone Problem, Acid rain, Eutrophication, Biomagnification, Concept of clean fuel technology: Biomass energy and biofuels

Module III

Biodegradation of Xenobiotic compounds i.e. oil, pesticide and PAHs and bioremediation of major pollutants

Biomineralisation: Use of microbial technology for mining

Module IV

Treatment of municipal solid and liquid wastes

Environmental impact assessment and Environmental audit

odule V

Bioassessment of Environmental Quality,

Biofertilizers and Biopesticides

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

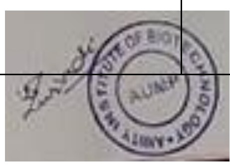
H. Suggested Text/Reference Books:

- Environmental Science, S.C. Santra
- Environmental Biotechnology, Pradipta Kumar Mohapatra
- Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
- Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill
- Agricultural Biotechnology, S.S. Purohit
- Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer
- Introduction to Environmental Biotechnology, Milton Wainwright
- Principles of Environmental Engineering, Gilbert Masters
- Principles of fermentation Technology, Salisbury, Whitaker and Hall
- Industrial Microbiology – Cassida

- Agricultural Biotechnology – S.S. Purohit
- Wastewater Engineering – Metcalf & Eddy.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Introduction of Environmental components.	Lecture	BSB 601.1.	Mid Term-1, Quiz & End Sem Exam
2	Environmental components. (Biotic)	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Environmental components. (Abiotic)	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Introduction to Environmental pollution.	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Environmental pollution and its types.	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Environmental pollution:Air	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Environmental pollution:Water	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Environmental pollution:Water	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Environmental pollution:Soil	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Environmental pollution:Impact	Lecture	BSB 601.2.	Mid Term-1, Quiz & End Sem Exam
11	Non-renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Non-renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Renewable energy resources.	Lecture		Mid Term-1, Quiz & End Sem Exam



15	Conventional fuels and their major impacts.	Lecture	BSB 601.2.	Mid Term-1, Quiz & End Sem Exam
16	Global Warming and GHGs	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Global Ozone Problem,	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Acid rain,	Lecture		Mid Term-1, Quiz & End Sem Exam
19	Eutrophication, Biomagnification,	Lecture		Mid Term-1, Quiz & End Sem Exam
20	Concept of clean fuel technology: Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
21	Concept of clean fuel technology: Biomass energy and biofuels	Lecture		Mid Term-1, & End Sem Exam
22	Concept of clean fuel technology: Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
23	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
24	Xenobiotic compounds	Lecture	BSB 601.3.	Quiz & End Sem Exam
25	Biodegradation of Xenobiotic compounds	Lecture		Quiz & End Sem Exam
26	Biodegradation of Xenobiotic compounds	Lecture		Quiz & End Sem Exam
27	Bioremediation of major pollutants	Lecture		Quiz & End Sem Exam
28	Bioremediation of major pollutants	Lecture		Quiz & End Sem Exam
29	Biomineralisation: Use of microbial technology for mining.	Lecture		Quiz & End Sem Exam
30	Biomineralisation: Use of microbial technology for mining.	Lecture		Quiz & End Sem Exam
31	Biomineralisation: Use of microbial technology for mining.	Lecture		Quiz & End Sem Exam
32	Biomineralisation: Use of microbial technology for	Lecture		Quiz & End Sem Exam

	mining.			
33	Treatment of municipal solid and liquid wastes	Lecture	BSB 601.4.	Quiz & End Sem Exam
34	Treatment of municipal solid and liquid wastes	Lecture		Quiz & End Sem Exam
35	Treatment of municipal solid and liquid wastes	Lecture		Quiz & End Sem Exam
36	Environmental impact assessment and Environmental audit	Lecture		Quiz & End Sem Exam
37	Environmental impact assessment and Environmental audit	Lecture		Quiz & End Sem Exam
38	Environmental impact assessment and Environmental audit	Lecture		Quiz & End Sem Exam
39	Bioassessment of Environmental Quality	Lecture	BSB 601.5.	Quiz & End Sem Exam
40	Bioassessment of Environmental Quality.	Lecture		Quiz & End Sem Exam
41	Bioassessment of Environmental Quality.	Lecture		Quiz & End Sem Exam
42	Biofertilizers and Biopesticides	Lecture		Quiz & End Sem Exam
43	Biofertilizers and Biopesticides	Lecture		Quiz & End Sem Exam
44	Biofertilizers and Biopesticides	Lecture		Quiz & End Sem Exam
45	Revision	Lecture		Quiz & End Sem Exam
46	Revision	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

BSB 601.1.	Understand the delicate interrelationship of different components of environment.	3	1	-	-	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.2.	Understand conventional fuels, their impact and concept of clean fuel technology.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.3.	Learn approaches and concepts behind bioremediation xenobiotic compounds, mechanism of microbial leaching and mining.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.4.	Learn the concept of municipal solid and liquid wastes management. environmental impact assessment (EIA) and assessment of environmental quality.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**
BSB 601.5.	Learn the concept of Biopesticides and biofertilizers and assessment of environmental quality.	3	1	2	2	-	1	-	3	-	-			**3**	**1**	**-**

Sample Question Paper

Amity Institute Biotechnology 2021-22						
Class: B.Sc.(H) Biotechnology VI Semester						
Subject Name: ENVIRONMENTAL BIOTECHNOLOGY		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,2,6	Q.3,4	Q.5,7,10	Q.6,8	Q. 9,	
Student will be able to:						

CO Map	Question No.	Questi on	Marks
CO1	Q.1	What is biological oxygen demand (BOD)? How it differs from Dissolved oxygen (DO) of water bodies?	6
CO1	Q.2	Define ecosystem and its major components.	6
	Q.3	Write a short note on concept of clean fuel technology.	6
CO2	Q.4	Write a brief note on Noise pollution. Point out WHO recommended day and night noise level.	6
CO5	Q.5	Write brief note on neem based bio-pesticides and its role in agricultural sustainability.	6
CO4	Q.6	Briefly explain Environment Impact assessment (EIA). Why it is important?	6
CO 1	Q.7	What is trophic level in ecosystem? Explain different levels in context of energy flow in ecosystem. Point out the 10% energy flow rule.	10

CO3	Q.8	Explain the impact of oil spills on water ecosystem and its bioremediation strategies.	10

CO3	Q.9	Define the term biomining. Discuss the following methods of metal extraction (i) Heap bioleaching (ii) Dump bioleaching.	10
CO4	Q.10	Discuss the following: (a) Explain the impact of nutrient enrichment of water bodies on water ecosystem. (b) Explain the process of biodiesel production, how it is helpful in reducing need of conventional fuels?	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental Biotechnology***/Course code ***BSB 601*** is level **3** for the academic year ***2020-21***.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

ROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Science (B.Sc.) Academic Year – 2020-21

PROGRAM OUTCOMES OF B.Sc. BIOTECHNOLOGY

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
VI SEM	**BSB 620**	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**1**	**2**	**-**	**-**	**2**	**3**	**1**

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL AND INDUSTRIAL BIOTECHNOLOGY LAB
Course Code : BSB 620, Crédits : 01, Session :2020-21 (Even Sem.), Class : B.Sc. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with impact of conventional fules/ pollutions on environment and plants by assessing through lab experiments i.e, Comparative and statistical analysis of the pigment contents, Sugar content, NR activity and alcohol production

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB 620.1. Understand and perform Symptomological studies and comparative and statistical analysis of the pigment content due to air pollution.
BSB 620.2. Understand and perform comparative and statistical analysis of the sugar content as an impact of air pollution and NR activity
BSB 620.3. Understand and perform production & downstream processing of alcoholic fermentation.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of

Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1 practical based	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination (Practical Exam)	EE	70%

Total			**100%**

F. **Syllabus**

Module I

Symptomological studies of the impacts of conventional fuel

Comparative and statistical analysis of the pigment content due to air pollution..

Module II

Comparative and statistical analysis of the sugar content as an impact of air pollution

NR activity estimation and its statistical analysis under pollution stress conditions.

Module III

Production & downstream processing of alcoholic fermentation.

G. **Examination Scheme:**

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. **Suggested Text/Reference Books:**

- Lab Manual for B.Sc.

I. **Lecture Plan**

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Lab Introduction	Practical	BSB 620.1.	Mid Term-, Quiz & End Sem Exam
2	Symptomological studies of the impacts of conventional fuel Symptomological studies of the impacts of conventional fuel	Practical		Mid Term-1, Quiz & End Sem Exam
3	Symptomological studies of the impacts of conventional fuel	Practical		Mid Term-1, Quiz & End Sem Exam

4	Symptomological studies of the impacts of conventional fuel	Practical		Mid Term-1, Quiz & End Sem Exam

5	Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution. Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution.	Practical		Mid Term-1, Quiz & End Sem Exam
6	Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution.	Practical	BSB 620.2.	Mid Term-1, Quiz & End Sem Exam
7	Comparative and statistical analysis of the pigment content (Chl a/b/ and carotenoids)due to air pollution.	Practical		Mid Term-1, Quiz & End Sem Exam
8	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
9	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
10	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
11	Comparative and statistical analysis of the sugar content as an impact of air pollution	Practical		Mid Term-1, Quiz & End Sem Exam
12	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam
13	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam
14	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam

15	NR activity estimation and its statistical analysis under pollution stress conditions.	Practical		Mid Term-1, Quiz & End Sem Exam

16	Production & downstream processing of alcoholic fermentation.	Practical	BSB 620.3.	Mid Term-1, Quiz & End Sem Exam
17	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
18	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
19	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
20	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
21	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, & End Sem Exam
22	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
23	Production & downstream processing of alcoholic fermentation.	Practical		Mid Term-1, Quiz & End Sem Exam
24	Production & downstream processing of alcoholic fermentation.	Practical	B	Quiz & End Sem Exam
		Practical		

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

BSB 620.1.	Understand and perform Symptomological studies and comparative and statistical analysis of the pigment content due to air pollution.	3	3	3	2	3	-	-	**1**	1	2	-	-	2	3	-
BSB 620.2.	Understand and perform comparative and statistical analysis of the sugar content as an impact of air pollution and NR activity	3	3	3	2	3	-	-	1	1	2	-	-	2	3	-
BSB 620.3.	Understand and perform production & downstream processing of alcoholic fermentation.	3	3	3	2	3	-	-	-	1	2	-	-	2	3	1

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental and Industrial Biotechnology Lab***/Course code ***BSB 620*** is level **3** for the academic year ***2020-21***.


AMITY INSTITUTE OF BIOTECHNOLOGY
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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Cell Biology
Course Code : BSB101, Credits : 03, Session : 2021-22(Odd Sem.), Class : B.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. Introduction: To acquaint the students to understand the basic concept of cell biology and cell as a unit of living system, its various organelles, their structure, function and metabolic processes. Further, to help students to understand the concept of cellular evolution. Enable students to strengthen the cellular structure of cell organelle and their function.

B. Course Outcomes: At the end of the course, students will be able to:

BSB101.1. To study cell as a basic unit of life. Cell Theory. Understanding cellular organisation of Plant and animal cells. Their tissue, organ and organisational structure.

BSB101.2. To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, ribosomes, cytoskeletal, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.

BSB101.3. Students will learn about Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome and eu and hetero-chromatin.

BSB101.4. To develop deeper knowledge about Cell cycle, interphase, mitosis and meiosis.

BSB101.5. Knowledge of cell locomotion, cell senescence and apoptosis.

BSB101.6. Understanding of mechanism of cell differentiation and difference between normal and cancer cell.

C. Programme Outcomes:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological

sciences and effective implementation of engineering technologies that manipulate

living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO 2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and

their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Cell as a basic unit of living systems: The cell theory, precellular evolution; broad classification of cell types: archaebacteria, PPLOs, bacteria, eukaryotic microbes, plant and animal cells; cell, tissue, organ and organisms, different levels of organization.

Module II: Ultrastructure of the cell membrane and cell organelles**:** Ultrastructure of cell membrane and function, Structure of cell organelles; golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes; cytoskeletal structures (actin, microtubules.), mitochondria, chloroplast, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus).

Module III: Chromosomes**:** Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome organisations; eu-and heterochromatin.

Module IV: Cell division and cell cycle**:** Cell cycle, interphase, mitosis and meiosis.

Module V: Cell interaction: Cell locomotion (amoeboid, flagellar and ciliar); cell

senescence and death (apoptosis).

Module VI: Cell differentiation: Mechanism of cell differention (e.g., RBC); difference between normal and cancer cells.

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.
- Cell and Molecular Biology –Sheelar & Bianchi, John Wiley
- Essential Cell Biology : An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company
- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J. Danell, W.H. Preeman and Company.
- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell Biology, Singh & Tomar
- The world of the cell Becker, Klinshmith & Harden, Pearson

H. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**
1	Cell Theory	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
2	Precellular Evolution	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
3	Broad Classification of Cell Types	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam

4	Eukaryotic Microbes	Lecture	BSB101.1	Mid Term, Quiz & End Sem

				Exam
5	Plant and animal cells, tissues and organs	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
6	Different levels of organization	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
7	Ultrastructure of cell membrane and function	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
8	Structure of cell organelles	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
9	Golgi bodies, Endoplasmic Reticulum (Smooth and Rough), Ribosomes	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
10	Cytokeletal Structures (Actin and Microtubules)	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
11	Mitochondria, Chloroplast	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
12	Lysosomes and Peroxisomes	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
13	Nucleus Structure	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
14	Nuclear Membrane, Nucleoplasm, Nucleolus	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
15	Structural organisation of chromosomes	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam

16	Chromatids	Lecture	BSB101.3	Mid Term, Quiz & End Sem

				Exam
17	Centromere and Telomere	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
18	Streptomycin and Tatracycline	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
19	Chromatin and Nucleosome Organization	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
20	Eu and Hetero-Chromatin	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
21	Cell Cycle	Lecture	BSB101.4	Quiz & End Sem Exam
22	Interphase	Lecture	BSB101.4	Quiz & End Sem Exam
23	Mitosis	Lecture	BSB101.4	Quiz & End Sem Exam
24	Meiosis	Lecture	BSB101.4	Quiz & End Sem Exam
25	Cell Locomotion	Lecture	BSB101.5	Quiz & End Sem Exam
26	Amoeboid, Flagellar and Cilliar	Lecture	BSB101.5	Quiz & End Sem Exam
27	Cell Senescence	Lecture	BSB101.5	Quiz & End Sem Exam
28	Cell Death	Lecture	BSB101.5	Quiz & End Sem Exam
29	Apoptosis	Lecture	BSB101.5	Quiz & End Sem Exam

30	Cell Division	Lecture	BSB101.5	Quiz & End Sem Exam
31	Mechanisms of Cell	Lecture	BSB101.6	Quiz &

	Differentiation			End Sem Exam
32	RBCs	Lecture	BSB101.6	Quiz & End Sem Exam
33	Cancer	Lecture	BSB101.6	Quiz & End Sem Exam
34	Carcinogens	Lecture	BSB101.6	Quiz & End Sem Exam
35	p53 Gene and its role in cancer development	Lecture	BSB101.6	Quiz & End Sem Exam
36	Difference between normal and cancer cell	Lecture	BSB101.6	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB101.1	To study cell as a basic unit of life. Cell Theory. Understanding cellular organization of Plant and animal cells. Their tissue, organ and organizational structure.	3	2	2	2	2	2	2	2	2	2	3	2	3

BSB101.2	To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, robosomes, cytoskeletal, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.	3	2	2	2	2	2	2	2	3	2	3	3	2
BSB101.3	Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome and eu and hetero-chromatin.	3	2	2	3	2	2	2	2	3	2	3	3	2
BSB101.4	To develop deeper knowledge about Cell cycle, interphase, mitosis and meiosis.	3	3	2	3	2	2	2	1	3	2	3	2	2
BSB101.5	Knowledge of cell locomotion, cell senescence and apoptosis.	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB101.6	Understanding of mechanism of cell differentiation and difference between normal and cancer cell.	3	3	2	2	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

<table>
<tr><td colspan="8" align="center">Amity Institute of Biotechnology
MID-SEMESTER 2021-22</td></tr>
<tr><td colspan="8" align="center">Class: BSB101 (Biotech) I Semester</td></tr>
<tr><td colspan="2">Subject Name:
BSB 101 Cell Biology</td><td colspan="3">Time: 2 Hrs</td><td colspan="3">Max. Marks: 30</td></tr>
<tr><td colspan="2">Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td colspan="2">Question Mapping</td><td>Q. 1,4</td><td>Q. 2,3</td><td>Q. 4</td><td>Q. 2,5,6</td><td></td><td></td></tr>
<tr><td colspan="8">Student will be able to
CO1: To understand cell as a basic unit of life. Cell Theory. Understanding cellular organization of Plant and animal cells, their tissue, organ and organizational structure.
CO2: To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, ribosome's, cytoskeleton, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the Cell Theory.	3
CO1	Q.2a	What are different cytoskeletal structures?	3
	Q.2b	How is mode of functioning of Peroxysomes and lysosomes are different from each other ?	3
CO1	Q.3	How Nucleosome organization affects eu and heterochromatin region of DNA ?	6
CO2	Q.4	Explain the different stages of cellular reductional division i.e. Meiosis.	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **CELL BIOLOGY/BSB 101** is **level 3** for the academic year 2021-22.

Manish Km

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MADHYA PRADESH

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY ISTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

PROGRAMME SPECIFIC OUTCOMES

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	BTB 301	3	3	3	1	-	-	1	2	2	1	3	1	-	1

AMITY UNIVERSITY
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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : CELL BIOLOGY
Course Code : BTB 301, Crédits : 03, Session :2020-21(Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Cell biology plays a central role to connect the different fields of biotechnology which is highly interdisciplinary. It incorporates elements of biology, maths, physics and chemistry with combination of computers and electronics. The object of the present course is to understand the structure and function of the cellular and sub cellular components of cells and tissues with the help of recent techniques.

B. Course Outcomes: After successful completion of the course student will be able to:

BTB 301.1. Understand and explain the cell theory origin of life, and evolution.
BTB 301.2. Understand the cell cycle, regulation and checkpoints' in the cell-cycle.
BTB 301.3. Understand structure of cell membranes, transport of solutes across cell membranes.
BTB 301.4. Learn structure and function of the cell cytoskeleton, cilia and flagella.
BTB 301.5. Understand mechanism of signaling and receptors involved in signaling process.
BTB 301.6. Understand mechanism of cancer and cancer mechanism. .
BTB 301.7. Understand mechanism of apoptosis process.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%

End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

The cell theory, pre cellular evolution, prokaryotic and eukaryotic cells.

Module II

Cell cycle - molecular events, cell division, mitosis and meiosis.

Module III

Cellular organelles - structure and function of cell wall, plasma membrane nucleus, Mitochondria, Chloroplast, Nucleus, lysosomes, peroxisomes, golgi bodies, and transport across membranes.

Module IV

Cell locomotion- cytoskeleton, structure and function of cilia and flagella.

Module V

Cellular signaling –general mechanism of signaling and structures of the various types of receptors.

Module VI

Types of cancer, etiology of cancer, metastasis, cytological role of p53 and p21 genes in cancer development.

Module VII

Apoptosis.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.

References:

- Cell in Development and Inheritance, E.B. Wilson, Macmilian
- Developmental Biology, S.F. Gilbert, Sinauer Associates Inc.
- Essential Cell Biology : An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company

- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J. Danell, W.H. Preeman and Company.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	The cell theory,	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
2	Pre cellular evolution,	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
3	Prokaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
4	Prokaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
5	Eukaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
6	Eukaryotic cell	Lecture	BTB 301.1	Mid Term-1, Quiz & End Sem Exam
7	Cell cycle - molecular events	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
8	Cell division	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
9	Mitosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
10	Mitosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
11	Meiosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
12	Meiosis	Lecture	BTB 301.2	Mid Term-1, Quiz & End Sem Exam
13	Cellular organelles - structure and function of cell wall,	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
14	Plasma Membrane	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
15	Nucleus	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
16	Mitochondria	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
17	Chloroplast	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
18	Lysosome	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
19	Peroxisomes	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
20	Golgi Bodies	Lecture	BTB 301.3	Mid Term-1, Quiz & End Sem Exam
21	Transportation	Lecture	BTB 301.3	Mid Term-2, Quiz & End Sem Exam

22	Transportation	Lecture	BTB 301.3	Mid Term-2, Quiz & End Sem Exam
23	Cell locomotion-cytoskeleton	Lecture	BTB 301.4	Mid Term-2, Quiz & End Sem Exam

24	Cell locomotion-cytoskeleton	Lecture	BTB 301.4	Quiz & End Sem Exam
25	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
26	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
27	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
28	Structure and function of cilia and flagella	Lecture	BTB 301.4	Quiz & End Sem Exam
29	Cellular signaling –general mechanism of signaling	Lecture	BTB 301.5	Quiz & End Sem Exam
30	Structures of the various types of receptors.	Lecture	BTB 301.5	Quiz & End Sem Exam
31	Structures of the various types of receptors..	Lecture	BTB 301.5	Quiz & End Sem Exam
32	Types of cancer, etiology of cancer, metastasis	Lecture	BTB 301.6	Quiz & End Sem Exam
33	Cytological role of p53 and p21 genes in cancer development.	Lecture	BTB 301.6	Quiz & End Sem Exam
34	Apoptosis	Lecture	BTB 301.7	Quiz & End Sem Exam
35	Apoptosis	Lecture	BTB 301.7	Quiz & End Sem Exam
36	Apoptosis	Lecture	BTB 301.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

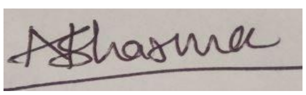
CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 301.1	Understand and explain the cell theory origin of life, and evolution.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.2	Understand the cell cycle, regulation and checkpoints' in the cell-cycle.	3	3	3	1	-	-	1	2	2	1	3	1	-	1

BTB 301.3	Understand structure of cell membranes, transport of solutes across cell membranes	3	3	3	1	-	-	1	2	2	1	3	1	-	1

BTB 301.4	Learn structure and function of the cell cytoskeleton, cilia and flagella.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.5	Understand mechanism of signaling and receptors involved in signaling process.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.6	Understand mechanism of cancer and cancer mechanism	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 301.7	Understand mechanism of apoptosis process.														

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Cell Biology*** Course code ***BTB 301*** is level **3** for the academic year 2020-21.



AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Microbiology
Course Code : BTB303, Credits : 04, Session : 2021-22(Odd Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** This fundamental paper discusses the importance of microorganisms. The course throws light on types of microorganisms in and around humans. At the end of the course, the student has understanding on the metabolism and mechanism of microbial life. Students will gain knowledge about the different cell organelles of microorganisms and their detailed functions. Students will also study the growth and control of microbes as well as different bacteriological techniques involved in microbiology. Students will learn about the biomolecules by studying their structures and types.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB303.1. Students will learn about the historical perspective of microbial world, spontaneous generation, role of microbes, pure culture, microbial nutrition, culture media, and sterilization.

BTB303.2. Students will gain knowledge of prokaryotic cell, structural and functional anatomy of cell and organelles. Growth and growth curve, culture types – batch and continuous, culture collection and maintenance of cultures.

BTB303.3. Students will gain knowledge about the Systematics and taxonomy of bacteria, ribotyping, nomenclature and Bergey's manual.

BTB303.4. Students will know about the Metabolic Diversity among microorganisms, microbial photosynthesis, photosynthetic pigments, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions.

BTB303.5. Students will develop deeper understanding of Archae, thermophiles,

psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles. Viruses –

Bacterial and Animal, their structure, reproduction. Viroids and Prions. Algae and Fungi – their reproduction and classification.

BTB303.6. Students will learn about the Host-parasite relationship, micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections, types of toxins (Exo, endo, entro) and their mechanism of action. Microbial pathogenesis and sexually transmitted disease.

BTB303.7. Students will have knowledge of Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics.

C. Programme Outcomes:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioral attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. **Syllabus**

Module I: Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization.

Module II: Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, Fed batch culture, continuous culture, culture collection and maintenance of cultures.

Module III: Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV: Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-ironnitrite- oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophilesViruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI: Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII: Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE

Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott
The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.
The Microbial World, Roger Y. Stanier, Prentice Hall
Microbiology, Tortora, Funke and Chase, Benzamin& Cummings
Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
Industrial Microbiology, Casida, New Age International
Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC.Brown Publisher.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Discovery of the microbial world	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
2	Controversy over spontaneous generation	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
3	Role of microorganisms in transformation of organic matter and in the causation of diseases	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
4	Development of pure culture methods	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
5	Methods in Microbiology	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
6	Principles of microbial nutrition, Culture media	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
7	Theory and practice of sterilization	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam

8	Prokaryotic structure and function	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
9	Functional anatomy of bacteria: cell envelope, cell	Lecture	BTB303.2	Mid Term,

	wall, cytoplasmic membrane, capsule			Quiz & End Sem Exam
10	Functional anatomy of bacteria: surface appendages, cytoplasm and cytoplasmic Inclusions	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
11	Growth - The definition of growth, mathematical expression of growth, growth curve	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
12	Measurement of growth, Synchronous growth	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
13	Fed batch culture, continuous culture	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
14	Culture collection and maintenance of cultures	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
15	Systematics and taxonomy	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
16	New approaches to bacterial taxonomy	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
17	Classification including ribotyping	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
18	Ribosomal RNA sequencing	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
19	Characteristics of primary domains	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
20	Taxonomy, nomenclature	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
21	Bergey's manual	Lecture	BTB303.3	Quiz & End Sem Exam
22	Metabolic Diversity among microorganisms	Lecture	BTB303.4	Quiz & End Sem Exam
23	Photosynthesis in microorganisms	Lecture	BTB303.4	Quiz & End Sem Exam
24	Role of bacteriochlorophylls, carotenoids and phycobilins	Lecture	BTB303.4	Quiz & End Sem Exam
25	Chemolithotrophy, hydrogen- iron-nitrite-oxidizing bacteria	Lecture	BTB303.4	Quiz & End Sem Exam

26	Nitrate and Sulphate reduction, methanogenesis and acetogenesis	Lecture	BTB303.4	Quiz & End Sem Exam

27	Fermentations, nitrogen fixation	Lecture	BTB303.4	Quiz & End Sem Exam
28	Plant microbe interactions (mycorrhizae)	Lecture	BTB303.4	Quiz & End Sem Exam
29	Archae as earliest life forms	Lecture	BTB303.5	Quiz & End Sem Exam
30	Thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BTB303.5	Quiz & End Sem Exam
31	Viruses: Bacterial, animal	Lecture	BTB303.5	Quiz & End Sem Exam
32	Structure of viruses	Lecture	BTB303.5	Quiz & End Sem Exam
33	Reproduction and life cycle of RNA and DNA viruses	Lecture	BTB303.5	Quiz & End Sem Exam
34	Viroids and prions.	Lecture	BTB303.5	Quiz & End Sem Exam
35	Algae and Fungi: Classification and Reproduction	Lecture	BTB303.5	Quiz & End Sem Exam
36	Host-parasite relationship	Lecture	BTB303.6	Quiz & End Sem Exam
37	Normal micro flora of skin, oral cavity, gastrointestinal tract	Lecture	BTB303.6	Quiz & End Sem Exam
38	Respiratory infections; entry of pathogens into the host	Lecture	BTB303.6	Quiz & End Sem Exam
39	Types of toxins (Exo, endo, entro) and their mode of actions	Lecture	BTB303.6	Quiz & End Sem Exam
40	Microbial pathogenesis - Disease reservoirs	Lecture	BTB303.6	Quiz & End Sem Exam
41	Epidemiological terminologies; Infectious disease transmission	Lecture	BTB303.6	Quiz & End Sem Exam
42	Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi	Lecture	BTB303.6	Quiz & End Sem Exam
43	Chemotherapy/antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam
44	Antimicrobial agents, sulfa drugs	Lecture	BTB303.7	Quiz & End Sem Exam
45	Antibiotics - Penicillin and Cephalosporins	Lecture	BTB303.7	Quiz & End Sem Exam

46	Broad spectrum antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam

47	Antifungal antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam
48	Mode of action of antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BTB303.1	historical perspective of microbial world, spontaneous generation, role of microbes, pure culture, microbial nutrition, culture media, and sterilization	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.2	prokaryotic cell, structural and functional anatomy of cell and organelles. Growth and growth curve, culture types – batch and continuous, culture collection and maintenance of cultures	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

BTB303.3	Systematics and taxonomy of bacteria, ribotyping, nomenclature and Bergey’s manual	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

BTB303.4	Metabolic Diversity among microorganisms, microbial photosynthesis, photosynthetic pigments, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.5	Archaea, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles. Viruses – Bacterial and Animal, their structure, reproduction. Viroids and Prions. Algae and Fungi – their reproduction and classification	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

BTB303.6	Host-parasite relationship, micro flora of skin, oral cavity, gastrointestinal tract,	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

	Respiratory infections, types of toxins (Exo, endo, entro) and their mechanism of action. Microbial pathogenesis and Sexually transmitted disease															
BTB303.7	Chemotherapy/ antibiotics - Antimicrobial agents, sulfa drugs, penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2021-22						
Class: B.Tech. Biotechnology III Semester						
Subject Name: BTB 303 MICROBIOLOGY		Time: 1.5 Hrs		Max. Marks: 30		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

Student will be able to
CO1: Enumerate bacterial count their isolation and development of pure culture.
CO2: Apply generation time calculation for different microbial entities.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief about microbial evolution.	3
CO1	Q.2a	What do you understand by isolation of culture?	3
	Q.2b	How are prokaryotic microbes different from eukaryotic microbes?	3
CO1	Q.3	Give an account of DNA sequencing.	6
CO2	Q.4	Explain the significance of bacterial toxins.	3
CO2	Q.5a	What are the factors favoring enteric bacteria?	3
	Q.5b	Discuss the different factors affecting the growth of bacteria.	3
CO2	Q 6	Differentiate between monoauxic and diauxic bacterial growth curve.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **MICROBIOLOGY/BTB 303** is **level 3** for the academic year 2021-22.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	BTB 320	3	3	3	1	-	-	1	2	2	1	3	1	-	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : CELL BIOLOGY LAB
Course Code : BTB 320, Crédits : 01, Session :2020-21(Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Cell biology plays a central role to connect the different fields of biotechnology which is highly interdisciplinary. It incorporates elements of biology, maths, physics and chemistry with combination of computers and electronics. The object of the present course is to understand the structure and function of the cellular and sub cellular components of cells and tissues with the help of recent techniques.

B. Course Outcomes: After successful completion of the course student will be able to:

BTB 320.1. Understand and explain the different types of microscopy
BTB 320.2 Understand the about the plant cell and cell organelles.
BTB 320.3. Understand the about the cell cycle, regulation and checkpoints' in the cell-cycle.
BTB 320.4. Understand mechanism of cancer and cancer mechanism.
BTB 320.5. Understand mechanism of apoptosis process.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other

means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Module I
Microscopy: Light microscopy, Bright field, Phase contrast & Gram's staining.
Module II
Study of chromoplasts, chloroplast in plant cell.
Module III: Cell Division
Mitosis and Meiosis
Module IV
Study of permanent slides of types of cancer
Module V
Study of apoptosis

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.

References:
- Cell in Development and Inheritance, E.B. Wilson, Macmilian
- Developmental Biology, S.F. Gilbert, Sinauer Associates Inc.
- Essential Cell Biology : An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company
- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J. Danell, W.H. Preeman and Company.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Bright Field Microscopy	Practical	BTB 320.1	Mid Term-1, Quiz & End Sem Exam
2	Phase Contrast Microscopy	Practical	BTB 320.1	Mid Term-1, Quiz & End Sem Exam
3	Gram's Staining	Practical	BTB 320.1	Mid Term-1, Quiz & End Sem Exam
4	Study of chromoplasts, in plant cell.	Practical	BTB 320.2	Mid Term-1, Quiz & End Sem Exam
5	Study of chloroplast in plant cell.	Practical	BTB 320.2	Mid Term-1, Quiz & End Sem Exam
6	Mitosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
7	Mitosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
8	Mitosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
9	Meiosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
10	Meiosis	Practical	BTB 320.3	Mid Term-1, Quiz & End Sem Exam
11	Study of permanent slides of types of cancer	Practical	BTB 320.4	Mid Term-1, Quiz & End Sem Exam
12	Study of Apoptosis	Practical	BTB 320.5	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BTB 320.1.	Understand and explain the different types of microscopy	3	3	3	1	-	-	1	2	2	1	3	1	-
BTB 320.2.	Understand the about the plant cell and cell organelles	3	3	3	1	-	-	1	2	2	1	3	1	-

BTB 320.3.	Understand the about the cell cycle,	3	3	3	1	-	-	1	2	2	1	3	1	-

	regulation and checkpoints' in the cell-cycle													
BTB 320.4.	Understand mechanism of cancer and cancer mechanism	3	3	3	1	-	-	1	2	2	1	3	1	-
BTB 320.5.	Understand mechanism of apoptosis process	3	3	3	1	-	-	1	2	2	1	3	1	-

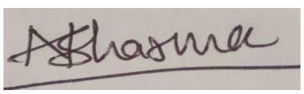
Sample Question Paper

Amity School of Engineering and Technology Department of Computer Science and Engineering I MID-SEMESTER (SEM –VII) 2020-21						
Class: B.Tech.(CSE) VII Semester						
Subject Name: CSE 703 CLOUD COMPUTING		Time: 2 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		
Student will be able to CO1: List the broad perceptive of cloud architecture and model. CO2: Apply different cloud programming models as per need.						

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the cloud computing concept.	3
CO1	Q.2a	What are the essential characteristics of cloud computing?	3
	Q.2b	How is cloud computing requirements and cloud servicerequirement services related to each other?	3
CO1	Q.3	Sketch NIST Cloud Computing Reference Architecture and depictits elements	6
CO2	Q.4	Explain the significance of Cloud Reference Model	3
CO2	Q.5a	Elaborate different cloud types with example.	3
	Q.5b	Write characteristics of private cloud.	3
CO2	Q 6	How virtualization is applied in cloud computing scenario?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Cell Biology lab*** Course code ***BTB 320*** is level **3** for the academic year 2020-21.



AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Microbiology Lab
Course Code : BTB322, Credits : 01, Session : 2021-22(Odd Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Manish Kumar

A. Introduction: To understand the basics of microbiology and different culture techniques. Preparation of culture media – liquid, slant and solid. Growth curve and different types of staining – grams, endospore and capsule staining. Isolation and identification of rhizobium from root nodules

B. Course Outcomes: At the end of the course, students will be able to:

BTB322.1. Students will learn about preparation of solid and liquid media.

BTB322.2. Students will do isolation and maintenance of organisms by plating, streaking and serial dilution.

BTB322.3. Students will know about the preparation of slant cultures.

BTB322.4. Students will learn about growth curve measurement of bacterial population by turbidometry.

BTB322.5. Students will know about measurement of bacterial population by dilution method.

BTB322.6. Students will gain knowledge of effect of temperature, pH, carbon and nitrogen sources on growth of bacteria.

BTB322.7. Students will do microscopic examination of bacteria by gram staining.

BTB322.8. Students will learn about Endospore staining.

BTB322.9. Students will be acquainted with Capsule Staining.

BTB322.10. Students will experimentally perform isolation and identification of Rhizobium from root nodules.

C. Programme Outcomes:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science,

engineering fundamentals, and an engineering specialization to the solution of

complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of

technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Internal Examination	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%

End Semester Examination	External Examination	EE	70%

Total			**100%**

E. Syllabus

Module I: Preparation of solid and liquid media.

Module II: Isolation and maintenance of organisms by plating, streaking and serial dilution.

Module III: Preparation of slant cultures.

Module IV: Growth curve measurement of bacterial population by turbidometry.

Module V: Measurement of bacterial population by dilution method.

Module VI: Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria.

Module VII: Microscopic examination of bacteria by gram staining.

Module VIII: Endospore staining.

Module IX: Capsule Staining.

Module X: Isolation and identification of Rhizobium from root nodules.

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian

Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott

The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

The Microbial World, Roger Y. Stanier, Prentice Hall

Microbiology, Tortora, Funke and Chase, Benzamin& Cummings

Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.

Industrial Microbiology, Casida, New Age International

Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of

Microbiology, R.M. Atlas, WMC.Brown Publisher.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Preparation of solid and liquid media	Practical	BTB322.1	Internal & External Exam
2	Learning about autoclave, laminar air flow	Practical	BTB322.1	Internal & External Exam
3	Isolation and maintenance of organisms by plating and streaking	Practical	BTB322.1	Internal & External Exam
4	Isolation and maintenance of organisms by serial dilution	Practical	BTB322.1	Internal & External Exam
5	Measurement of bacterial population by dilution	Practical	BTB322.1	Internal & External Exam
6	Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria	Practical	BTB322.1	Internal & External Exam
7	Microscopic examination of bacteria by gram staining	Practical	BTB322.1	Internal & External Exam
8	Endospore staining	Practical	BTB322.2	Internal & External Exam
9	Capsule staining	Practical	BTB322.2	Internal & External Exam
10	Collection of Root Nodules	Practical	BTB322.2	Internal & External Exam
11	Isolation of Rhizobium from root nodules	Practical	BTB322.2	Internal & External Exam
12	Identification of Rhizobium from root nodules	Practical	BTB322.2	Internal & External Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BTB 322.1	Preparation of solid and liquid media	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.2	Isolation and maintenance of organisms by plating, streaking and serial dilution	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.3	Preparation of slant cultures	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.4	Growth curve measurement of bacterial population by turbidometry	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.5	Measurement of bacterial population by dilution method	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.6	Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.7	Microscopic examination of bacteria by gram staining	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.8	Endospore staining	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.9	Capsule Staining	3	2	2	2	3	2	2	2	2	2	3	2	2
BTB 322.10	Isolation and identification of Rhizobium from root nodules	3	2	2	2	2	2	2	2	2	2	3	2	2

Sample Question Paper

Amity Institute of Biotechnology MID-SEMESTER 2021-22
Class: B.Tech (Biotech) III Semester

Subject Name: BTB 322 Microbiology Lab	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to
CO1: List the broad perceptive of cloud architecture and model.
CO2: Apply different cloud programming models as per need.

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss the development of pure cultures.	3
CO1	Q.2a	Differentiate between bacteria and fungi.	3
	Q.2b	Write a short note on bacterial DNA marker.	3
CO1	Q.3	Differentiate between genotype and ribotype.	6
CO2	Q.4	Explain about the capsule staining and	3

Attainments		Rubric
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **MICROBIOLOGY LAB/BTB 322** is **level 2** for the academic year 2021-22.

Manish Kr

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : GENETICS
Course Code : BTB 402, Credits : 04, Session : 2020-21.(Even Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Pushpika Udawat

A. **Introduction :** To acquaint the students to understand the basic concept of genetics incorporating the concepts of classical, molecular genetics. Students will learn about Mendelian Laws, Extension of Mendels Law, Multiple allele and isoallele, etc. Mutation, Mutagen, Chromosomal Aberrations, Human Genetic Disorders. Knowledge of methods of sex determination, Chromosomal non-disjunction, Chromosomal theory of inheritance, Sex linked, Sex limited and Sex limited Inheritance, Extra-chromosomal inheritance. Understanding of Population Genetics, Hardy-Weinberg Equilibrium, Gene and Genotype Frequencies.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB402.1. Students will develop an understanding of History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance.

BTB402.2. Understanding the pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation.

BTB402.3. To study the classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage.

BTB402.4. Students will develop a basic understanding of Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders.

BTB402.5. Knowledge of Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance.

BTB402.6. Students will learn about extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA.

BTB402.7. Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies.

C. **Programme Outcomes:**

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of

experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyze problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied

mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioral attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Brief history, scope and significance of Genetics. Mendelian law of inheritance. Lethality and interaction of gene. Multiple allele and isoallele. Penetrance and Expressivity. Linkage and crossing over. Mapping of genes. interference and coincidence.

Module II: Basic microbial genetics, Conjugation, transformation, transduction and their use in genetic mapping.

Module III: Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over and complementation test, Benzers work on rII locus in T4 Bacteriophage.

Module IV: Mutation; spontaneous and induced, Mutagen;chemical and physical. Chromosomal aberrations; structural and numerical. Economic importance of mutation. Genetic disorders in human; Kleinefelter, Turner, Cri-du-Chat and Down syndrome.

Module V: Sex determination in plant and animal. Non disjunction as a proof of chromosomal theory of inheritance. Sex linked, sex influenced and sex limited inheritance.

Module VI: Extra chromosomal inheritance; cytoplasmic inheritance, Mitochondrial and Chloroplast genetic system.

Module VII: Population genetics; Hardy-Weinberg equilibrium law, Gene and genotype frequencies.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Principles of Genetics, E. J. Gardner, John Wiley & Sons Inc.

Genetics, P.K. Gupta, Rastogi Publication.

Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, Pearson Education.

Genetics, M.W. Strickberger, Prentice Hall College Division.

Genetics, P.J. Russell, Benjamin/Cummings.

Genetics, R. Goodenough, International Thomson Publishing.

Introduction to Genetic Analysis, A.J. F. Griffiths, W.H. Freeman and Company.

Principles of Genetics, D.P. Snustad & M.J. Simmons, John Wiley and Sons Inc.

Molecular Biology of the Gene (Fifth Edition), J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison Wiesley Publishing.

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing CO**
1	Brief history of Genetics	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
2	Scope and significance of Genetics	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
3	Mendelian law of inheritance	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
4	Lethality and interaction of gene.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam

5	Multiple allele and isoallele.	Lecture	BTB402.1	Mid Term, Quiz & End

				Sem Exam
6	Penetrance and Expressivity.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
7	Linkage and crossing over.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
8	Mapping of genes.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
9	Interference and coincidence.	Lecture	BTB402.1	Mid Term, Quiz & End Sem Exam
10	Basic microbial genetics	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
11	Conjugation	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
12	Transformation	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
13	Transduction	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
14	Genetic Mapping	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
15	Uses of Conjugation, Transformation and Transduction in Genetic Mapping	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
16	Significance of Genetic Mapping	Lecture	BTB402.2	Mid Term, Quiz & End Sem Exam
17	Classical and modern concept of gene	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam
18	Pseudoallelism,	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam
19	Position effect	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam

20	Intragenic crossing over	Lecture	BTB402.3	Mid Term, Quiz & End Sem Exam
21	Mapping of genes	Lecture	BTB402.3	Quiz & End Sem Exam

22	Interference	Lecture	BTB402.3	Quiz & End Sem Exam
23	Coincidence	Lecture	BTB402.3	Quiz & End Sem Exam
24	Mutation; spontaneous and induced	Lecture	BTB402.4	Quiz & End Sem Exam
25	Mutagen; chemical and physical	Lecture	BTB402.4	Quiz & End Sem Exam
26	Chromosomal aberrations Structural	Lecture	BTB402.4	Quiz & End Sem Exam
27	Chromosomal aberrations numerical Aberration	Lecture	BTB402.4	Quiz & End Sem Exam
28	Economic importance of mutation	Lecture	BTB402.4	Quiz & End Sem Exam
29	Genetic disorders in human	Lecture	BTB402.4	Quiz & End Sem Exam
30	Kleinfelters, Terners, Cri-Du-Chat and Down Syndrome	Lecture	BTB402.4	Quiz & End Sem Exam
31	Sex determination in plants	Lecture	BTB402.5	Quiz & End Sem Exam
32	Sex determination in animals	Lecture	BTB402.5	Quiz & End Sem Exam
33	Non disjunction of chromosomes	Lecture	BTB402.5	Quiz & End Sem Exam
34	Non disjunction as a proof of chromosomal theory of inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
35	Sex linked inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
36	Sex influenced inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
37	Sex limited inheritance	Lecture	BTB402.5	Quiz & End Sem Exam
38	Extra chromosomal inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
39	Cytoplasmic inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
40	Mitochondrial DNA	Lecture	BTB402.6	Quiz & End Sem Exam
41	Chloroplast genetic system	Lecture	BTB402.6	Quiz & End Sem Exam
42	Significance of Extra chromosomal inheritance	Lecture	BTB402.6	Quiz & End Sem Exam

43	Significance of Cytoplasmic inheritance	Lecture	BTB402.6	Quiz & End Sem Exam

44	Example of Cytoplasmic Inheritance	Lecture	BTB402.6	Quiz & End Sem Exam
45	Population genetics	Lecture	BTB402.7	Quiz & End Sem Exam
46	Hardy-Weinberg equilibrium law	Lecture	BTB402.7	Quiz & End Sem Exam
47	Gene frequencies	Lecture	BTB402.7	Quiz & End Sem Exam
48	Genotype frequencies	Lecture	BTB402.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BTB402.1	History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.2	Pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation	3	2	2	2	2	2	2	2	2	2	3	2	2

BTB402.3	To study the classical and modern concept of gene,	3	2	2	2	2	2	2	2	2	2	3	2	2

	pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage													
BTB402.4	Mutation- Types, Mutagen- Types, and Chromosomal aberrations- structural & numerical and human genetic disorders	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.5	Knowledge of Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.6	Extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB402.7	Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies	3	2	2	2	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

Amity Institute of Biotechnology MID-SEMESTER 2020-21.
Class: B. Tech (Biotech) IV Semester

Subject Name: BTB 402 GENETICS	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzin g	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to

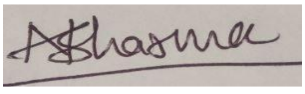
CO1: History and scope of Genetics

CO2: Understanding the pre Mendelian genetic concepts

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the scope and significance of genetics.	3
CO1	Q.2a	What are different steps involved in genetic mapping ?	3
	Q.2b	How is mechanism of conjugation is different from transformation ?	3
CO1	Q.3	How classical concept of gene is different from modern concept of gene ?	6
CO2	Q.4	Explain the significance of extra-chromosomal inheritance and cytoplasmic inheritance.	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Genetics*** Course code ***BTB 402*** is level **3** for the academic year 2020-21.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2020-21

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent

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AUMP

responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12		PSO 1	PSO 2	PSO 3	PSO 4
V SEM	BTB 502	3	2	2	3	2	1	2	2	1	2	1	-		3	2	1	-

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ANIMAL BIOTECHNOLOGY
Course Code : BTB 502, Crédits : 03, Session :2020-21 (Odd Sem.), Class : B.Tech. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in animal biotechnology like in vitro fertilization, animal cell and tissue culture, hormone vaccine and important enzyme production through animal biotechnology.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB 502.1. Understand Concepts of animal biotechnology and its commercial applicability methods of sterilization techniques and understanding of organ culture.
BTB 502.2. Learn methods of animal cell culture and maintenance and immobilization cell culture techniques.
BTB 502.3. Understand the technology and concepts of invitro fertilization and embryo transfer, and development of superior live stocks.
BTB 502.4. Become familiar with concept of somatic hybridization and hybridoma technology for vaccine production
BTB 502.5. Understand Animal genetic engineering -vectors, gene transfer methods
BTB 502.6. Understand transgenic technology in animal biotechnology for producing commercially important products.
BTB 502.7. Understand ethical issues in animal biotechnology

C. **Programme Outcomes:**

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to

the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. **Syllabus**

Module I

Historical perspectives, sterilization methods, organ culture - culture techniques, plasma clot, raft methods, agar gel, grid method, organ engineering.

Module II

Cell culture substrates, cultural media, natural and artificial media, initiation and maintenance of cell cultures, cell culture products, cryopreservation techniques, immobilized cultures

Module III

In vitro fertilization and embryo transfer

Module IV

Somatic cell hybridization, hybridoma technology

Module V

Animal genetic engineering -vectors, gene transfer methods - microinjection, virus mediated and other methods of gene transfer

Module VI

Transgenic animals with new traits, transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutic etc.

odule VII

Bioethical issues related to animal biotechnology,

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

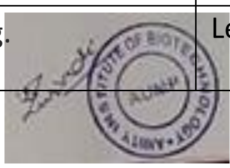
CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss. References:
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford.
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag.
- Cell Culture LabFax, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press.
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Historical perspectives, sterilization methods,	Lecture	BTB 502.1.	Mid Term-1, Quiz & End Sem Exam
2	organ culture - culture techniques, plasma clot, raft methods,	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Agar gel, grid method of Organ culture	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Organ engineering.	Lecture		Mid Term-1, Quiz & End Sem Exam



5	Animal Cell culture substrates for attatchment	Lecture	BTB 502.2.	Mid Term-1, Quiz & End Sem Exam
6	Broad outline of Animal Cell culture Media	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Animal Cell Culture Media: Natural media	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Animal Cell Culture Media: Artificial media	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Advantages and limitations of natural and artificial media.	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Methods of Initiation of Cell culture	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Preversation and maintenance of cell culture.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	cryopreservation techniques,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	immobilized cultures	Lecture		Mid Term-1, Quiz & End Sem Exam
14	In-vitro fertilization technique	Lecture	BTB 502.3.	Mid Term-1, Quiz & End Sem Exam
15	In-vitro fertilization technique	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Embryo transfer	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Embryo transfer .	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Somatic cell hybridization	Lecture	BTB 502.4.	Quiz & End Sem

				Exam
19	Somatic cell hybridization	Lecture		Quiz & End Sem Exam
20	Hybridoma technology for MAbs production	Lecture		Quiz & End Sem Exam
21	Hybridoma technology for MAbs production	Lecture		Quiz & End Sem Exam
22	Applications of bioreactoras and MAbs	Lecture		Quiz & End Sem Exam
23	Animal genetic engineering -vectors, gene transfer methods : Direct	Lecture	BTB 502.5.	Quiz & End Sem Exam
24	Animal genetic engineering -vectors, gene transfer methods: Indirect	Lecture		Quiz & End Sem Exam
25	Vectors for transgene transfer	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Transgenic animals	Lecture	BTB 502.6.	Quiz & End Sem Exam
27	Methods of transgenic animal production	Lecture		Quiz & End Sem Exam
28	Methods of transgenic animal production	Lecture		Quiz & End Sem Exam
29	Transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutic etc.	Lecture		Quiz & End Sem Exam
30	Transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutic etc.	Lecture		Quiz & End Sem Exam
31	Transgenic animals with new traits	Lecture		Quiz & End Sem Exam
32	Transgenic animals with new traits	Lecture		Quiz & End Sem Exam
33	Bioethical issues related to animal biotechnology,	Lecture	BTB 502.7.	Quiz & End Sem Exam
34	Bioethical issues related to animal biotechnology,	Lecture		Quiz & End Sem Exam
35	Bioethical issues related to animal biotechnology,	Lecture		Quiz & End Sem Exam

36	Test	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFI OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
BTB 502.1.	Understand Concepts of animal biotechnology and its commercial applicability methods of sterilization techniques and understanding of organ culture. .	3	2	1	2	1	1	-	-	1	-	-	1	3	1	1
BTB 502.2.	Learn methods of animal cell culture and maintenance and immobilization cell culture techniques	3	2	1	2	1	1	-	-	**1**	-	-	1	3	2	1
BTB 502.3.	Understand the technology and concepts of invitro fertilization and embryo transfer, and development of superior live stocks.	3	2	1	2	1	1	1	-	1	-	-	1	3	2	1

BTB 502.4.	Become familiar with concept of somatic hybridization and hybrodoma technology for vaccine production	3	1	1	-	1	1	-	-	1	-	-	1	3	2	-

BTB 502.5.	Understand Animal genetic engineering -vectors, gene transfer methods	3	-	1	-	1	1	-	-	1	-	-	1	3	2	-
BTB 502.6.	Understand transgenic technology in animal biotechnology for producing commercially important products.	3	-	1	2	1	1	2	-	1	-	-	1	3	2	1
BTB 502.7.	Understand ethical issues in animal biotechnology	3	-	1	-	1	1	3	-	1	-	-	1	3	2	-

Sample Question Paper

Amity Institute Biotechnology 2020-21						
Class: B. Tech. Biotechnology V Semester						
Subject Name: ANIMAL BIOTECHNOLOGY		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4,6	Q.2,5,3	Q.7,8	Q.9	Q. 10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO2	Q.1	Write a short note on primary cell culture including its advantages and limitations.	6

	Q.2	Write a short note on reporter genes used during cloning in animal cells.	6

CO5 CO1	Q.3	Briefly discuss moist heat sterilization method including its advantages and limitations.	6
CO2	Q.4	Write a short note on Stirred tanked bioreactor.	6
CO5	Q.5	Explain the selection method of hybridoma cells for vaccine production.	6
CO7	Q.6	Define bioethics? Enlist the initiatives of CSIRO's animal ethics committee.	6
	Q.7	Explain various methods of cell separation from animal tissue, clearly indicating their merits and demerits. How is cell culture maintained in the laboratory?	10
CO1	Q.8	Explain the following- (a) Method of selection of myeloma cells form bone marrow. (b) Recombinant erythropoietin (EPO) and its commercial applications.	10
CO3	Q.9	Discuss the principal and steps involved in Intra-cytoplasmic Sperm Injection (ICSI) with suitable diagramme during IVF for genetically superior livestock development. Enlist the risks associated with IVF.	10
CO2	Q.10	Discuss the following in detail (a) Various selection criteria for grading best embryos for embryo transfer technology (ETT). (b) Natural animal cell culture media.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Animal Biotechnology***/Course code ***BTB 502*** is level **3** for the academic year ***2020-21***.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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO1 2	PSO1	PSO2	PSO 3	PSO4
V	BTB 503	3	3	3	1	-	-	1	2	2	3	2	1	3	1	-	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : STRUCTURAL BIOLOGY
Course Code : BTB 503, Crédits : 03, Session :2020-21(Odd Sem.), Class : B.Tech 3rd Year
Faculty Name : DR. NEHA SHARMA and DR. PUSHPIKA UDAWAT

A. **Introduction:** The course aims to provide an understanding of the principles and applications of proteins, enzymes and nucleic acids for their role in biochemical pathway as well as interactions among themselves.

B. **Course Outcomes:** After successful completion of the course student will be able to:

BTB503.1. Students will learn about amino acids structure and function, Primary, secondary, tertiary and quaternary structure of protein; Motifs and domains of protein structures; Conformational analysis, Protein folding.

BTB503.2. Students will develop an understanding of Architecture and building blocks of proteins. : Evaluate different mechanism of substrate recognition, its structural basis, reaction mechanism of enzymes and G-protein coupled receptors.

BTB503.3. Students will understand the protein denaturation, refolding and stabilization.

BTB503.4. Students will understand structural parameters of DNA molecule understand about the protein-DNA interaction and its mechanism.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

1. PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of

the information to provide valid conclusions.

5. PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering

activities with an understanding of the limitations.
6. PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
7. PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
9. PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%

Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves	A	5%

	including medical leaves.		
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Chemistry of amino acids and peptides: Side chain structure and function in protein folding and functionality: Secondary structure of proteins - helices, sheets, loops and turns; Structural and functional proteins. Tertiary structure of proteins, homo and hetero-dimers, trimers and tetramers; forces governing protein-protein interactions; open tertiary structure; Classification of proteins; Structure and function of an antibody; structure of haemoglobin, muscle proteins; Sequence and structural motifs in proteins.

Module II: Protein-ligand interactions: Lock and key versus handshake mechanism of substrate recognition; structural basis of recognition; reaction mechanisms of enzymes, G-Protein coupled receptors.

Module III: Protein solubility, protein stability and stabilization: Salting in and salting out, Parameters affecting; enthalpic and entropic stabilization, mutations increasing stability, .helix capping; Native, partially denatured and denatured proteins; Protein denaturation, Physical and chemical denaturants; Refolding.

Module IV: DNA structure: Covalent structure of DNA, base pairing, hydrogen bonding, DNA melting and annealing, difference between AT and GC pairing, DNA models, The Watson Crick model; Crystal structure of B-DNA, major and minor groves, dyad symmetry, base pair stacking, propellor twist, A and Z- DNA, triple stranded DNA, telomeric sequences and structure, G-quartcts, palindromic and tandem sequences, Base pair flipping and DNA bulges, DNA methylation; Protein-DNA interactions; drug-DNA interactions; Databases of sequences and structure for protein and DNA, public domain softwares for visualizing and modelling biomolecules -Rasmol, Deepview, Whatif.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Biochemistry, R.H. Abeles, P.A. Frey and W.A. Jencks, Jones and Bartlett.
- Essentials of Molecular Biology, D. Freifelder, Jones and Bartlett Publications.
- Genes VII, B. Lewin, Oxford University Press.

References:

- Introduction to Protein Structure, C. Branden and J Tooze, Garland Publishing Company.
- Protein Structure, M. Perutz, Oxford University Press.

Proteins (Structures and Molecular Properties), T.E. Creighton, W.H. Freeman and Company.
Database Annotation in Molecular Biology, Arthur M. Lesk.
From Genes to Clones, E.L. Winnacker.

- Genes & Genomes, M.S. Paul Berg.
- Structure and Machanism in Protein Science, Alan Fersht.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Side chain structure and function in protein folding and functionality	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
2	Secondary structure of proteins - helices, sheets, loops and turns	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
3	Structural and functional proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
4	Tertiary structure of proteins, homo and hetero-dimers, trimers and tetramers	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
5	Forces governing protein-protein interactions	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
6	Open tertiary structure	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
7	Classification of proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
8	Structure and function of an antibody	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
9	Structure of *haemoglobin*	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
10	Muscle proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
11	Protein Sequences	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
12	Structural motifs in proteins	Lecture	BTB503.1	Mid Term-1, Quiz & End Sem Exam
13	Lock and key mechanism of substrate recognition	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam

14	Handshake mechanism of substrate recognition	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam

15	Structural basis of substrate recognition	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
16	Reaction mechanisms of enzymes	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
17	G-Protein coupled receptors	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
18	Mechanism of G-Protein coupled receptors	Lecture	BTB503.2	Mid Term-1, Quiz & End Sem Exam
19	Salting in and salting out,	Lecture	BTB503.3	Quiz & End Sem Exam
20	Parameters affecting; enthalpic and entropic	Lecture	BTB503.3	Quiz & End Sem Exam
21	stabilization, mutations increasing stability,	Lecture	BTB503.3	Quiz & End Sem Exam
22	Helix capping; Native, partially denatured and denatured proteins	Lecture	BTB503.3	Quiz & End Sem Exam
23	Protein denaturation,	Lecture	BTB503.3	Quiz & End Sem Exam
24	Physical and chemical denaturants; Refolding	Lecture	BTB503.3	Quiz & End Sem Exam
25	Covalent structure of DNA, base pairing,	Lecture	BTB503.4	Quiz & End Sem Exam
26	Hydrogen bonding, DNA melting and annealing,	Lecture	BTB503.4	Quiz & End Sem Exam
27	Difference between AT and GC pairing,	Lecture	BTB503.4	Quiz & End Sem Exam
28	DNA models, The Watson Crick model; Crystal structure of B-DNA, major and minor groves, dyad symmetry,	Lecture	BTB503.4	Quiz & End Sem Exam
29	base pair stacking, propellor twist, A and Z- DNA, triple stranded DNA,	Lecture	BTB503.4	Quiz & End Sem Exam
30	telomeric sequences and structure, G-quartcts	Lecture	BTB503.4	Quiz & End Sem Exam

31	Palindromic and tandem sequences,	Lecture	BTB503.4	Quiz & End Sem Exam

32	Base pair flipping and DNA bulges, DNA methylation;	Lecture	BTB503.4	Quiz & End Sem Exam
33	Protein-DNA interactions; drug-DNA interactions;	Lecture	BTB503.4	Quiz & End Sem Exam
34	Databases of sequences and structure for protein and DNA,	Lecture	BTB503.4	Quiz & End Sem Exam
35	Public domain softwares for visualizing and modeling biomolecules -Rasmol, Deepview, Whatif.	Lecture	BTB503.4	Quiz & End Sem Exam
36	Public domain softwares for visualizing and modeling biomolecules -Rasmol, Deepview, Whatif.	Lecture	BTB503.4	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 503.1	Students will learn about amino acids structure and function, Primary, secondary, tertiary and quaternary structure of protein; Motifs and domains of protein structures; Conformational analysis, Protein folding.	3	3	3	1	-	-	1	2	2	1	3	1	-	1

BTB 503.2	Students will develop an understanding of Architecture and building blocks of proteins. : Evaluate different mechanism of substrate recognition, its structural	3	3	3	1	-	-	1	2	2	1	3	1	-	1

	basis, reaction mechanism of enzymes and G-protein coupled receptors														
BTB 503.3	Students will understand the protein denaturation, refolding and stabilization	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 503.4	Students will understand structural parameters of DNA molecule understand about the protein-DNA interaction and its mechanism.	3	3	3	1	-	-	1	2	2	1	3	1	-	1

Sample Question Paper

Amity Institute Biotechnology 2020-21		
Class: B.Tech. Biotechnology VI Semester		
Subject Name: **Immunology & Immunotechnology**	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Students will learn about amino acids structure and function, Primary, secondary, tertiary and quaternary structure of protein; Motifs and domains of protein structures; Conformational analysis, Protein folding.
- Students will develop an understanding of Architecture and building blocks of proteins. : Evaluate different mechanism of substrate recognition, its structural basis, reaction mechanism of enzymes and G-protein coupled receptors.
- Students will understand the protein denaturation, refolding and stabilization.
- Students will understand structural parameters of DNA molecule understand about the protein-DNA interaction and its mechanism.

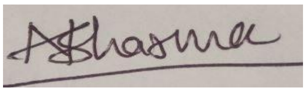
CO Map	Question No.	Question	Marks
CO1	Q.1	What are the salient features of structure of Watson crick model? Explain with diagram.	6

	Q.2	What is CpG dinucleotides? Explain the role of CpG dinucleotide in methylation.	6

CO2			
	Q.3	Explain Anfinsen experiment and discuss the role of different factors in protein stability.	6
CO4	Q.4	Which DNA double helix do you think would be harder to separate into two strands: DNA composed predominantly of AT base pairs, or of GC base pairs? Why?	6
CO4	Q.5	Discuss about the software which is used in visualization of structure of DNA.	6
CO3	Q.6	Discuss the importance of Chaperonins during protein folding with suitable diagram.	6
	Q.7	What is salting-in and salting-out? Explain the importance of precipitation protein in salting-in process.	10
CO4	Q.8	Explain the different types of interactions are involved in protein-DNA recognition	10
CO3	Q.9	What are the four pairs of DNA bases that form in the double helix? Draw the structure of each base.	10
CO3	Q.10	What is protein danaturation? Explain the role of denaturants such as urea and guanidinium hydrochloride in protein denaturation.	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Structural Biology**/Course code ***BTB 503*** is level **2** for the academic year 2020-21.

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MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2020-21

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12		PSO1	PSO2	PSO3	PSO4
	BTB 521	3	3	1	2	-	1	2	-	1	1		1		3	2	-	-
V SEM																		

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ANIMAL BIOTECHNOLOGY LAB
Course Code : BTB 521, Crédits : 03, Session :2020-21 (Odd Sem.), Class : B.Tech. 3rd Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with different techniques in animal biotechnology like , Media preparation, cell culture, subculturing and cytotoxicity assay.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB 521.1. Prepare and sterilize animal cell culture media under aseptic conditions.
BTB 521.2. Inoculate specific cells or tissues for callusing in media
BTB 521.3. Maintain cell culture by subculturing.
BTB 521.4. Perform cytotoxicity test

Programme Outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering

activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

C. **Programme Specific Outcomes:**

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer

programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

D. **Assessment Plan:**

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. **Syllabus**

1. Preparation, standardization and sterilization of culture media
2. Inoculation of specific tissues for callusing
3. Inoculation and maintenance of cell lines
4. Study of toxicity on cell lines

F. **Examination Scheme:**

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

IA			**EE**			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. **Suggested Text/Reference Books:**

- Lab Manual
- Culture of Animal Cells, R.I Freshney, Wiley-Leiss. References:

- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford.
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Basic calculations and preparation of solutions and buffers	Practical	BTB 521.1.	Mid Term-1, Quiz & End Sem Exam
2	Basic calculations and preparation of solutions and buffers	Practical		Mid Term-1, Quiz & End Sem Exam
3	Preparation of cell Culture Media (Natural)	Practical		Mid Term-1, Quiz & End Sem Exam
4	Study of composition and Preparation of cell Culture Media (Artificial)	Practical		Mid Term-1, Quiz & End Sem Exam
5	Method of sterilization of culture media.	Practical	BTB 521.2.	Mid Term-1, Quiz & End Sem Exam
6	Separation of cells from tissue/ and inoculation in culture vessel	Practical		Mid Term-1, Quiz & End Sem Exam
7	Separation of cells from tissue/ and inoculation in culture vessel	Practical		Mid Term-1, Quiz & End Sem Exam
8	Cell separation and Inoculation of specific tissues for callusing	Practical		Mid Term-1, Quiz & End Sem Exam
9	Observation of callus development and data recording	Practical		Mid Term-1, Quiz & End Sem Exam
10	preparations of buffers and stains to Study of toxicity on cell lines MTT assay.	Practical		Mid Term-1, Quiz & End Sem Exam
11	Study of cytotoxicity using MTT assay.	Practical		Mid Term-1, Quiz & End Sem Exam
12	Spot identification /slides	Practical		Mid Term-1, Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			PSO	PSO	PSO	PSO

													1	2	3	4
BTB 521.1.	Prepare and sterilize animal cell culture media under aseptic conditions.	3	3	1	-	-	-	-	-	1	-		**3**	**1**	**-**	**-**
BTB 521.2.	Inoculate specific cells or tissues for callusing in media	3	3	1	-	-	1	2	-	1	-		**3**	**1**	**-**	**-**
BTB 521.3.	Maintain cell culture by subculturing.	3	3	1	1	-	1	1	-	1	-		**3**	**1**	**-**	**-**
BTB 521.4.	Perform cytotoxicity test	3	3	1	2	-	1	-	-	1	-		**3**	**1**	**-**	**-**

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Animal Biotechnology***/Course code ***BTB 521*** is level **3** for the academic year ***2020-21***.


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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
V	BTB 522	3	3	3	1	-	-	1	2	2	1	3	1	-	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : STRUCTURAL BIOLOGY LAB
Course Code : BTB 522, Crédits : 01, Session :2020-21(Odd Sem.), Class : B.Tech 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe physical properties of protein, analysis of protein structure, protein finger printing, fraction folding and degradation.

B. **Course Outcomes:** After successful completion of the course student will be able to:

BTB 522.1. Experimental Understanding of physical properties of protein, analysis of protein structure, finger printing, protein fractionation.
BTB 522.2. Understand the mechanism of protein folding and degradation through experiments.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced engineering and technology for understanding and improvement of biological research. PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic and applied sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and

other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Course Contents:

1. Study of physical properties of proteins. **(02 Hours)**
2. Analysis of protein structure.
3. Study of protein finger printing
4. Study of protein fractionation
5. Study of protein folding
6. Study of protein degradation.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Practical based on online available softwares.

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**
1	Study of physical properties of proteins.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
2	Study of physical properties of proteins.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
3	Analysis of protein structure.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
4	Analysis of protein structure.	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
5	Study of protein finger printing	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
6	Study of protein finger printing	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
7	Study of protein fractionation	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam

8	Study of protein fractionation	Practical	**BTB 522.1**.	Mid Term-1, Quiz & End Sem Exam
9	Study of protein folding	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam

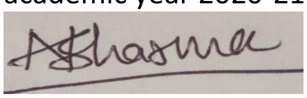
10	Study of protein folding	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam
11	Study of protein degadation.	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam
12	Study of protein degadation.	Practical	**BTB 522.2**	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 522.1.	Experimental Understanding of physical properties of protein, analysis of protein structure, finger printing, protein fractionation	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 522.2.	Understand the mechanism of protein folding and degradation through experiments	3	3	3	1	-	-	1	2	2	1	3	1	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Structural Biology Lab*** Course code ***BTB 522*** is level **3** for the academic year 2020-21.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
VI	BTB 603	3	3	3	1	-	-	1	2	2	1	3	3	3	1	-	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : IMMUNOLOGY AND IMMUNOTECHNOLOGY
Course Code : BTB 603, Crédits : 04, Session :2020-21(Even Sem.), Class : B.Tech. 3rd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. Course Outcomes : After successful completion of the course student will be able to:

- **BTB 603.1**. Understand the phylogeny of immune system, types of immunity and immune response.
- **BTB 603.2**. Understand the organization and structure of lymphoid organs and immune cells
- **BTB 603.3**. Understand and explain the concept of antibody and antigen.
- **BTB 603.4**. Understand and explain the concept and types of hypersensitivity and vaccination.
- **BTB 603.5**. Understand the mechanism of autoimmune disorders, transplantation and immune response against tumor.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

1. PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess

societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

7. PO7. Environment and sustainability: Understand the impact of the professional engineering

solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

9. PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leavesincluding medical leaves.	A	5%

End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Introduction

Phylogeny of Immune System, Innate and acquired immunity, clonal nature of Immune Response. Organization and structure of lymphoid organs Nature and Biology of antigens and super antigens Antibody structure and function; Types of immunity- innate, acquired, active and passive.

Module II: Major Histocompatibilty

MHC, BCR and TCR, generation of antibody diversity, Complement system

Module III: Cells of the immune system

Hematopoiesis and differentiation, lymphocyte trafficking, B-Lymphocytes, T -Lymphocytes, macrophages, dendritic cells, natural killer, lymphokines and lymphokine activated killer cells, eosinophils, neutrophils and mast cells

Module IV: Regulation of immune response

Antigen processing and presentation, activation of B and T lymphocytes, cytokines and their role in immune regulation, T cell regulation and MHC restriction, immunological tolerance

Module V: Cell mediated toxicity

Mechanism of T cell and NK cell mediated lysis and macrophage mediated cytotoxicity.

Module VI: Hypersensitivity

Module VII: Autoimmunity

Module VIII: Tumor immunology, Immunity to infectious agents

Module IX: Transplantation Immunology

Module X: Synthetic vaccines

Vaccines: General consideration, ideotype network hypothesis, Synthetic vaccines

Module XI: Hnmunological Techniques

Immuno diffusion, immuno-electrophoresis, ELISA, RIA, fluorescence activated cell sorter

Module XII: Hybridoma technology and its applications

Fusion of myeloma cells with lymphocytes

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

Text:

- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company

References:

- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).

- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.
- Immunology, Roitt, Mosby – Yearbook Inc.
- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Free

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Phylogeny of Immune System, Innate and acquired immunity,	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
2	Phylogeny of Immune System, Innate and acquired immunity	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
3	Clonal nature of Immune Responses	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
4	Clonal nature of Immune Responses	Lecture	BTB 603.1	Mid Term-1, Quiz & End Sem Exam
5	Organization and structure of lymphoid organs	Lecture	BTB 603.2	Mid Term-1, Quiz & End Sem Exam
6	Organization and structure of lymphoid organs	Lecture	BTB 603.2	Mid Term-1, Quiz & End Sem Exam
7	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
8	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
9	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
10	Nature and Biology of antigens and super antigens	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
11	Antibody structure and function; Types of immunity- innate, acquired, active and passive.	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
12	Antibody structure and function; Types of immunity- innate, acquired, active and passive	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
13	Antibody structure and function	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
14	Antibody structure and function	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
15	Types of immunity- innate, acquired, active and passive	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
16	MHC	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
17	BCR	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
18	TCR	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
19	Generation of antibody diversity	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam
20	Generation of antibody diversity	Lecture	BTB 603.3	Mid Term-1, Quiz & End Sem Exam

21	Complement system	Lecture	BTB 603.3	Quiz & End Sem Exam
22	Complement system	Lecture	BTB 603.3	Quiz & End Sem Exam

23	Hematopoiesis and differentiation, lymphocyte trafficking,	Lecture	BTB 603.3	Quiz & End Sem Exam
24	B-Lymphocytes,	Lecture	BTB 603.3	Quiz & End Sem Exam
25	T -Lymphocytes,	Lecture	BTB 603.3	Quiz & End Sem Exam
26	Macrophages, dendritic cells, natural killer	Lecture	BTB 603.3	Quiz & End Sem Exam
27	lymphokines and lymphokine activated killer cells,	Lecture	BTB 603.3	Quiz & End Sem Exam
28	NK cells	Lecture	BTB 603.3	Quiz & End Sem Exam
29	Eosinophils, neutrophils and mast cells	Lecture	BTB 603.3	Quiz & End Sem Exam
30	Antigen processing and presentation,	Lecture	BTB 603.3	Quiz & End Sem Exam
31	activation of B and T lymphocytes,	Lecture	BTB 603.3	Quiz & End Sem Exam
32	cytokines and their role in immune regulation,	Lecture	BTB 603.3	Quiz & End Sem Exam
33	T cell regulation and MHC restriction, immunological tolerance	Lecture	BTB 603.3	Quiz & End Sem Exam
34	Mechanism of T cell and NK cell mediated lysis and macrophage mediated cytotoxicity.	Lecture	BTB 603.3	Quiz & End Sem Exam
35	Mechanism of T cell and NK cell mediated lysis and macrophage mediated cytotoxicity.	Lecture	BTB 603.3	Quiz & End Sem Exam
36	Hypersensitivity	Lecture	BTB 603.4	Quiz & End Sem Exam
37	Hypersensitivity	Lecture	BTB 603.4	Quiz & End Sem Exam
38	Autoimmunity	Lecture	BTB 603.4	Quiz & End Sem Exam
39	Autoimmunity	Lecture	BTB 603.4	Quiz & End Sem Exam
40	Tumor immunology	Lecture	BTB 603.4	Quiz & End Sem Exam
41	Immunity to infectious disease	Lecture	BTB 603.4	Quiz & End Sem Exam
42	Transplantation	Lecture	BTB 603.4	Quiz & End Sem Exam
43	Transplantation	Lecture	BTB 603.4	Quiz & End Sem Exam
44	Vaccines: General consideration, ideotype network hypothesis, Synthetic vaccines	Lecture	BTB 603.4	Quiz & End Sem Exam
45	Immuno diffusion, immuno-electrophoresis,	Lecture	BTB 603.5	Quiz & End Sem Exam
46	ELISA, RIA, fluorescence activated cell sorter	Lecture	BTB 603.5	Quiz & End Sem Exam
47	Hybridoma technology and its applications Fusion of myeloma cells with lymphocytes	Lecture	BTB 603.5	Quiz & End Sem Exam

48	Hybridoma technology and its applications Fusion of myeloma cells with lymphocytes	Lecture	BTB 603.5	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
BTB 603.1.	Understand the phylogeny of immune system, types of immunity and immune response.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.2.	Understand the organization and structure of lymphoid organs and immune cells	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.3.	Understand and explain the concept of antibody and antigen.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.4.	Understand and explain the concept and types of hypersensitivity and vaccination.	3	3	3	1	-	-	1	2	2	1	3	1	-	1
BTB 603.5.	Understand the mechanism of autoimmune disorders, transplantation and immune response against tumor.														

Sample Question Paper

Amity Institute Biotechnology
2020-21

Class: B.Tech. Biotechnology

VI Semester

Subject Name: **Immunology & Immunotechnology**	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand and explain the phylogeny of immune system, types of immunity, immune response.
- Describe the concept of clonal selection theory, humoral and cell mediated immunity.
- Understand and explain the structure and functions of the organs and cells of the immune system.
- Understand the mechanism of antigen-antibody interaction.
- Describe the structure of antibodies, their types and functions in immunity.

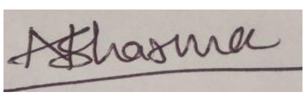
CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about innate and adaptive immunity. Discuss about the different types of innate immunity with characters.	6
CO2	Q.2	Write a note on different phases of cytotoxic cell mediated targeting killing mechanism.	6
	Q.3	Write a general organization of class I and class II MHC molecules with suitable diagram.	6
CO4	Q.4	Discuss the role of IgG immunoglobulin in immune system.	6
CO4	Q.5	What is antibody diversity? Discuss the role of light chain gene rearrangement in antibody diversity.	6
CO3	Q.6	Draw a well labeled diagram of hybridoma technology with production of monoclonal antibody.	6
	Q.7	Discuss the role of innate and adaptive immunity in tissue grafting. Explain with suitable example.	10
CO4	Q.8	Give a comparison between all type of vaccine with examples and applications.	10

CO3	Q.9	Discuss about features of any two primary lymphoid organs with suitable diagram	10

CO3	Q.10	A. Although all lymphocytes are formed in bone marrow. Explain how these cells get differentiated into B cell and T cell. B Where the CDR regions located on an antibody molecule and what are are their functions? Discuss the ELISA method on the basis of antigen and antibody interaction.	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Immunology and immunotechnology**/Course code ***BTB 603*** is level **2** for the academic year 2020-21.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR

AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year 2020-21

		PROGRAMME ARTICULATION MATRIX														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3
VI SEM	BTB620	3	3	1	2	-	-	-	1	2	1	3	1	3	1	1

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High) If there is no correlation, put "- "

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : Immunology and immunotechnology Lab
Course Code : BTB 622, Crédits : 01, Session: 2020-21(Even Sem.), Class : B.Tech. IIIrd Year
Faculty Name : (Dr.) Neha Sharma

A. **Introduction:** Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. **Course Outcomes :** After successful completion of the course student will be able to:

- **BTB 603.1**. Understand the phylogeny of immune system, types of immunity and immune response.
- **BTB 603.2**. Understand the organization and structure of lymphoid organs and immune cells
- **BTB 603.3**. Understand and explain the concept of antibody and antigen.
- **BTB 603.4**. Understand and explain the concept and types of hypersensitivity and vaccination.
- **BTB 603.5**. Understand the mechanism of autoimmune disorders, transplantation and immune response against tumor.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

1. PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess

societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

7. PO7. Environment and sustainability: Understand the impact of the professional engineering

solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
9. PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%

End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. Syllabus

Course Contents:

1. Purification of immunoglobin G.
2. Study of antigen- antibody pattern (ODD).
3. Study of sandwich ELISA.
4. Study of haemeagglutination.
5. Study of immunoelectrophoresis.
6. Isolation and identification of rosette cells.
7. Antigen capture ELISA

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;

A: Attendance

H. Suggested Text/Reference Books:

- Manual of Molecular and Clinical Laboratory Immunology, 8th Edition Barbara Detrick (Editor), John L. Schmitz (Editor), Robert G. Hamilton (Editor) ISBN: 978-1-555-81871-5 May 2016 ASM Press
- Immunology Laboratory Manual Published by LAP LAMBERT Academic Publishing (2018) ISBN 10: 6138386175 ISBN 13: 9786138386179

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Purification of Immunoglobulin G	Lecture	**MSB 320.1**	Mid Term-1, Quiz & End Sem Exam
2	Radial Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
3	Double Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
4	Study of sandwich ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
5	Study of DOT ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
6	Study of heamagglutination (Blood group)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
7	Rh factor determination	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
8	Study of heamagglutination (Widal test)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
9	Study of immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
10	Study of rocket immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
11	Isolation and identification of rostte cells	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
12	Revision and discussion	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4

MSB 320.1	Demonstrate detailed knowledge of purification of immunoglobulin, cells and antigen antibody	3	3	3	1	1	-	-	1	2	1	3	1	3	1

	interaction.														
MSB 320.2	Apply knowledge and incorporate experimental understanding of the agglutination mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 320.3	Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

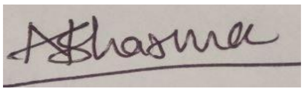
<table>
<tr><td colspan="7">Amity Institute Biotechnology
2020-21</td></tr>
<tr><td colspan="7">Class: B.Tech Biotechnology
VI Semester</td></tr>
<tr><td colspan="2">Subject Name: Advanced Immunology Lab</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.3 & Q.4</td><td>Q.1</td><td></td><td>Q.2</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to:
• Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
• Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
• Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
• the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.</td></tr>
</table>

CO Map	Question No.	Question	Marks
C	Q.1	Perform Dot Elisa for detection of antigen-antibody interaction.	35

O 1			
C O 2	Q.2	Perform hemagglutination (Blood group) test.	15
	Q.3	*Viva-voce*	10
C O 3	Q.4	Record	10

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Immunology and immunotechnology Lab***/Course code ***BTB 622*** is level **3** for the academic year 2020-21.




AMITY INSTITUTE OF BIOTECHNOLOGY
AUUP

Sample Question Paper

Amity School of Engineering and Technology Department of Computer Science and Engineering I MID-SEMESTER (SEM –VII) 2021-22
Class: B.Tech.(CSE) VII Semester

Subject Name: CSE 703 CLOUD COMPUTING	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

Student will be able to
CO1: List the broad perceptive of cloud architecture and model.
CO2: Apply different cloud programming models as per need.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the cloud computing concept.	3
CO1	Q.2a	What are the essential characteristics of cloud computing?	3
	Q.2b	How is cloud computing requirements and cloud servicerequirement services related to each other?	3
CO1	Q.3	Sketch NIST Cloud Computing Reference Architecture and depictits elements	6
CO2	Q.4	Explain the significance of Cloud Reference Model	3
CO2	Q.5a	Elaborate different cloud types with example.	3
	Q.5b	Write characteristics of private cloud.	3
CO2	Q 6	How virtualization is applied in cloud computing scenario?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2020-21

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge

to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
VII SEM	BTB 701	3	2	2	1	1	1	1	-	1	2	1	-	3	2	-	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOPROCESS TECHNOLOGY
Course Code : BTB 701, Crédits : 03, Session :2020-21 (Odd Sem.), Class : B.Tech. 4th Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques in bioprocess technology. The objective of the course is to apply the principles of biochemical engineering in large scale cultivation of microorganism for production of important products. The present course will make them competent academically to envisage the different problems.

B. Course Outcomes: At the end of the course, students will be able to:

BTB 701.1. Understand Concepts of bioprocess technology the advantages of biochemical processes and its conventions.
BTB 701.2. Develop skill of process technology for ethanol, amino acids and biomass production.
BTB 701.3. Gain understanding of production of secondary metabolites and antibiotics.
BTB 701.4. Get knowledge of industrial production of commercially important enzymes.

C. Programme Outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and

environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and

research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial

biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Advantage of bioprocess over chemical process. Basic principle in bioprocess technology. Media formulation, Cell culture techniques; Inoculum development and aseptic transfers. Different types of pumps, valves, and line materials, piping conventions etc. used in Biochemical Process

Module II

Process technology for the production of primary metabolites, eg. Biomass, ethanol, acetone-butanol, citric acid, amino acids, polysaccharides and plastics.

Ethanol: production by batch, continuous and cell recycle adopted by various technologies practiced in Indian distilleries using molasses and grains. Computation of fermentation efficiency, distillation efficiency and overall efficiency of ethanol production, recovery, uses, glucose effect etc. Power alcohol – definition, uses, merits and demerits of various technologies for its production.

Amino Acid: Genetic Control of metabolic pathway.

Lysine: Indirect and direct fermentation – mechanism of ph of metabolic block in accumulation of L-

lysine by inhibition and repression mechanism.

Biomass: Bakers and distillers yeast production using various raw materials, “bios” factors for growth, Crabtree effect, harvesting, different forms and uses.

What are mushroom, different forms of common mushroom production from agro based raw materials and uses. Biofertilizers, biocompost and biopesticides

Module III

Production of secondary metabolites – penicillin, cephalosporins, streptomycin, tetracycline etc. Metabolites from plant and animal cell culture

Penicillin: Classification, various penicillin as precursor and 'R' – side chain, penicillinase, 6-APA, penicillin production, harvest and recovery, uses of various forms etc.

Streptomycin: chemical structure, production, harvest and recovery, use by-product of streptomycin fermentation etc.

Tetracycline: chemical structure, production, harvest and recovery, use by-product of tetracycline fermentation etc.

Module IV

Microbial production of industrial enzymes – glucose isomerase, penicillin acylase, cellulase, amylase, lipase, protease etc.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Biochemical Engineering- Kinetics, Mass Transport, Reactors and Gene Expression, W F Weith, John Wiley and Sons Inc
- Biochemical Engineering, S Aiba, A E Humphery and N F Millis, University of Tokyo Press
- Bioprocess Engineering Basic Concepts, M.L. Shuler and F. Kargi, Prentice Hall
- Bioprocess Engineering, B.K. Lydersen, K.L. Nelson, B.K. Lyderson and N. D'Elia, John Wiley and Sons Inc.
- Bioprocess Engineering Principles, P Doran, Academic Press
- Biotechnology. A Textbook of Industrial Microbiology, W. Crueger and a. Crueger, Sinauer Associates.
- Principles of Fermentation Technology, P.F. Stanbury and A. Whitaker, Pergamon Press
- Process Engineering in Biotechnolgy, A T Jackson , Prentice Hall

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Advantage of bioprocess over chemical process. Basic principle in bioprocess technology.	Lecture	BTB 701.1.	Mid Term-1, Quiz & End Sem Exam
2	Techniques; Inoculum development and aseptic transfers.	Lecture		Mid Term-1, Quiz & End Sem Exam

3	Different types of pumps, valves, and line materials, piping conventions etc.	Lecture		Mid Term-1, Quiz & End Sem Exam

4	Different types of pumps, valves, and line materials, piping conventions etc.	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Ethanol: production by batch, continuous and cell recycle adopted by various technologies	Lecture	BTB 701.2.	Mid Term-1, Quiz & End Sem Exam
6	Ethanol: production by batch, continuous and cell recycle adopted by various technologies	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Power alcohol – definition, uses, merits and demerits of various technologies for its production.	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Power alcohol – definition, uses, merits and demerits of various technologies for its production.	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Amino Acid: Genetic Control of metabolic pathway.	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Lysine: Indirect and direct fermentation – mechanism of ph of metabolic block in accumulation of L- lysine by inhibition and repression mechanism.	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Lysine: Indirect and direct fermentation – mechanism of ph of metabolic block in accumulation of L- lysine by inhibition and repression mechanism.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Biomass: Bakers and distillers yeast production using various raw materials,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Biomass: Bakers and distillers yeast production using various raw materials,	Lecture		Mid Term-1, Quiz & End Sem Exam
14	What are mushroom, different forms of Mushrooms	Lecture		Mid Term-1, Quiz & End Sem Exam

15	common mushroom production from agro based raw materials and uses	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Biofertilizers, biocompost	Lecture		Mid Term-1, Quiz

				& End Sem Exam
17	Biopesticides	Lecture		Mid Term-1, Quiz & End Sem Exam
18	Production of secondary metabolites – penicillin,	Lecture	BTB 701.3.	Quiz & End Sem Exam
19	Production of secondary metabolites – cephalosporins,	Lecture		Quiz & End Sem Exam
20	Production of secondary metabolites – streptomycin	Lecture		Quiz & End Sem Exam
21	Production of secondary metabolites – tetracyclin	Lecture		Quiz & End Sem Exam
22	Metabolites from plant and animal cell culture	Lecture		Quiz & End Sem Exam
23	Penicillin: Classification, various penicillin as precursor and „R? – side chain,	Lecture		Quiz & End Sem Exam
24	penicillinase, 6-APA, penicillin production,	Lecture		Quiz & End Sem Exam
25	Harvest and recovery, uses of various forms etc	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Streptomycin: chemical structure, production, harvest and recovery, use by-product of streptomycin fermentation etc.	Lecture		Quiz & End Sem Exam
27	Production, harvest and recovery, use by-product of tetracycline fermentation etc.	Lecture		Quiz & End Sem Exam
28	Tetracycline: chemical structure, production, harvest and recovery, use by-product of tetracycline fermentation etc.	Lecture		Quiz & End Sem Exam
29	Tetracycline: chemical structure, production, harvest and recovery, use	Lecture		Quiz & End Sem Exam
30	Tetracycline: chemical structure, production, harvest and recovery, use	Lecture		Quiz & End Sem Exam
31	Microbial production of industrial enzymes –	Lecture	BTB 701.4.	Quiz & End Sem Exam
32	Microbial production of industrial enzymes – glucose isomerase,	Lecture		Quiz & End Sem Exam

33	Microbial production of industrial enzymes –			Quiz & End Sem Exam

	Penicillin acylase,			
34	Microbial production of industrial enzymes – cellulase, amylase, lipase, protease etc.	Lecture		Quiz & End Sem Exam
35	Microbial production of industrial enzymes – cellulase, amylase, lipase, protease etc.	Lecture		Quiz & End Sem Exam
36	Microbial production of industrial enzymes – cellulase, amylase, lipase, protease etc.	Lecture		Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
BTB 701.1.	Understand Concepts of bioprocess technology the advantages of biochemical processes and its conventions.	3	2	-	2	-	1	-	-	1	-	-	3	2	-	-
BTB 701.2.	Develop skill of process technology for ethanol, amino acids and biomass production.	3	2	1	1	-	1	-	-	1	-	-	3	2	-	-

BTB 701.3.	Gain understanding of production of secondary metabolites and antibiotics.	3	2	1	1	-	1	-	-	-	-	-	3	2	-	-

BTB 701.4.	Get knowledge of industrial production of commercially important enzymes.	3	2	1	1	-	1	-	-	1	-	-	3	2	-	1

<u>Sample Question Paper</u>

Amity Institute Biotechnology 2020-21						
Class: B.Tech.Biotechnology VII Semester						
Subject Name: BIOPROCESS TECHNOLOGY		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,2	Q.3,4	Q.,5,6	Q.9,7	Q. 8,10	
Student will be able to:						

CO Map	Question No.	Question	Marks
CO1	Q.1	Write a short note on crabtree effect.	6
CO2	Q.2	*Discuss* basic principles and applications of bioprocess technology.	6
	Q.3	Differentiate between primary metabolites and secondary metabolites with suitable example	6
CO2	Q.4	Define the term Auxotrophs. Name the bacterial auxotrophs used in L-lysin production.	6
CO3	Q.5	What is penicillin? Explain the mode of action and target site of Penicillin.	6
	Q.6	Write a short note on ion exchange chromatography for product recovery	6

CO4	Q.7	Discuss the process of Industrial production of the following enzymes. (a) Glucose Isomerase. (b) Amylase.	10

CO2	Q.8	Discuss the Different forms Mushrooms production methods using various substrates.	10
CO3	Q.9	Discuss the process of media formulation. Why it is very for fermentation process	10
CO4	Q.10	Discuss the following in details (a) Indirect method of large scale production of L-Lysine amino acid (b) Discuss the industrial production of tetracycline antibiotic using solid state fermentation.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioprocess Technology***/Course code ***BTB 701*** is level **3** for the academic year ***2020-21***.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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR

AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2020-21

B.Tech. Biotechnology (Eight Semesters)

Programme Outcomes:

PROGRAMME OUTCOMES OF B.TECH. BIOTECHNOLOGY

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge

to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “

PROGRAMME ARTICULATION MATRIX																		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3	PSO 4
VII SEM	BTB 708	1	2	3	3	2	1	3	1	-	1	1	1	-	3	2	-	1
																-	-	-
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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL BIOTECHNOLOGY
Course Code : BTB 708, Crédits : 03, Session :2020-21 (Odd Sem.), Class : B.Tech. 4th Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in environmental biotechnology. Environment constitutes one of the most important ingredients because of the global problems. Thus, it is imperative to understand the Bioremeditation of different components of environment. The present course will make them competent academically to envisage the different problems.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB 708.1. Understand Concepts of Ecology and ecosystem.
BTB 708.2. Understand environmental components and their delicate interrelationship and pollutions.
BTB 708.3. Learn concepts of waste water treatment using biotechnological interventions.
BTB 708.4. Understand the concept and theory of solid waste disposal methods.
BTB 708.5. Understand microbial role in bioremediation of various xenobiotic.
BTB 708.6. Build up understanding the mechanism of microbial leaching and mining of metals from
BTB 708.7. Understand Wasteland management uses and biorestoration
BTB 708.8. Understand environmental genetics especially release of genetically engineered microbes in environment.
BTB 708.9. Understand Hazardous wastes their source , management and safety.

C. **Programme Outcomes:**

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with

appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology,

structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology,

biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. **Syllabus**

Module I: Introduction

Ecology and ecosystem.

Module II: Environmental pollution

Water, soil and air, noise and thermal pollution, their sources and effects.

Module III: Waste water (sewage and industrial effluents) treatments

Anaerobic and aerobic treatment, conventional and advanced treatment technology, methanogenesis, methanogenic, acetogenic, and fermentative bacteria- technical process and conditions, emerging biotechnological processes in waste - water treatment.

Module IV: Solid waste management

Landfills, composting, earthworm treatment, recycling and processing of organic residues.

Module V: Biodegradation

Biodegradation of xenobiotic compounds, organisms involved in degradation of chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants and microbial treatment of oil pollution

Module VI: Microbial leaching and mining

Microbial leaching and mining: Extraction of metals from ores; Recovery of metals from solutions; Microbes in petroleum extraction; Microbial desulfurization of coal.

Module VII: Wasteland

Wasteland: Uses and management, bioremediation and biorestoration of contaminated lands.

Module VIII:Environmental genetics

Environmental genetics: degradative plasmids, release of genetically engineered microbes in environment.

Module IX: Hazardous wastes

Hazardous wastes: source management and safety.

G. **Examination Scheme:**

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. **Suggested Text/Reference Books:**

- Environmental Biotechnology by PK Mohapatra
- Comprehensive Biotechnology (Vol. 1-4): M.Y.Young (Eds.), Pergamon Press, Oxford.
- Environmental Microbiology: W.D. Grant & P.E. Long, Blakie, Glassgow and London.
- Microbial Gene Technology: H. Polasa (ED.) South Asian Publishers, New Delhi.
- BiotreatmentSystems, Vol.22, D. L. Wise (Ed.), CRCPress, INC.
- Standard Methods for the Examination of Water and Waste Water (14th Education), 1985. American Public health Association.

I. **Lecture Plan**

Lecture	**Topics**	**Mode of Delivery**	**Correspon ding CO**	**Mode of Assessing CO**

1	Broad outline of Ecology	Lecture	BTB 708.1.	Mid Term-1, Quiz & End Sem Exam
2	Components of Ecology	Lecture		Mid Term-1, Quiz

				& End Sem Exam
3	Components of Ecosystem	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Types of Ecosystem	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Water pollution and its sources and effects	Lecture	BTB 708.2.	Mid Term-1, Quiz & End Sem Exam
6	Soil pollution and its sources and effects	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Air pollution and its sources and effects	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Noise and Thermal Pollution and their sources and effects.	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Waste-water and sewage water treatment- An overview	Lecture	BTB 708.3.	Mid Term-1, Quiz & End Sem Exam
10	Methods of sewage water treatment	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Role of Methanogenic, Acetogenic and fermentative bacteria in waste water treatment.	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Emerging biotechnological approaches in waste - water treatment.	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Solid wastes, origin sources and types	Lecture	BTB 708.4.	Mid Term-1, Quiz & End Sem Exam
14	Solid waste management: Composting, earthworm treatment.	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Solid waste management: Landfills and their impact	Lecture		Mid Term-1, Quiz & End Sem Exam
16	Solid waste management :Recycling and processing of organic residues.	Lecture		Mid Term-1, Quiz & End Sem Exam
17	Xenobiotic compounds: An overview	Lecture	BTB 708.5.	Quiz & End Sem Exam
18	Biodegradation of xenobiotic compounds:	Lecture		Quiz & End Sem Exam
19	Biodegradation of xenobiotic compounds:	Lecture		Quiz & End Sem Exam
20	Microbial Biosurfactants	Lecture		Quiz & End Sem Exam
21	Microbial bio degradation of Oil :	Lecture		Quiz & End Sem Exam

22	Microbial treatment of oil pollution	Lecture		Quiz & End Sem Exam
23	Microbial leaching and mining:	Lecture	BTB 708.6.	Quiz & End Sem Exam

	Extraction of metals from ores.			
24	Microbial leaching and mining: Mechanism and methods	Lecture		Quiz & End Sem Exam
25	Microbial leaching and mining: Mechanism and methods	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Microbes in petroleum extraction;	Lecture		Quiz & End Sem Exam
27	Microbes in petroleum extraction;	Lecture		Quiz & End Sem Exam
28	Microbes in petroleum extraction;	Lecture		Quiz & End Sem Exam
29	Microbial desulfurization of coal.	Lecture		Quiz & End Sem Exam
30	Wasteland: Uses and management,	Lecture	BTB 708.7.	Quiz & End Sem Exam
31	Bioremediation and biorestoration of contaminated lands.	Lecture		Quiz & End Sem Exam
32	Bioremediation and biorestoration of contaminated lands.	Lecture		Quiz & End Sem Exam
33	Environmental genetics: Degradative Plasmids	Lecture	BTB 708.8.	Quiz & End Sem Exam
34	Environmental genetics: GE microbes and environment	Lecture		Quiz & End Sem Exam
35	Hazardous wastes: characteristics and types	Lecture	BTB 708.9.	Quiz & End Sem Exam
36	Hazardous wastes: characteristics and types	Lecture		Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4

BTB 708.1.	Understand Concepts of Ecology and ecosystem.	3	2	2	3	1	-	-	3	-	-	-	3	2	-	1

BTB 708.2.	Understand environmental components and their delicate interrelationship and pollutions.	3	2	2	3	1	-	-	3	-	-	-	3	2	-	1
BTB 708.3.	Learn concepts of waste water treatment using biotechnological interventions.	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.4.	Understand the concept and theory of solid waste disposal methods	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.5.	Understand microbial role in bioremediation of various xenobiotic.	3	2	2	3	1	1	-	3	-	-	-	3	2	-	1
BTB 708.6.	Build up understanding the mechanism of microbial leaching and mining of metals from ores.	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.7.	Understand Wasteland management uses and biorestoration	3	2	2	3	1	2	-	3	-	-	-	3	2	-	1
BTB 708.8.	Understand environmental genetics especially release of genetically engineered microbes in environment	3	2	**2**	3	1	2	-	3	-	-	-	3	2	-	1

BTB 708.9.	Understand Hazardous wastes their source ,	3	2	2	1	1	2	-	3	-	-	-	3	2	-	1

	management and safety.															

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2020-21</td></tr>
<tr><td colspan="7">Class: B.Tech Biotechnology
VII Semester</td></tr>
<tr><td colspan="2">Subject Name: ENVIRONMENTAL BIOTECHNOLOGY</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,6</td><td>Q.2,4</td><td>Q.3,5,7</td><td>Q.9,</td><td>Q. 8,10</td><td></td></tr>
<tr><td colspan="7">Student will be able to:</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	What is Ecosystem? Briefly point out its vital components.	6
CO2	Q.2	Write a short note on acid rain and its impact on old monuments.	6
	Q.3	Write a short note on vermicomposting. How it is useful in agricultural sustainability?	6
CO4	Q.4	Explain the following terms with suitable example (i) Rhizofilteration (ii) Phytoextraction	6
CO3	Q.5	Write a short note on genetically engineered microbes in bioremediations and their limitations.	6
CO6	Q.6	Give brief description of characteristic features of hazardous wastes.	6
	Q.7	Write explanatory note on main stages of sewage water treatment. How biotehnological interventions offers better solution over conventional approach?	10

CO7	Q.8	microbial enhanced oil recovery (MEOR), briefly explain the microbial products and their e in enhanced petroleum oil extraction. Enlist the key factors affecting MEOR.	10

CO9	Q.9	in-situ bioremediation. Explain the following in context of in-situ bioremediation of land tic Bioagumentation (ii) Biostimulation (iii) Biosparging	10
CO4	Q.10	Explain the following in details a) What is microbial desulfurization of coal? Discuss the methods of coal desulphurization and its beneficial effect on air pollution. b) Discuss the role of microbial enzymes in pesticides and PAHs degradation.	20

Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental Biotechnology***/Course code ***BTB 708*** is level **3** for the academic year ***2020-21***.


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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) BT, Academic Year – 2020-21

Programme Outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the

knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
VII SEM	BTB 720	3	2	3	3	1	-	-	1	1	-		3	3	-	2

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOPROCESS TECHNOLOGY LAB
Course Code : BTB 720, Crédits : 01, Session :2020-21 (Odd Sem.), Class : B.Tech. 4th Year
Faculty Name : Dr. Raghvendra Saxena

A. **Introduction:** The objective of this course is to familiarize the students with applications and techniques in bioprocess technology. The objective of the course is to provide laboratory exposure and hands on experiments to produce large scale cultivation of microorganism, production of important commercial pharmaceutical products through fermentation like., ethanol, enzymes etc.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB 720.1. Isolate and cultivate of industrially important microorganisms for microbial processes.
BTB 720.2. Perform and standardization of fermentation procedure for ethanol production.
BTB 720.3. Produce single cell protein product as well as enzymes.
BTB 720.4. Perform immobilization of enzymes or cells and Sauer Krant fermentation processes.

C. **Programme Outcomes:**

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and

synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class test (practical based)	CT	15%
	Mid term-Viva-Voce	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Isolation of industrially important micro organisms for microbial processes.

Module II: Determination of Thermal Death Point and Thermal death time of micro organisms for design of a sterilizer

Module III: Determination of growth curve of a supplied micro organism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.

Module IV: Comparative studies of ethanol production using different substrates.

Module V : Production of single cell protein

Module VI: Production and estimation of alkaline protease

Module VII: Sauer Krant fermentation

Module VIII: Use of alginate for cell immobilization

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**

Weightage (%)	5	15	10	70

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Bioprocess Engineering Principles, P Doran, Academic Press
- Biotechnology. A Textbook of Industrial Microbiology, W. Crueger and a. Crueger, Sinauer Associates.
- Principles of Fermentation Technology, P.F. Stanbury and A. Whitaker, Pergamon Press
- Process Engineering in Biotechnolgy, A T Jackson , Prentice Hall

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Isolation of industrially important microorganisms for microbial processes.	Practical	BTB 720.1.	Class test Mid Term Viva/ End Sem Exam
2	Determination of Thermal Death Point and Thermal death time of micro organisms for design of a sterilizer	Practical		Class test Mid Term Viva/ End Sem Exam
3	Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.	Practical		Class test Mid Term Viva/ End Sem Exam
4	Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.	Practical		Class test Mid Term Viva/ End Sem Exam

5	Comparative studies of ethanol production using different substrates.	Practical	BTB 720.2.	Class test Mid Term Viva/ End Sem Exam

6	Comparative studies of ethanol production using different substrates.	Practical		Class test Mid Term Viva/ End Sem Exam
7	Comparative studies of ethanol production using different substrates.	Practical		Class test Mid Term Viva/ End Sem Exam
8	Production of single cell protein	Practical	BTB 720.3.	Class test Mid Term Viva/ End Sem Exam
9	Production and estimation of alkaline protease	Practical		Class test Mid Term Viva/ End Sem Exam
10	Sauer Krant fermentation	Practical	BTB 720.4.	Class test Mid Term Viva/ End Sem Exam
11	Use of alginate for cell immobilization	Practical		Class test Mid Term Viva/ End Sem Exam
12	Use of alginate for cell immobilization	Practical		Class test Mid Term Viva/ End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
BTB 720.1.	Isolate and cultivate of industrially important microorganisms for microbial processes.	3	2	3	3	1	-	-	1	1	-		3	3	-	1

BTB 720.2.	Perform and standardization of fermentation procedure for ethanol production.	3	2	3	3	1	-	-	-	-	-		3	3	-	1

BTB 720.3.	Produce single cell protein product as well as enzymes.	3	2	2	3	1	-	-	-	-	-		3	3	-	1
BTB 720.4.	Perform immobilization of enzymes or cells and Sauer Krant fermentation processes.	3	2	3	2	1	-	-	-	-	-		3	3	-	1

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioprocess Lab***/Course code ***BTB 720*** is level **3** for the academic year ***2020-21***.


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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY
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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY-I
Course Code : BTB-302 Credits: 03, Session :2021-22 (Odd Sem.), Class : B. Tech. 2^{nd} Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

B. Course Outcomes: At the end of the course, students will be able to:

BTB302.1. Learn about chemical interactions in biological system.

BTB302.2. Develop the understanding between structure and function of carbohydrates & lipids.

BTB302.3. Learn the concept of metabolism and energy involved in metabolic pathways.

BTB302.4. Understand the metabolic pathways and regulations of carbohydrates metabolism.

BTB302.5. Learn about the digestion, transport, anabolism and catabolism of lipids in the body.

C. Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and

norms of engineering practices.
[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in

diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction aims and scope

Chemical foundations of Biology -Properties of water, acids, bases and buffers, covalent bonds, Non-covalent interactions in biological systems.

Module II

Introduction to biomolecules - *Carbohydrates* -Sugars; Polysaccharides

Lipids -classification, structure and function. Lipids and biological membranes, Lipid linked proteins and lipoproteins, Atherosclerosis.

Module III

Metabolism and bioenergetics -First and second law, free energy and chemical equilibrium, Organic reaction mechanisms, Design of metabolism-concept of free energy, ATP-ADP cycle. Cellular energy transactions -role of mitochondria and chloroplast

Module IV

Carbohydrate metabolism-glycolysis pathway and reactions, Glycogen breakdown and synthesis, control of glycogen metabolism, glycogen storage and its diseases, Citric acid cycle -Overview, Metabolic sources of Acetyl Co-A, enzymes and regulation, The amphibolic nature of the Citric acid cycle Electron transport chain and oxidative photophosphorylation - mitochondrion and electron transport, phosphorylation and control of ATP production Gluconeogenesis, The glyoxylate pathway, Pentose phosphate pathway

Module V

Lipid metabolism -Lipid digestion, absorption and transport, fatty acid oxidation, ketone bodies, fatty acid biosynthesis, regulation of fatty acid metabolism. Cholesterol and Arachidonic Acid metabolism, Phospholipids, Sphingolipids and Glycolipids

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Harper's Biochemistry, K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw-Hill/Appleton and Lange.
- Biochemistry, L. Stryer, W.H. Freeman and Company
- Tools of Biochemistry, T.G. Cooper, John Wiley and Sons Inc.

References:

- Cellular Biophysics I & II, Thomas F. Weiss 1995, MIT Press
- Biochemical calculations, I.H. Segal. Publisher, John Wiley and Sons
- Biochemistry, C.K. Mathews, K.E. Van Holde and K.G. Ahern, Benjamin / Cummings.
- Devlin's Textbook of Biochemistry with Clinical correlations, John Wiley and Sons Inc.
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox, Worth Publishing

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction aims and scope	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
2	Chemical Foundations of Biology- Properties of water, acids, bases and buffers	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
3	Chemical Foundations of Biology- Properties of water, acids, bases and buffers	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
4	Covalent and Non-covalent interactions in biological systems	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
5	Introduction to biomolecules- Carbohydrates, Sugars, Polysaccharides	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
6	Introduction to biomolecules- Carbohydrates, Sugars, Polysaccharides	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
7	Lipids- Classification, Structure and Function	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
8	Lipids and biological membranes	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
9	Lipid linked proteins and lipoproteins, Atherosclerosis	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
10	Metabolism and bioenergetics- First and Second law	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
11	Free energy and chemical equilibrium	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
12	Organic reaction mechanisms	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
13	Design of metabolism-concept of free energy, ATP-ADP cycle	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
14	Cellular energy transactions- role of mitochondria and chloroplast	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
15	Carbohydrate pathway- glycolysis pathway and reactions	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
16	Glycogen breakdown and synthesis	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
17	Glycogen breakdown and synthesis	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
18	Control of glycogen metabolism, glycogen storage and its diseases	Lecture	BTB302.4	Quiz & End Sem Exam
19	Citric acid cycle-Overview, Metabolic sources of Acetyl Co-A	Lecture	BTB302.4	Quiz & End Sem Exam

20	Enzymes and regulation	Lecture	BTB302.4	Quiz & End Sem Exam
21	Amphibolic nature of the Citric acid cycle	Lecture	BTB302.4	Quiz & End Sem Exam

22	Electron transport chain	Lecture	BTB302.4	Quiz & End Sem Exam
23	Oxidative phosphorylation	Lecture	BTB302.4	Quiz & End Sem Exam
24	Mitochondrion and electron transport	Lecture	BTB302.4	Quiz & End Sem Exam
25	Phosphorylation and control of ATP production	Lecture	BTB302.4	Quiz & End Sem Exam
26	Gluconeogenesis	Lecture	BTB302.4	Quiz & End Sem Exam
27	Glyoxylate pathway	Lecture	BTB302.4	Quiz & End Sem Exam
28	Pentose phosphate pathway	Lecture	BTB302.4	Quiz & End Sem Exam
29	Lipid metabolism- Lipid digestion	Lecture	BTB302.5	Quiz & End Sem Exam
30	Absorption and transport	Lecture	BTB302.5	Quiz & End Sem Exam
31	Fatty acid oxidation, Ketone bodies	Lecture	BTB302.5	Quiz & End Sem Exam
32	Fatty acid biosynthesis	Lecture	BTB302.5	Quiz & End Sem Exam
33	Regulation of fatty acid metabolism	Lecture	BTB302.5	Quiz & End Sem Exam
34	Cholesterol and Arachidonic acid metabolism	Lecture	BTB302.5	Quiz & End Sem Exam
35	Phospholipids, Sphingolipids and Glycolipids	Lecture	BTB302.5	Quiz & End Sem Exam
36	Phospholipids, Sphingolipids and Glycolipids	Lecture	BTB302.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB302.1.	Learn about chemical interactions in biological system.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.2.	Develop the understanding between structure and function of carbohydrates & lipids.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.3.	Learn the concept of metabolism and energy involved in metabolic pathways.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.4.	Understand the metabolic pathways and regulations of carbohydrates metabolism.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.5.	Learn about the digestion, transport, anabolism and catabolism of lipids in the body.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

Amity Institute of Biotechnology
I MID-SEMESTER (SEM –III) 2021-22

Class: B.Tech. Biotechnology III Semester

Subject Name: BTB 302 BIOCHEMISTRY-I	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biopolymers with examples.	3
CO1	Q.2a	What do you understand by proton hopping?	3
	Q.2b	How is monosaccharide different from polysaccharide?	3
CO1	Q.3	Give an account of lipid digestion in body.	6
CO2	Q.4	Explain the significance of lipoproteins in clinics.	3
CO2	Q.5a	What are the factors favoring glycogenolysis.	3
	Q.5b	Discuss the different factors affecting fat oxidation.	3
CO2	Q 6	Glycolysis and Gluconeogenesis will never occur simultaneously. Why?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry-I**/Course code **BTB-302** is level **3** for the academic year 2020-21.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.
[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.
[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.
[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY
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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR BIOLOGY
Course Code : BTB-304, Credits: 04, Session :2021-22 (Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:
BTB304.1. Learn about the mechanism of replication of DNA in prokaryotes and eukaryotes.
BTB304.2. Learn and compare the mechanism of transcription in prokaryotes and eukaryotes.
BTB304.3. Learn the various post-transcriptional processes in cell.
BTB304.4. Learn about the mechanism of protein synthesis in prokaryotes and eukaryotes.
BTB304.5. Understand about gene expression regulation.
BTB304.6. Understand about various mechanisms of gene silencing.

C. **Programme Outcomes:**
[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and

norms of engineering practices.
[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: DNA Replication and repair

Nucleic Acid Structure and Functions, Mechanism of Prokaryotic and Eukaryotic DNA replication, Enzymes and accessory proteins involved in DNA replication, DNA repair Mechanism.

Module II: Transcription
Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements.

Module III: Modifications in RNA
5'-cap formation, transcription termination, 3 '-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA and mRNA stability.

Module IV: Translation
Prokaryotic and Eukaryotic translation, the translation Machinery; Mechanisms of initiation, elongation and termination, regulation of translation, co-and post-translational modifications of proteins.

Module V: Regulation of Gene Expression in prokaryotic and eukaryotic systems
Lac operon, Ara operan, regulation in Eukaryotes, Epigenetics.

Module VI: Antisense and Ribozyme technology
Molecular mechanism of antisense molecules, inhibition of spilicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of Ribozyme; Hammerhead, hairpin and other ribozymes, strategies for designing ribozymes, applications of antisense and ribozyme technologies.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education
- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Biology of the Cell. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing
- Gene VIII, Benjamin Lewin 2005, Oxford University Press

References:

- Molecular Cell Biology, H. Lodish, A.Berk, S. Zipursky, P Matsundaira, D.Baltimore and J.E. Barnell, W.H. Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing.

I. **Lecture Plan**

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Nucleic Acid Structure and Functions	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
2	Mechanism of Prokaryotic and Eukaryotic DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
3	Mechanism of Prokaryotic and Eukaryotic DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
4	Enzymes and accessory proteins involved in DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
5	Enzymes and accessory proteins involved in DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
6	DNA repair Mechanism	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
7	DNA repair Mechanism	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
8	Tutorial	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
9	Prokaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
10	Prokaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
11	Eukaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
12	Eukaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
13	RNA polymerase	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
14	General and specific transcription factors	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
15	Regulatory elements	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
16	Tutorial	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
17	5'-cap formation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
18	transcription termination	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
19	3'-end processing and polyadenylation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
20	3'-end processing and polyadenylation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
21	Splicing, Editing	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam

22	Nuclear export of mRNA and mRNA stability	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
23	Tutorial	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam

24	Prokaryotic and Eukaryotic translation	Lecture	BTB304.4	Mid Term, Quiz & End Sem Exam
25	Prokaryotic and Eukaryotic translation	Lecture	BTB304.4	Quiz & End Sem Exam
26	the translation Machinery	Lecture	BTB304.4	Quiz & End Sem Exam
27	Mechanisms of initiation	Lecture	BTB304.4	Quiz & End Sem Exam
28	elongation and termination	Lecture	BTB304.4	Quiz & End Sem Exam
29	regulation of translation	Lecture	BTB304.4	Quiz & End Sem Exam
30	co-and post-translational modifications of proteins	Lecture	BTB304.4	Quiz & End Sem Exam
31	Tutorial	Lecture	BTB304.4	Quiz & End Sem Exam
32	Lac operon	Lecture	BTB304.5	Quiz & End Sem Exam
33	Ara operon	Lecture	BTB304.5	Quiz & End Sem Exam
34	regulation in Eukaryotes	Lecture	BTB304.5	Quiz & End Sem Exam
35	Epigenetics	Lecture	BTB304.5	Quiz & End Sem Exam
36	Tutorial	Lecture	BTB304.5	Quiz & End Sem Exam
37	Molecular mechanism of antisense molecules	Lecture	BTB304.6	Quiz & End Sem Exam
38	Molecular mechanism of antisense molecules	Lecture	BTB304.6	Quiz & End Sem Exam
39	inhibition of spilicing, polyadenylation and translation	Lecture	BTB304.6	Quiz & End Sem Exam
40	disruption of RNA structure and capping	Lecture	BTB304.6	Quiz & End Sem Exam
41	Biochemistry of Ribozyme	Lecture	BTB304.6	Quiz & End Sem Exam
42	Hammerhead, hairpin and other ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
43	Hammerhead, hairpin and other ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
44	strategies for designing ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
45	applications of antisense	Lecture	BTB304.6	Quiz & End Sem Exam
46	ribozyme technologies	Lecture	BTB304.6	Quiz & End Sem Exam

47	Applications of ribozyme technologies	Lecture	BTB304.6	Quiz & End Sem Exam
48	Tutorial	Lecture	BTB304.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB304.1.	Learn about the mechanism of replication of DNA in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.2.	Learn and compare the mechanism of transcription in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.3.	Learn the various post-transcriptional processes in cell.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.4.	Learn about the mechanism of protein synthesis in prokaryotes and eukaryotes	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.5.	Understand about gene expression regulation.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.6.	Understand about various mechanisms of gene silencing.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

Amity Institute of Biotechnology
I MID-SEMESTER (SEM –III) 2021-22

Class: B.Tech. Biotechnology III Semester

Subject Name: BTB 304 MOLECULAR BIOLOGY	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the nucleic acids with examples.	3
CO1	Q.2	What do you understand by semi discontinuous replication of DNA?	6
CO1	Q.3	Give an account of RNA synthesis in *E. coli*.	6
CO2	Q.4	Explain the significance of 5'-capping in RNA.	3
CO2	Q.5a	How does tRNA bring amino acid to ribosome for protein synthesis?	3
	Q.5b	Discuss the different mechanisms of gene silencing.	3
CO2	Q 6	How does cell ensure the correct incorporation of amino acids in translation?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology**/Course code **BTB-304** is level **3** for the academic year 2020-21.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	3	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY
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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR BIOLOGY LAB
Course Code : BTB-323, Credits: 01, Session :2021-22 (Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB323.1. Practical based understanding of preparation of genomic and plasmid DNA.

BTB323.2. Practical based understanding of isolation of RNA.

BTB323.3. Practical based understanding of RFLP analysis.

BTB323.4. Practical based understanding of gel filtration.

BTB323.5. Practical based understanding of Preparation of Competent Cells.

BTB323.6. Practical based understanding of Restriction Digestion and Ligation of DNA.

C. **Programme Outcomes:**

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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norms of engineering practices.
[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

F. Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Preparation of DNA: genomic, Plasmid

Module II

Isolation of RNA

Module III
RFLP analysis
Module IV
Gel filtration
Module V
Preparation of Competent Cells
Module VI
Restriction Digestion and Ligation of DNA

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:

Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

I. Lecture Plan

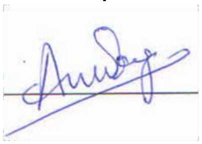
Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Preparation of DNA: genomic, Plasmid	Practical	BTB323.1	Class Test (Practical Based) & End Sem Exam
2	Preparation of DNA: genomic, Plasmid	Practical	BTB323.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of RNA	Practical	BTB323.2	Class Test (Practical Based) & End Sem Exam
4	Isolation of RNA	Practical	BTB323.2	Class Test (Practical Based) & End Sem Exam
5	RFLP analysis	Practical	BTB323.3	Class Test (Practical Based) & End Sem Exam
6	RFLP analysis	Practical	BTB323.3	Class Test (Practical Based) & End Sem Exam
7	Gel filtration	Practical	BTB323.4	Class Test (Practical Based) & End Sem Exam
8	Gel filtration	Practical	BTB323.4	Class Test (Practical Based) & End Sem Exam
9	Preparation of Competent Cells	Practical	BTB323.5	Class Test (Practical Based) & End Sem Exam
10	Preparation of Competent Cells	Practical	BTB323.5	Class Test (Practical Based) & End Sem Exam
11	Restriction Digestion and Ligation of DNA	Practical	BTB323.6	Class Test (Practical Based) & End Sem Exam
12	Restriction Digestion and Ligation of DNA	Practical	BTB323.6	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB323.1.	Practical based understanding of preparation of genomic and plasmid DNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.2.	Practical based understanding of isolation of RNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.3.	Practical based understanding of RFLP analysis.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.4.	Practical based understanding of gel filtration.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.5.	Practical based understanding of Preparation of Competent Cells.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.6.	Practical based understanding of Restriction Digestion and Ligation of DNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology Lab**/Course code **BTB-323** is level **3** for the academic year 2020-21.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY - II
Course Code : BTB-401, Credits : 04, Session :2021-22 (Even Sem.), Class : B. Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB401.1. Understand relationships between structure and functions Amino acids and Proteins and the concept of Enzymes, their mode of action and regulation.

BTB401.2. Understand the structure and properties of Nucleic acids – DNA and RNA.

BTB401.3. Learn and understand the amino acid metabolism.

BTB401.4. Understand the metabolism of purines and pyrimidines in the body.

C. **Programme Outcomes:**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Proteins -Amino acids and peptides - classification, chemical reactions and physical properties. Introduction to protein structure and function. Cis-trans peptide bond formation. Glycoproteins -structure and function, *Vitamins and Coenzymes*: structure and function of water soluble vitamins.
Enzymes -Introduction to kinetic and catalytic mechanisms of enzymes; Regulation of enzyme activity; Effects of physical parameters on enzyme activity, enzyme inhibitors – types of inhibition.

Module II
Nucleic acids - nitrogenous bases, nucleotides, types, structure and properties of nucleic acids

Module III
Amino acid metabolism -Amino acid deamination, urea cycle, biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine,
Tyrosine. Specialized Products of Amino Acids, Nitrogen fixation

Module IV
Nucleotide Metabolism -structure and metabolism of purines and pyrimidines, biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN; Catabolism of heam and clinical significance of bilirubin.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Harper's Biochemistry, K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw-Hill/Appleton and Lange.
- Biochemistry, L. Stryer, W.H. Freeman and Company
- Tools of Biochemistry, T.G. Cooper, John Wiley and Sons Inc.

References:
- Cellular Biophysics I & II, Thomas F. Weiss 1995, MIT Press
- Biochemical calculations, I.H. Segal. Publisher, John Wiley and Sons
- Biochemistry, C.K. Mathews, K.E. Van Holde and K.G. Ahern, Benjamin / Cummings.
- Devlin's Textbook of Biochemistry with Clinical correlations, John Wiley and Sons Inc.
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox, Worth Publishing

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
2	Proteins - Amino acids and peptides - classification	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
3	Proteins - Amino acids and peptides - classification	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
4	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
5	Chemical reactions and physical properties	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
6	Introduction to protein structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
7	Introduction to protein structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
8	Glycoproteins -structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
9	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
10	Vitamins and Coenzymes: structure and function of water soluble vitamins	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
11	Vitamins and Coenzymes: structure and function of water soluble vitamins	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
12	Enzymes - Introduction to kinetic mechanisms of enzymes	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
13	Catalytic mechanisms of enzymes	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
14	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
15	Regulation of enzyme activity	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
16	Effects of physical parameters on enzyme activity	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
17	Enzyme inhibitors – types of inhibition.	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
18	Enzyme inhibitors – types of inhibition.	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
19	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
20	Nucleic acids - nitrogenous bases	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam

21	Nucleotides, types, structure and properties of nucleic acids	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam
22	Nucleotides, types, structure and properties of nucleic acids	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam

23	Amino acid metabolism - Amino acid deamination	Lecture	BTB401.3	Mid Term, Quiz & End Sem Exam
24	TUTORIAL	Lecture	BTB401.3	Mid Term, Quiz & End Sem Exam
25	Urea cycle	Lecture	BTB401.3	Quiz & End Sem Exam
26	Urea cycle	Lecture	BTB401.3	Quiz & End Sem Exam
27	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
28	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
29	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
30	Tutorial	Lecture	BTB401.3	Quiz & End Sem Exam
31	Specialized Products of Amino Acids	Lecture	BTB401.3	Quiz & End Sem Exam
32	Specialized Products of Amino Acids	Lecture	BTB401.3	Quiz & End Sem Exam
33	Nitrogen fixation	Lecture	BTB401.3	Quiz & End Sem Exam
34	Nitrogen fixation	Lecture	BTB401.3	Quiz & End Sem Exam
35	TUTORIAL	Lecture	BTB401.3	Quiz & End Sem Exam
36	Nucleotide Metabolism -structure of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
37	Nucleotide Metabolism -structure of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
38	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
39	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
40	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
41	Biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN)	Lecture	BTB401.4	Quiz & End Sem Exam

42	Biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN)	Lecture	BTB401.4	Quiz & End Sem Exam
43	Biosynthesis of nucleotide	Lecture	BTB401.4	Quiz & End Sem

	coenzymes (NAD, NADP, FAD, FMN)			Exam
44	TUTORIAL	Lecture	BTB401.4	Quiz & End Sem Exam
45	Catabolism of heam	Lecture	BTB401.4	Quiz & End Sem Exam
46	Catabolism of heam	Lecture	BTB401.4	Quiz & End Sem Exam
47	Clinical significance of bilirubin	Lecture	BTB401.4	Quiz & End Sem Exam
48	Clinical significance of bilirubin	Lecture	BTB401.4	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB401.1.	Understand relationships between structure and functions Amino acids and Proteins and the concept of Enzymes, their mode of action and regulation.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.2.	Understand the structure and properties of Nucleic acids – DNA and RNA.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.3.	Learn and understand the amino acid metabolism.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.4.	Understand the metabolism of purines and pyrimidines in the body.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
I MID-SEMESTER (SEM –IV) 2021-22</td></tr>
<tr><td colspan="7">Class: B.Tech. Biotechnology IV Semester</td></tr>
<tr><td colspan="2">Subject Name:
BTB 401 BIOCHEMISTRY-II</td><td colspan="3">Time: 1.5 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4</td><td>Q.2,3</td><td>Q.4</td><td>Q.2,5,6</td><td></td><td></td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the amino acids with examples.	3
CO1	Q.2	What do you understand by enzyme kinetics?	6
CO1	Q.3	Give an account of biochemistry of glycoproteins.	6
CO2	Q.4	Explain the significance of peptide bond.	3
CO2	Q.5a	How does inhibitors work against enzymes?	3
	Q.5b	Discuss the importance of SGOT and SGPT in liver and kidney function tests.	3
CO2	Q 6	Discuss the importance of mis regulation in nucleic acid metabolism.	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry-II**/Course code **BTB-401** is level **3** for the academic year 2020-21.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	3	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY LAB-II
Course Code : BTB-420, Credits: 01, Session :2021-22 (Even Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend understanding of the qualitative and quantitative estimation of proteins and nucleic acids.

B. **Course Outcomes:** At the end of the course, students will be able to:
BTB420.1. Practical based understanding of qualitative and quantitative tests of protein and amino acids.
BTB420.2. Practical based understanding of qualitative and quantitative tests of DNA and RNA.

C. **Programme Outcomes:**
[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
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[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

F. Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Colour reactions of proteins (Ninhydrin test, Biuret test, Xanthoprotein test).

Estimation of proteins.

Module II

Biochemical estimation of DNA

Biochemical estimation of RNA

Quantitative determination of DNA and RNA by spectrophotometric method using UV range.

Determination of melting temperature of DNA from thermal denaturation characteristics.

G. Examination Scheme:

IA			**EE**			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Ninhydrin test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Xanthoprotein test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
4	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
5	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
6	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
7	Biochemical estimation of DNA	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
8	Biochemical estimation of RNA	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
9	Quantitative determination of DNA and RNA by spectrophotometric method using UV range	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
10	Quantitative determination of DNA and RNA by spectrophotometric method using UV range	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
11	Determination of melting temperature of DNA from thermal denaturation characteristics	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
12	Determination of melting temperature of DNA from thermal denaturation characteristics	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB420.1.	Practical based understanding of qualitative and quantitative tests of protein and amino acids.	3	3	3	3	-	1	2	-	2	2	**-**	**2**	3	3	1	-
BTB420.2.	Practical based understanding of qualitative and quantitative tests of DNA and RNA.	3	3	3	3	-	1	2	-	2	2	**-**	**2**	3	3	1	-

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry lab-II**/Course code **BTB-420** is level **3** for the academic year 2020-21.

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **ADVANCED GENOMICS & PROTEOMICS**
Course Code : MSB 204, Crédits : 04, Session :2021-22(Even Sem.), Class : M.Sc. Ist Year
Faculty Name : Dr. MANISH KUMAR

A. **Introduction:** The course helps in developing a detailed understanding of eukaryotic genome complexity and organization. Current research on the molecular basis of the control of gene expression in eukaryotic has developed a detailed understanding of techniques of gene diagnostics and DNA profile to acquire the fundamental of genomics and bioinformatics, it is desirable to have in depth study on these lines.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB204.1 Understand the basic of genomics, Anatomy of genomics and human genome project
MSB204.2 Able to understand gene expression, and mapping
MSB204.3 Learn different DNA markers
MSB204.4 Understand Microarray and their applications in analysis of gene expression
MSB204.5 Develop knowledge of fundamental techniques in proteomics.
MSB204.6 Understand Post translational modification.
MSB204.7 Get detail knowledge and understanding of Protein – protein interaction.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction to Genomics: The human genome project "Anatomy of prokaryotic and eucaryotic

genome: repetitive DNA and RNA Contents of genomes.

Module II

Transcriptomics and meta-transcriptomics: Introduction, method and uses. Genetic mapping

Module III
Microsatellite DNA markers, RFLP, DNA sequencing, Phylogeny

Module IV
Micro array: DNA micro array marker, computational methods.

PART-II: PROTEOMICS

Module V
Introduction to proteomics
Fundamental methods used in proteomics. 2-D gel electrophoresis + mass spectroscopy.

Module VI
Post translationalprotein modification

Module VII
Protein – protein interaction some examples

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Genes & Genomes, Maxine Singer and Paul Berg
- Genomes II, T.A. Brown

***References*:**

- A Primer of Genome Science, Greg Gibson and Spencer V. Muse
- Database Annotation in Molecular Biology: Principles and Practice, Arthur M. Lesk
- DNA: Structure and Function, Richard R. Sinden
- Recombinant DNA (Second Edition), James D. Watson and Mark Zoller
- Gene Cloning and DNA Analysis – An introduction (Fourth Edition), T.A. Brown
- www.panimatext.com

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam

2	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
3	Human Genome project	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam

4	Human Genome project	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
5	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
6	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
7	repetitive DNA and RNA Contents of genoms	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
8	repetitive DNA and RNA Contents of genoms	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
9	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
10	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
11	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
12	Introduction , method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
13	Introduction , method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
14	Introduction , method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
15	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
16	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
17	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
18	RFLP	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
19	RFLP	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
20	DNA sequencing, polyogemy	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
21	DNA sequencing, polyogemy	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
22	DNA sequencing, polyogemyprocedure	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
23	DNA sequencing, polyogemy	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
24	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam
25	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam
26	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam

27	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam
28	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam

29	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam
30	Introduction to proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
31	Introduction to proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
32	Fundamental methods used in proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
33	Fundamental methods used in proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
34	Fundamental methods used in proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
35	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
36	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
37	2-D gel electrophoresis + mass spectroscopy 2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
38	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
39	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
40	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
41	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
42	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
43	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
44	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
45	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
46	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
47	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
48	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB204.1	Understand the basic of genomics, Anatomy of genomics and human genome project	3	3	1	3	1	1	1	-	2	1	3	1	-	1
MSB204.2	Able to understand gene expression, and mapping	3	3	**2**	3	1	-	-	-	2	1	3	1	-	1
MSB204.3	Learn different DNA markers	3	3	2	3	1	-	-	1	2	1	3	1	1	1
MSB204.4	Understand Microarray and their applications in analysis of gene expression	3	3	1	3	1	-	-	-	2	1	3	1	-	1
MSB204.5	Develop knowledge of fundamental techniques in proteomics.	3	3	1	3	1	-	-	-	2	1	3	1	-	1
MSB204.6	Understand Post translational modification.	3	3	1	3	1	-	-	-	2	1	3	1	1	1
MSB204.7	Get detail knowledge and understanding of Protein – protein interaction.	3	3	1	3	1	-	-	-	2	1	3	1	1	1

Amity Institute of Biotechnology I MID-SEMESTER (SEM –II) 2021-22
Class: M.Sc Biotechnology II Semester

Subject Name: MSB 204 Advanced Genomics & Proteomics	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

Student will be able to
CO1: Understand the basics of genomics, Anatomy of genomics and human genome project.
CO2: understand gene expression, and mapping.

CO Map	Question No.	Question	Marks
CO1	Q.1	Differentiate between genomics and proteomics.	3
CO1	Q.2a	Discuss the separation processes in genomics.	3
	Q.2b	Discuss the separation processes in proteomics.	3
CO1	Q.3	Discuss physical mapping and use of restriction enzymes.	6
CO2	Q.4	Discuss linkage mapping with suitable example.	3
CO2	Q.5a	Write a short note on phylogeny.	3
	Q.5b	How genomic study is useful in the identification of genomes?	3
CO2	Q 6	Discuss the role of recombination and recombinants in the linkage mapping.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Genomics & Proteomics/MSB 204** is **level 3** for the academic year 2021-22.

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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
II	MSB 205	3	3	3	1	1	-	-	1	2	1	3	1	3	1

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **COMPUTATIONAL BIOLOGY**
Course Code : MSB 205, Crédits : 03, Session :2020-21(Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe how molecular data can be used to construct a phylogenetic tree and characterize the rates and causes of nucleotide substitutions. The aim is also to explain how a gene/protein family arises and the mechanisms, which underlie evolution at the molecular level.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MSB 205.1 Understand and explain the development of computational biology.

MSB 205.2 Describe the fundamentals of bioinformatics databases and their application.

MSB 205.3 Understand and explain the use of various computational methods for phylogentic studies.

MSB 205.4 Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling. Explain the applications of computational biology in different fields of sciences.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various

sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Introduction to Computational Biology. History of Bioinformatics
Module II: Bioinformatics Fundamentals

1. Major information Resources & Databases in Bioinformatics
 a. Information Resources: NCBI, EBI, ExPasy Entrez & SRS System
 b. Primary Sequence & Structure Databases: Genbank, SwissProt/Uniprot, EMBL, PIR, PDB, MMDB, NDB, CSD, KEGG etc.
 c. Derived (Secondry) Databases of Sequences and structure:
   i. Prosite, PRODOM, PRINTS, Pfam, BLOCK, INTERPRO etc.
   ii. SCOP, CATH, DSSP, FSSP, RNAbase,
 d. Genome Databases (at NCBI, EBI, TIGR, SANGER), High-throughput genomics sequence (EST, STS, GSS), ENSEMBL.
2. Sequence File formats: fasta, genbank, embl, Swiss-prot, pdb, nbrf, pir and multiple sequences formats (Aln, Mega, Pileup, phylip etc.)
3. Sequence Similarty Basics: Similarty, Indentity, Homology, Scoring, selectivity/Sensitivity, Gap cost, Linear and Affine Gap Penalty, Basic of scoring system and matrices (PAM, BIOSUM, GONNET etc.)
4. Pairwise Sequences Aligment: Brute Force method, Dot matrix method, Global (Needleman-Wunsch) and Local Alignment (Smith-Waterman) using Dynamic programming.
5. Scoring Matrices: Substitution Matrices, Concept log-odds, PAM & BLOSUM Series, Derivation of PAM & BLOSUM matrices, Distance and Similarity matrices.
6. Similarity Searching Tools: BLAST and FASTA, Theory and Algorithms, variants of BLAST and FASTA, PSI-BLAST and PHI BLAST, Statistical Significance.

7. Sequence Pattern and Profiles: Concepts of motif, pattern and profile, Profile construction and its application in Bioinformatics,

Module III: Computational Methods

Scoring methods of MSA (sum of pair, Multidimensional DP, Progressive, Iterative, Probabilistic)

Phylogenetics prediction mrthods: Basics, molecular clock, Substitution Models of evolution, Tree reconstruction methods (Distance based, character based method, statistical), Bootsstrapping.

Suffix tree and its applications in Bioinformatics

Gene Indentification Methods

Predictive Methods using DNA and Protein sequences.

Statistical Modeling: Log-likelihood, Bayesian network, Markov and hidden markov models.

Clustering Algorithms: K-means, Hierarchical and Mixture of Gaussion.

Module IV: Application and software tools

Software and Programmes for sequence comparison and analysis.

Phylogenetics analysis software.

Molecular Structure drawing tool.

Molecular modeling/Docking.

Application of computational biology/Bioinformatics in Agriculture, Human health, Enviroment, Biotechnology, Molecular Biology, Neurobiology, Drug Designing, Veterinary Science.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Computational Modeling of Genetic and Biochemical Networks, J.M. Bower and H. Bolouri, MIT Press
- Computational Molecular Biology: An Algorithmic Approach, P.A. Pevzner, MIT Press
- Computer Methods for Macromolecular Sequence Analysis, R.F. Doolittle, J.N, Abelson, M.I. Simon, Academic press
- Essentials of Genomics and Bioinformatics, C.W. Sensen, John Wiley and Sons Inc.
- Introduction to Bioinformatics, T. Attwood and D. Parry-Smith, Prentice Hall
- Introduction to Computational Biology: Maps, Sequences and Genomes, M. Waterman, Chapman and Hall
- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit, G. V. Heijne and G.V. Heijne, Academic Press

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Introduction to computational Biology & History of Bioinformatics	Lecture	**MSB 205.1**	Mid Term-1, Quiz & End Sem Exam
2	Major information Resources & Databases in Bioinformatics (a & b)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
3	Major information Resources & Databases in Bioinformatics (c & d)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
4	Sequence File formats & Multiple sequence formats	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
5	Sequence Similarity Basics	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
6	Basic of scoring system and matrices	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
7	Pairwise Sequences Aligment	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
8	Local Alignment	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
9	Scoring Matrices	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
10	Similarity Searching Tools (BLAST)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
11	Similarity Searching Tools (FASTA)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
12	Sequence Pattern and Profiles	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
13	Scoring methods of MSA	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
14	Phylogenetics prediction methods	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
15	Gene Identification Methods Predictive Methods using DNA and Protein sequences.	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
16	Statistical Modeling: Log-likelihood, Bayesian network, Markov	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
17	Hidden markov models	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam

18	Clustering Algorithms: K-means, Hierarchical and Mixture of Gaussion	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
19	Software and Programmes for	Lecture	**MSB 205.4**	Mid Term-1, Quiz

	sequence comparison and analysis			& End Sem Exam
20	Phylogenetics analysis software (I)	Lecture	**MSB 205.4**	Mid Term-1, Quiz & End Sem Exam
21	Molecular Structure drawing tool (I)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
22	Molecular Structure drawing tool (II)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
23	Molecular modeling/Docking (I)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
24	Molecular modeling/Docking (II)	Lecture	**MSB 205.4**	Quiz & End Sem Exam
25	Application of computational biology/Bioinformatics in Agriculture	Lecture	**MSB 205.4**	Quiz & End Sem Exam
26	Application of computational biology/Bioinformatics in Human health	Lecture	**MSB 205.4**	Quiz & End Sem Exam
27	Application of computational biology/Bioinformatics in Human health	Lecture	**MSB 205.4**	Quiz & End Sem Exam
28	Application of computational biology/Bioinformatics in Environment	Lecture	**MSB 205.4**	Quiz & End Sem Exam
29	Application of computational biology/Bioinformatics in Environment	Lecture	**MSB 205.4**	Quiz & End Sem Exam
30	Application of computational biology/Bioinformatics in Neurobiology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
31	Application of computational biology/Bioinformatics in Neurobiology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
32	Application of computational biology/Bioinformatics in molecular Biology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
33	Application of computational biology/Bioinformatics in molecular Biology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
34	Application of computational biology/Bioinformatics in Drug Designing	Lecture	**MSB 205.4**	Quiz & End Sem Exam

35	Application of computational biology/Bioinformatics in Drug	Lecture	**MSB 205.4**	Quiz & End Sem Exam

	Designing			
36	Application of computational biology/Bioinformatics in Veterinary Science	Lecture	**MSB 205.4**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 205.1	Understand and explain the development of computational biology	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.2	Describe the fundamentals of bioinformatics databases and their application	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.3	Understand and explain the use of various computational methods for phylogentic studies	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.3	Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling. Explain the applications of computational biology in different fields of sciences	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

Amity Institute Biotechnology 2020-21						
Class: M.Sc. Biotechnology II Semester						
Subject Name: Computational Biology		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand and explain the development of computational biology.
- Describe the fundamentals of bioinformatics databases and their application.
- Understand and explain the use of various computational methods for phylogentic studies.
- Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling.
- Explain the applications of computational biology in different fields of sciences.

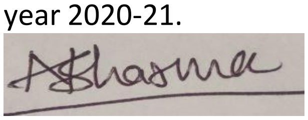
CO Map	Question No.	Question	Marks
CO1	Q.1	Bioinformatics is the integrated field of science" Explain this statement with suitable examples.	6
CO2	Q.2	What is a primary sequence database? Give any five examples of primary databases with features.	6
	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	Compare the Global and Local alignment methods with suitable example of matrix.	6
CO4	Q.5	Give the description of commonly used secondary databases of nucleic acid and protein.	6
CO3	Q.6	Write any five applications of bioinformatics in biological sciences and agriculture.	6

	Q.7	BLAST is a popular program for exploring protein family relationship. Discuss the types and applications of BLAST program.	10
CO4	Q.8	What is Neighbor-joining and UPGMA method? How it is useful in	10

		constructing phylogenetic tree.	
CO3	Q.9	What is sequence alignment? Write the difference between pairwise and multiple sequence alignment.	10
CO3	Q.10	A. Consider the following multiple sequence alignment: A.TCGGTAGGCT B. ACCGTTCCAT C. ACCCAAGGCT D. ATGGTAGGCT How many rooted and un-rooted phylogenies can you construct out of the taxa shown in the alignment? Explain any one method to construct a phylogenetic tree. B. Explain dendogram, cladogram and phylogram. How many different unrooted and rooted trees topologies are possible for 3, 4 and 5 species?	20

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Computational Biology***/Course code ***MSB 205*** is level **3** for the academic year 2020-21.



AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M.Sc.) BT, Academic Year – 2021-22

M.Sc Biotechnology (Four Semesters)

Programme Outcomes:

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
II SEM	**MSB 206**	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**3**	**1**	**-**	**1**

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENVIRONMENTAL BIOTECHNOLOGY
Course Code : MSB 206, Crédits : 03, Session :2020-21 (Odd Sem.), Class : M.Sc.. 1st Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques used in *Environmental* biotechnology. To introduce the students to regenerate clean environment using biotechnology as the key tool and provide them the insight for eco-friendly approach along with the concept of sustainable development.

B. Course Outcomes: At the end of the course, students will be able to:

MSB 206.1. Understand concept of climate change, pollution and mitigation approaches.
MSB 206.2. Understand concept of energy sustainability, clean fuel technology, Biomass energy and biofuels.
MSB 206.3. Understand concept of Biodegradation, Bioremediation and Phytoremediation. Advances in bioleaching and biomineralization.
MSB 206.4. Understand Advanced waste water treatments.
MSB 206.5. Understand Agriculture Sustainability and Clean agricultural practices, Biosensors and biomarkers, Principles of ecotoxicity
MSB 206.6. Understand the Environmental impact assessment and Environmental audit, Related case studies from India.

C. Programme Outcomes:
M.Sc Biotechnology (Four Semesters)

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%

Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Environmental pollution and its major impacts on human beings, plants, animals and climate, concept of Global warming and climate change, Global Ozone Problem, Eutrophication, Land degradation, Biomagnification.

Module II

Non-renewable and renewable energy resources, concept of clean fuel technology, Biomass energy and biofuels

Module III

Biodegradation, Bioremediation and Phytoremediation of major pollutants (PAH, Pesticides etc), Use of microbial technology for mining of metals (Bioleaching) and Concept of Biomineralisation.

Module IV

Waste water engineering: physicochemical characteristic of water, waste water treatment of municipal wastes and industrial effluents with special focus on use of biological methods, Advanced waste water treatments

Module V

Bioassessment of environmental quality: Biosensors and biomarkers, Principles of ecotoxicity.
Agriculture Sustainability and Clean agricultural practices: Biofertilizers, Biopesticides and vermi composting

Module VI

Environmental impact assessment and Environmental audit, Related case studies from India.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Environmental Science, S.C. Santra
- Environmental Biotechnology, Pradipta Kumar Mohapatra
- Environmental Biotechnology – Concepts and Applications" by Hans-Joachim Jordening and Jesef Winter

- Waste Water Engineering by Metcalf and Eddy. Publisher: Tata McGraw hill
- Environmental Microbiology: Methods and Protocols by Alicia L. Ragout De Spencer, John F.T. Spencer
- Introduction to Environmental Biotechnology by Milton Wainwright
- Principles of Environmental Engineering by Gilbert Masters

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Environmental pollution and its major impacts	Lecture	MSB 206.1.	Mid Term-1, Quiz & End Sem Exam
2	Environmental pollution and its major impacts	Lecture		Mid Term-1, Quiz & End Sem Exam
3	concept of Global warming and climate change,	Lecture		Mid Term-1, Quiz & End Sem Exam
4	concept of Global warming and climate change,	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Global Ozone Problem,	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Eutrophication,	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Land degradation, Biomagnification.	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Non-renewable energy resources,	Lecture	MSB 206.2.	Mid Term-1, Quiz & End Sem Exam
9	Non-renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
11	Renewable energy resources,	Lecture		Mid Term-1, Quiz & End Sem Exam
12	concept of clean fuel technology,	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Biomass energy and biofuels	Lecture		Mid Term-1, Quiz & End Sem Exam
15	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture	MSB 206.3.	Quiz & End Sem Exam
16	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture		Quiz & End Sem Exam
17	Biodegradation, Bioremediation and Phytoremediation of major pollutants	Lecture		Mid Term-1, Quiz & End Sem Exam

18	Microbial technology for mining of metals (Bioleaching)	Lecture		Quiz & End Sem Exam

19	Microbial technology for mining of metals (Bioleaching)	Lecture		Quiz & End Sem Exam
20	Concept of Biomineralisation.	Lecture		Quiz & End Sem Exam
21	Waste water engineering: physicochemical characteristic of water,	Lecture	MSB 206.4.	Quiz & End Sem Exam
22	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
23	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
24	waste water treatment of municipal wastes and industrial effluents	Lecture		Quiz & End Sem Exam
25	Advanced waste water treatments	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Bioassessment of environmental quality: Biosensors and biomarkers,	Lecture	MSB 206.5.	Quiz & End Sem Exam
27	Bioassessment of environmental quality: Biosensors and biomarkers,	Lecture		Quiz & End Sem Exam
28	Bioassessment of environmental quality: Principles of ecotoxicity.	Lecture		Quiz & End Sem Exam
29	Agriculture Sustainability and Clean agricultural practices:	Lecture		Quiz & End Sem Exam
30	Biofertilizers,	Lecture		Quiz & End Sem Exam
31	Biopesticides	Lecture		Quiz & End Sem Exam
32	Vermi composting	Lecture		Quiz & End Sem Exam
33	Environmental impact assessment	Lecture	MSB 206.6.	Quiz & End Sem Exam
34	Environmental impact assessment	Lecture		Quiz & End Sem Exam
35	Environmental audit,	Lecture		Quiz & End Sem Exam
36	Environmental audit,	Lecture		Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
MSB 206.1.	Understand concept of climate change, pollution and mitigation approaches.	3	2	2	-	-	1	-	3	1	-	-	3	1	-	1
MSB 206.2.	Understand concept of energy sustainability, clean fuel technology, Biomass energy and biofuels.	3	2	1	-	-	1	-	3	1	-	-	3	1	-	1
MSB 206.3.	Understand concept of Biodegradation, Bioremediation and Phytoremediation. Advances in bioleaching and biomineralization.	3	-	1	1	-	1	-	3	1	-	-	3	1	-	1
MSB 206.4.	Understand Advanced waste water treatments.	3	-	1	1	-	1	-	3	1	-	-	3	1	-	1

MSB 206.5.	Understand Agriculture Sustainability and Clean agricultural practices, Biosensors and biomarkers, Principles of ecotoxicity	3	1	2	1	-	1	-	3	1	-	-	3	1	-	1

	Understand the Environmental impact assessment and Environmental audit, Related case studies from India.															

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute Biotechnology
2021-22</td></tr>
<tr><td colspan="7">Class: M.Sc.Biotechnology
II Semester</td></tr>
<tr><td colspan="2">Subject Name: ENVIRONMENTAL BIOTECHNOLOGY</td><td colspan="3">Time: 3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,6</td><td>Q.2, 3, 7</td><td>Q.5,10</td><td>Q. 4, 8,</td><td>Q. 9,</td><td></td></tr>
<tr><td colspan="7">Student will be able to:</td></tr>
</table>

<table>
<tr><td>CO Map</td><td>Question No.</td><td>Question</td><td>Marks</td></tr>
<tr><td>CO1</td><td>Q.1</td><td>Briefly explain the following (i) Activated sludge (ii) Biomethanation.</td><td>6</td></tr>
<tr><td rowspan="2">CO1</td><td>Q.2</td><td>Write a short note on different tools of conducting EIA.</td><td>6</td></tr>
<tr><td>Q.3</td><td>Define clean fuels and their advantages? How they differ from fossil fuels?</td><td>6</td></tr>
<tr><td>CO2</td><td>Q.4</td><td>Write a short note on the problems associated with prolonged and indiscriminate use of chemical fertilizers and pesticides in present agriculture system.</td><td>6</td></tr>
</table>

CO5	Q.5	Briefly discuss the role and benefits of biofertilizers in sustainable agriculture system.	6

CO4	Q.6	Write a short note on modes of dispersion of toxic substances in the environment.	6
CO 1	Q.7	What is biodegradation? Discuss role of microbial enzymes especially microbial Dehalogenases and Phosphotriesterase (PTEs) in biodegradation of pesticides in soil.	10
CO3	Q.8	(a) Explain the Solar energy and Wind energy, point out their significance in context of environment and energy (b) Sustainability	10
CO3	Q.9	(c) Explain Explain the following with suitable example. (i) Rhizofilteration (ii) Biomagnification.	10
CO4	Q.10	Discuss the following in detail. (d) What is microbial leaching of metal ores? Explain any two ex-situ methods of microbial leaching from metal ore. How these methods are better eco-friendly options over conventional chemical metal extraction process? (e) Describe secondary treatment of municipal waste water through advanced biofilm based approaches. What impurities and toxic pollutants are usually removed during secondary waste water treatment?	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Environmental Biotechnology*** /Course code ***MSB 206*** is level **3** for the academic year ***2020-21***.


AMITY INSTITUTE OF BIOTECHNOLOGY
AUMP


AMITY INSTITUTE OF BIOTECHNOLOGY
AUMP

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	MSB 301	3	3	3	1	1	-	-	1	2	1	3	2	1	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY
Course Code : MSB 301, Crédits : 03, Session :2020-21(Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The aim to teach immunology and immuno technology to the students for their better understanding of immune system, types and mechanism of immunity, immune responses, their tolerance and suppression as well as tools and techniques involved in diagnosis and identification of immune related diseases.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MSB 301.1. Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.

MSB 301.2. Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.

MSB 301.3. Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.

MSB 301.4. the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Types of immunity - innate, aquired, passive and active physiology of immune response – MI and CMI specificity and memory. Antigen, antibody reactions. Antigens types Hapten, immunoglobuin structure, distribution and function

Module II

Molecular biology of Ig synthesis, Lymphoid tissues – ontogeny and physiology of immuno system - origin and development, differentiation of lymphocytes. Lymphocyte subpopulation of mouse and man. Structure and function of class I and II molecules antigen distribution in population – HLA in human health and diseases. Transplantation immunity – organ transplantation and HLA tissue typing.

Module III

Cell mediated cytotoxicity. Hypersensitivity reactions, cellular interaction in immune response. Antigen recognition. T.B. cell receptors, MHC restriction, Lymphocyte activation clonal proliferation, differentiation. Interleukins and their roles. The complement systems mode of activation, classical and alternate pathway biological functions.

Module IV

Introduction to tumor immunology, autoimmune disorders and immunology of infectious diseases.

Antigen antibody reactions in vitro methods agglutination precipitation, complement fixation,

immunofluorescence, immunoelectrophoresis, ELISA, Radio immuno assays, In vitro methods, skin tests and immune complex tissue demonstrations. Applications of these methods in diagnosis of microbial infections, Vaccines

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Kuby Immunology, R.A. Goldsby, T.J. Kindt and B.A. Obsorne, Freeman
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company

References:

- Immunology (Sixth Edition), Roitt, Brostoff, Male, Panima Publication
- Fundamentals of Immunology, W. Paul, Lippincot Williams and Wilkins
- Immunology, W.L. Anderson, Frence Creek Publishing (Blackwell)
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.
- Immunology, Poitt, Mosby – Yearbook Inc.
- Perkin Elmer Antibody Manual
- Production of Monoclonal Antibodies – Detailed Protocol, G.K. Lewis, University of Maryland

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I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing CO**
1	Type of immunity	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
2	Antigen and haptens	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
3	Antibody : function and structure	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
4	Types of antibody and their functions	Lecture	**MSB 301.1**.	Mid Term-1, Quiz & End Sem Exam
5	Synthesis of Ig molecule	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
6	Light Chain gene rearrangement	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
7	Heavy Chain gene rearrangement	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
8	Antibody Diversity	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam

9	Primary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
10	Primary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam

11	Secondary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
12	Secondary lymphoid organs	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
13	MHC I: Structure, types and function	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
14	MHC II: Structure, types and function	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
15	Transplantation Immunology	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
16	Cell mediated cytotoxicity	Lecture	**MSB 301.2**	Mid Term-1, Quiz & End Sem Exam
17	Hypersensitivity : Types and function.	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
18	Hypersensitivity : Types and function.	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
19	Complement system: Types and importance	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
20	Complement system: Types and importance and Regulation	Lecture	**MSB 301.3**	Mid Term-1, Quiz & End Sem Exam
21	Lymphocyte activation and clonal proliferation	Lecture	**MSB 301.3**	Mid Term-2, Quiz & End Sem Exam
22	Antigen recognition and T.B. cell receptor	Lecture	**MSB 301.3**	Mid Term-2, Quiz & End Sem Exam
23	Revision of module I and II	Lecture	**MSB 301.3**	Mid Term-2, Quiz & End Sem Exam
24	Introduction of tumor immunology	Lecture	**MSB 301.3**	Quiz & End Sem Exam
25	Tumor immunology	Lecture	**MSB 301.4**	Quiz & End Sem Exam
26	Autoimmune disorder: Organ specific	Lecture	**MSB 301.4**	Quiz & End Sem Exam
27	Autoimmune disorder: systemic	Lecture	**MSB 301.4**	Quiz & End Sem Exam
28	Autoimmunity : mechanism and regulation	Lecture	**MSB 301.4**	Quiz & End Sem Exam
29	Agglutination reaction	Lecture	**MSB 301.4**	Quiz & End Sem Exam
30	Precipitation reaction	Lecture	**MSB 301.4**	Quiz & End Sem Exam
31	Complement fixation	Lecture	**MSB 301.4**	Quiz & End Sem Exam
32	Immunofluorescence and immunoelectrophoresis	Lecture	**MSB 301.4**	Quiz & End Sem Exam

33	ELISA and RIA	Lecture	**MSB 301.4**	Quiz & End Sem Exam
34	Skin test and immune complex tissue demonstration	Lecture	**MSB 301.4**	Quiz & End Sem Exam

35	Application of these methods in diagnosis of microbial infection, Vaccines	Lecture	**MSB 301.4**	Quiz & End Sem Exam
36	Immunofluorescence and immunoelectrophoresis	Lecture	**MSB 301.4**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 301.1	Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.	3	3	3	1	1	-	-	1	2	1	3	2	1	1
MSB 301.2	Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

MSB 301.3	Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

MSB 301.4	the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

Amity Institute Biotechnology 2020-21						
Class: M.Sc. Biotechnology III Semester						
Subject Name: Computational Biology		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
- Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
- Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
- the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

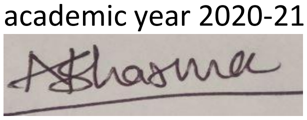
CO Map	Question No.	Question	Marks
CO1	Q.1	Specific immunity exhibits four characteristic attributes, which are mediated by lymphocytes. List these four attributes and briefly explain how they arise.	6

CO2	Q.2	Draw a schematic diagram of a typical IgG molecule and label each of the following parts: H chains, L chains, inter-chain disulfide bonds, intra-chain disulfide bonds, hinge, Fab, Fc, and all the domains. Indicate which domains are involved in antigen binding.	6

	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	What is antigen? Discuss about the typing procedures for HLA antigens.	6
CO4	Q.5	Describe one advantage and one disadvantage of N-nucleotide addition during the rearrangement of immunoglobulin heavy-chain gene segments.	6
CO3	Q.6	Explain why NK cells from a given host will kill many types of virus-infected cells but do not kill normal cells from that host.	6
	Q.7	Discuss about that the role of cell-Mediated Immunity is Important for Viral Control and Clearance.	10
CO4	Q.8	What is the mechanism of tumor generation and how does normal cells are differentiated from transformed cells?	10
CO3	Q.9	Describe the main stages of leukocyte migration from the blood to a site of inflammation.	10
CO3	Q.10	What are the hallmark features of adaptive immunity? An individual has a mutation severely inhibiting the natural function of the transporter associated with antigen processing (TAP). Which antigen processing pathway would be rendered inefficient? What classes of agents would the individual have a problem attacking and why?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advanced Immunology***/Course code ***MSB 301*** is level **3** for the academic year 2020-21.



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MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M.Sc.) BT, Academic Year – 2020-21

M.Sc Biotechnology (Four Semesters)

Programme Outcomes:

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of

technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem

solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "-

ROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
III SEM	MSB 303	3	2	2	2	2	1	1	1	1	3	-	3	1	-	1

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED ANIMAL BIOTECHNOLOGY
Course Code : MSB 303, Crédits : 03, Session :2020-21 (Odd Sem.), Class : M.Sc.. 2nd Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques used in Animal biotechnology. It aims to promote an understanding and knowledge of animal cell culture and function with particular emphasis on in vitro proliferation and differentiation, applications in gene therapy, enzyme therapy, vaccine production, and development of transgenics.

B. Course Outcomes: At the end of the course, students will be able to:

MSB 303.1. Understand conventional and advanced aspects of Animal biotechnology. Learn the cell culture media, cell culture methods and their maintenance
MSB 303.2. Identify therapeutic enzymes, strategies of efficient enzyme replacement therapy methods. .
MSB 303.3. Understand concept of DNA vaccines and other vaccines using animal cell culture.
MSB 303.4. Address the concepts and technology behind Gene therapy**.**
MSB 303.5. Learn molecular mechanism of transgenic animal technology., Gene knockout tech.

C. Programme Outcomes:

M.Sc Biotechnology (Four Semesters)

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%

Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves	A	5%

	including medical leaves.		
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction of animal cell culture-culture substrate, culture media, maintenance of cell lines. Stem cell Therapy: Methods and applications.

Module II

Enzyme therapy –introduction, therapeutic enzymes- Dnase I, adenosine deaminase, dihydrfolate reductase,streptokinase

Module III

DNA based vaccines, subunit vaccines, peptide vaccines, recombinant DNA vaccines, attenuated vaccines, vector vaccines.

Module IV

Gene therapy - SCID, cystic fibrosis, familial by hypercholestremia, prospects and problem, Biotechnological applications for HIV diagnostics and possible gene therapy for cancer.

Module V

Transgenic animal production and application in production of therapeutic proteins, gene Knock out and mice model for human genetic disorder, baculo virus for expression of foreign gene mapping of human genome

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag
- Cell Culture Lab FAx, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Animal cell culture: An Overview	Lecture	MSB 303.1.	Mid Term-1, Quiz & End Sem Exam
2	ell culture attachment substrates: Types, Advantages and Applications	Lecture		Mid Term-1, Quiz & End Sem Exam
3	Animal Cell culture Media: Natural Media.	Lecture		Mid Term-1, Quiz & End Sem Exam
4	Animal Cell culture Media: Artificial Media.	Lecture		Mid Term-1, Quiz & End Sem Exam
5	Applications, advantages and limitations of media	Lecture		Mid Term-1, Quiz & End Sem Exam
6	Method of Initiation of of Cell culture (primary/secondary etc)	Lecture		Mid Term-1, Quiz & End Sem Exam
7	Method of Initiation of of Cell culture (primary/secondary etc)	Lecture		Mid Term-1, Quiz & End Sem Exam
8	Maintenance of cell lines and subculturing	Lecture		Mid Term-1, Quiz & End Sem Exam
9	Stem cell therapy:Method an applications	Lecture		Mid Term-1, Quiz & End Sem Exam
10	Enzyme replacement therapy: An Overview	Lecture	MSB 303.2.	Mid Term-1, Quiz & End Sem Exam
11	Mechanism and role in SCID disease treatment using ERT Adagen-1	Lecture		Mid Term-1, Quiz & End Sem Exam
12	Mechanism and role in CSID disease treatment using ERT DNAse-1.	Lecture		Mid Term-1, Quiz & End Sem Exam
13	Mechanism and role in cronory blockage disease treatment using ERT Streptokinase	Lecture		Mid Term-1, Quiz & End Sem Exam
14	Mechanism and role of DHFR in ERT.	Lecture		Mid Term-1, Quiz & End Sem Exam
15	DNA vaccines:An Overview.	Lecture	MSB 303.3.	Quiz & End Sem Exam
16	Subunit vaccines and Peptide vaccines	Lecture		Quiz & End Sem Exam
17	DNA based vaccines: Recombinant vaccines.	Lecture		Mid Term-1, Quiz & End Sem Exam

18	Method and production of recombinant vaccines	Lecture		Quiz & End Sem Exam

19	Attenuated vaccines and their limitations	Lecture		Quiz & End Sem Exam
20	Advantages and Applications of DNA vaccines.	Lecture		Quiz & End Sem Exam
21	Gene Therapy - An Overview	Lecture	MSB 303.4.	Quiz & End Sem Exam
22	Methods of Gene Therapy	Lecture		Quiz & End Sem Exam
23	Gene therapy -Mechanism and treatment of SCID disease	Lecture		Quiz & End Sem Exam
24	Gene therapy -Mechanism and treatment of CF disease	Lecture		Quiz & End Sem Exam
25	Gene therapy -Mechanism and treatment of hypercholestremia disease	Lecture		Mid Term-2, Quiz & End Sem Exam
26	Gene therapy-Applications and current advancement	Lecture		Quiz & End Sem Exam
27	Applications for HIV diagnostics and therapy.	Lecture		Quiz & End Sem Exam
28	Introduction of Transgenic Animals	Lecture	MSB 303.5.	Quiz & End Sem Exam
29	transgene transfer methods in animal cells	Lecture		Quiz & End Sem Exam
30	transgene transfer methods in animal cells	Lecture		Quiz & End Sem Exam
31	Transgenic Animals: Application in production of therapeutic proteins	Lecture		Quiz & End Sem Exam
32	Transgenic Animals: Application in production of therapeutic proteins	Lecture		Quiz & End Sem Exam
33	Production of Gene Knock out mice.			Quiz & End Sem Exam
34	Applications of Knockout mice model for human genetic disorder,	Lecture		Quiz & End Sem Exam
35	Baculo virus for expression of foreign gene	Lecture		Quiz & End Sem Exam
36	Mapping of human genome	Lecture		Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME

														SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3	PSO4
MSB 303.1.	Understand conventional and advanced aspects of Animal biotechnology. Learn the cell culture media, cell culture methods and their maintenance	3	2	3	2	-	-	1	-	1	-	-	3	2	-	1
MSB 303.2.	Identify therapeutic enzymes, strategies of efficient enzyme replacement therapy methods.	3	2	3	1	-	-	-	-	1	-	-	3	2	-	1
MSB 303.3.	Understand concept of DNA vaccines and other vaccines using animal cell culture.	3	2	2	2	-	-	-	-	1	-	-	3	2	-	1
MSB 303.4.	Address the concepts and technology behind Gene therapy**.**	3	2	1	2	-	-	-	-	1	-	-	3	2	-	1
MSB 303.5.	Learn molecular mechanism of transgenic animal technology., Gene knockout tech.	3	2	3	2	-	-	1	-	1	-	-	3	2	-	1

AMITY INSTITUTE OF BIOTECHNOLOGY
AUMP

Sample Question Paper

Amity Institute Biotechnology
2020-21

Class: B.Sc.(H) Biotechnology
VI Semester

Subject Name: ADVANCED ANIMAL BIOTECHNOLOGY	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,2,	Q.3,4,6	Q.5,10	Q. 8, 7	Q. 9,	

Student will be able to:

CO Map	Question No.	Question	Marks
CO1	Q.1	What is primary cell culture? How it differs from cell lines?	6
CO1	Q.2	Name the different plant sources for following enzymes (i) Bromelain (ii) Rutin (iii) Papain.	6
	Q.3	Write a short note on subunit vaccines? How it differs from attenuated vaccine?	6
CO2	Q.4	Write a short note on Congenital sucrase-isomaltase deficiency (CSID) and its treatment method.	6
CO5	Q.5	Write a brief note on particle gun method and liposome method for gene delivery.	6
CO4	Q.6	Briefly explain about DNA vaccine	6
CO 1	Q.7	Discuss the following enzymes and their role in cell separation in animal cell culture. (a) Collagenase (b) Trypsin	10
CO3	Q.8	What is Media? Describe the natural cell culture media and its advantage and limitations. Why artificial media is preferred over natural media for proliferation of specific cell culture?	10

CO3	Q.9	What is Gene Augmentation therapy? Explain the symptoms and method of treatment of severe combined immune deficiency syndrome (SCID) in humans using this method with suitable illustrations.	10

CO4 CO5	Q.10	Explain the following in detail. (a) Familial Hypercholesterolemia (FH). It is an inherited disorder that leads to aggressive and premature cardiovascular disease. What are the causes of this disease? Clearly indicate the name of the genes affected (mutated) and their subsequent impact. Explain the strategy to overcome the effect of this disease. Why this disease is unnoticed in children and young people. (b) Explain the Gene directed enzyme prodrug therapy (GDEPT) for the treatment of cancer cells.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advance Animal Biotechnology***/Course code ***MSB 303*** is level **3** for the academic year ***2020-21***.


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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY LAB
Course Code : MSB 320, Crédits : 01, Session :2020-21(Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe the immunological questions through experimentation. The aim is also to explain the antigen antibody interaction patterns through various experiments.

B. **Course Outcomes:** After successful completion of the course student will be able to:
MSB 320.1. Demonstrate detailed knowledge of purification of immunologlobulin, cells and antigen antibody interaction.
MSB 320.2. Apply knowledge and incorporate experimental understanding of the agglutination mechanism.
MSB 320.3. Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global

biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized

for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. **Syllabus**

Course Contents:

1. Purification of immunoglobin G.
2. Study of antigen- antibody pattern (ODD).
3. Study of sandwich ELISA.
4. Study of haemeagglutination.
5. Study of immunoelectrophoresis.
6. Isolation and identification of rosette cells.
7. Antigen capture ELISA

G. **Examination Scheme:**

Components	A	CT	S/V/Q/HA	EE

Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;
A: Attendance

H. Suggested Text/Reference Books:

- Manual of Molecular and Clinical Laboratory Immunology, 8th Edition Barbara Detrick (Editor), John L. Schmitz (Editor), Robert G. Hamilton (Editor) ISBN: 978-1-555-81871-5 May 2016 ASM Press
- Immunology Laboratory Manual Published by LAP LAMBERT Academic Publishing (2018) ISBN 10: 6138386175 ISBN 13: 9786138386179

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Purification of Immunoglobulin G	Lecture	**MSB 320.1**	Mid Term-1, Quiz & End Sem Exam
2	Radial Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
3	Double Immuno Diffusion Test	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
4	Study of sandwich ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
5	Study of DOT ELISA	Lecture	**MSB 320.2**	Mid Term-1, Quiz & End Sem Exam
6	Study of heamagglutination (Blood group)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
7	Rh factor determination	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
8	Study of heamagglutination (Widal test)	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
9	Study of immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
10	Study of rocket immunoelectrophoresis	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam
11	Isolation and identification of rostte cells	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam

12	Revision and discussion	Lecture	**MSB 320.3**	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 320.1	Demonstrate detailed knowledge of purification of immunoglobulin, cells and antigen antibody interaction.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 320.2	Apply knowledge and incorporate experimental understanding of the agglutination mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 320.3	Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

Amity Institute Biotechnology 2020-21						
Class: M.Sc. Biotechnology III Semester						
Subject Name: Advanced Immunology Lab		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.3 & Q.4	Q.1		Q.2		

Student will be able to:

- Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
- Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
- Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
- the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

CO Map	Question No.	Question	Marks
CO1	Q.1	Perform Dot Elisa for detection of antigen-antibody interaction.	35
CO2	Q.2	Perform hemagglutination (Blood group) test.	15
	Q.3	*Viva-voce*	10

CO 3	Q.4	Record	10

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advanced Immunology lab***/Course code ***MSB 320*** is level **3** for the academic year 2020-21.

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M.Sc.) BT, Academic Year – 2020-21

M.Sc Biotechnology (Four Semesters)

Programme Outcomes:

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
III SEM	MSB 322	3	2	3	3	1	-	-	-	1	-	-	3	2	-	1


AMITY INSTITUTE OF BIOTECHNOLOGY
AUMP

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED ANIMAL BIOTECHNOLOGY & PLANT BIOTECHNOLOGY LAB
Course Code : MSB 322, Crédits : 01, Session :2020-21 (Odd Sem.), Class : M.Sc.. 2nd Year
Faculty Name : Dr. Raghvendra Saxena

A. Introduction: The objective of this course is to familiarize the students with applications and techniques used in Animal biotechnology and plant biotechnology. It aims to promote an understanding and knowledge of animal cell culture and function with particular emphasis on in vitro proliferation and differentiation. In plant biotech aim to quint the students with plant tissue culture techniques.

B. Course Outcomes: At the end of the course, students will be able to:

MSB 322.1. Learn preparation of the cell culture media, cell culture methods of chicken fibroblast cells
MSB 322.2. Learn the maintenance of cell culture by subculturing.
.
MSB 322.3. Learn the preparation of, stock solutions, Plant tissue culture Media, sterilization etc.
MSB 322.4. Learn the callus development, anther culture embryo culture etc.

C. Programme Outcomes:
[M.Sc Biotechnology (Four Semesters)

PROGRAM OUTCOMES OF M. SC. BIOTECHNOLOGY

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest

knowledge in Biotechnology. This will help students to fill the growing need of

professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

ADVANCED ANIMAL BIOTECHNOLOGY

1. Histological study of important animal tissues.
2. Estimation of enzyme activity from animal tissues.
3. Study of toxicity on invitro model.
4. Culture and maintenance of animal cell lines.
5. Culture of chickenfibroblasts.
6. Invitro expression of proteins in animal cell lines.

PLANT BIOTECHNOLOGY

1. Tissue culture lab and organization.Sterilisation of glasswares, tools and equipments.
2. Preparation of stocks and media.Surface sterilization of various explants
3. ORGAN CULTURE
4. Callus culture
5. Anther culture
6. Embryo culture, Protoplast isolation and culture

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

IA	**EE**

Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Culture of Animal Cells, R.I Freshney, Wiley-Leiss
- Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford
- Animal Cell Culture Techniques, M. Clynes, Springer Verlag
- Cell Culture Lab FAx, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Histological study of important animal tissues.		MSB 322.1.	Mid Term-1, Quiz & End Sem Exam
2	Estimation of enzyme activity from animal tissues.			Mid Term-1, Quiz & End Sem Exam
3	Study of toxicity on invitro model.			Mid Term-1, Quiz & End Sem Exam
4	Culture and maintenance of animal cell lines.			Mid Term-1, Quiz & End Sem Exam
5	Culture of chickenfibroblasts.			Mid Term-1, Quiz & End Sem Exam
6	Invitro expression of proteins in animal cell lines.			Mid Term-1, Quiz & End Sem Exam
7	**PLANT BIOTECHNOLOGY** Tissue culture lab and organization.Sterilisation of glasswares, tools and equipments.			Mid Term-1, Quiz & End Sem Exam
8	Preparation of stocks and media.Surface sterilization of various explants			Mid Term-1, Quiz & End Sem Exam

9	ORGAN CULTURE			Mid Term-1, Quiz & End Sem Exam
10	Callus culture		MSB	Mid Term-1, Quiz

			322.2.	& End Sem Exam
11	Anther culture			Mid Term-1, Quiz & End Sem Exam
12	Embryo culture, Protoplast isolation and culture			Mid Term-1, Quiz & End Sem Exam

H. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MSB 322.1.	Learn preparation of the cell culture media, cell culture methods of chicken fibroblast cells	3	1	3	3	1	-	-	-	1	-	-	3	2	-	**-**
MSB 322.2.	Learn the maintenance of cell culture by subculturing. .	3	2	3	3	1	-	-	-	1	-	-	3	2	-	1
MSB 322.3.	Learn the preparation of, stock solutions, Plant tissue culture Media, sterilization etc.	3	1	2	3	1	-	-	-	1	-	-	3	2	-	1
MSB 322.4.	Learn the callus development, anther culture embryo culture etc.	3	**1**	2	3	1	-	-	-	1	-	-	3	2	-	1
MSB 322.5.		3	2	3	3	1	-	-	-	1	-	-	3	2	-	1


AMITY INSTITUTE OF BIOTECHNOLOGY
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Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advance Animal and Plant Biotechnology***/Course code ***MSB 322*** is level **3** for the academic year ***2020-21***.


AMITY INSTITUTE OF BIOTECHNOLOGY
AUUP

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

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PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

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PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM SPECIFIC OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

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Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3: Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MSB101	3	3	2	3	1	3	2	2	2	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED BIOCHEMISTRY
Course Code : MSB 101, Credits: 04, Session :2021-22 (Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** Objective of this course is to help students navigate the discipline of biochemistry that explains how the collection of inanimate molecules that constitute the living systems interact, to maintain and perpetuate life. This knowledge has its roots in medicine, nutrition, agriculture, fermentation and natural products chemistry. It also aims to provide an understanding of the principles and application of primary and secondary metabolites.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB101.1. Understand the basics of structures of biopolymers.

MSB101.2. Learn carbohydrate metabolism in detail by analyzing all the pathways.

MSB101.3. Learn the various aspects of lipid metabolism and their regulation.

MSB101.4. Understand the metabolism of Nitrogen and excretion of urea from body.

MSB101.5. Learn Nucleotide metabolism and clinical disorders of purine metabolism.

MSB101.6. Develop advanced knowledge of action of major hormones.

MSB101.7. Understand the principles and application of primary and secondary metabolites.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

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and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

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PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Basics of structures of biopolymers; Carbohydrates, Lipids, Proteins and Nucleic Acids.

Module II

Carbohydrates Metabolsm – I

Anaerobic processes in generating metabolic energy

Glycolysis, fates of pyruvate: Lactate and ethanol metabolism, regulation of glycolysis, glycogen mobilization, regulation of glycogen breakdown.

Oxidative processes: Pyruvate oxidation, coenzymes involved in pyruvate oxidation and citric acid cycle, action of PDH, Complex, Krebs Cycle, Regulation of PDH and Krebs Cycle, anaplerotic sequences, glyoxylate cycle, PPP, Human genetic disorder involving PPP enzymes.

ETC and OP: Electron carriers in respiratory chain, OP, enzyme system for ATP synthesis, chemiosmotic coupling.

Carbohydrate Metabolism – II

Gluconeogenesis. Ethanol consumption and gluconeogenesis, reciprocal regulation of glycolysis and gluconeogenesis, glycogen metabolism in humans, photosynthesis.

Module III: Lipid Metabolism

Utilization and transport of fat and cholesterol, lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain, control of fatty acid oxidation, biosynthesis of fatty acids, fatty acid desaturation, control of fatty acid synthesis, variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.

Module IV: Nitrogen Metabolism

Utilization of ammonia – GDH, GS, transamination, Biosynthetic of amino acids, amino acids degradation, detoxification and excretion of ammonia, urea cycle, transport of ammonia to liver, porphyrin and hememetabolism – The succinate-glycine pathway, Biological Nitrogen fixation.

Module V: Nucleotide Metabolism

De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides, purine degradation and clinical disorders of purine metabolism (Gout, lesch – nyhan syndrome, immuno deficiency), pyrimidine breakdown, reduction of ribonucleotides to deoxyibonucleotides, thymidylate synthetase – a target enzyme for chemotheraphy.

Module VI: Integration of cellular metabolism and hormonal regulation

Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation.

Module VII: Secondary Plant Metabolism

Importance of secondary metabolites, terpenes, classification, mevalonic acid pathway, phenolic compounds, shikimic acid pathway, alkaloids.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox. , Worth Publishing

References:

- Harper's Biochemistry K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw Hill/ Appleton and Lange.
- Biochemistry (Fifth Edition), Lubert Stryer

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Basics of structures of Carbohydrates	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
2	Basics of structures of Carbohydrates	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
3	Basics of structures of Lipids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
4	Basics of structures of Lipids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
5	Basics of structures of Proteins	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
6	Basics of structures of Proteins	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
7	Basics of structures of Nucleic Acids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
8	Basics of structures of Nucleic Acids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
9	Anaerobic processes in generating metabolic energy	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
10	Glycolysis, fates of pyruvate: Lactate and ethanol metabolism	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
11	Glycolysis, fates of pyruvate: Lactate and ethanol metabolism	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
12	regulation of glycolysis, glycogen mobilization	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
13	glycogen breakdown	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
14	Oxidative processes: Pyruvate oxidation, coenzymes involved in pyruvate oxidation	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
15	citric acid cycle, action of PDH, Complex	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
16	Krebs Cycle, Regulation of PDH and Krebs Cycle, anaplerotic sequences	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
17	glyoxylate cycle, PPP, Human genetic disorder involving PPP enzymes.	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
18	ETC and OP: Electron carriers in respiratory chain, OP.	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
19	enzyme system for ATP synthesis, chemiosmotic coupling	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
20	Gluconeogenesis. Ethanol consumption and gluconeogenesis	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam

21	reciprocal regulation of glycolysis and gluconeogenesis, glycogen metabolism in humans	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
22	Photosynthesis	Lecture	MSB101.2	Mid Term, Quiz

				& End Sem Exam
23	Utilization and transport of fat and cholesterol	Lecture	MSB101.3	Mid Term, Quiz & End Sem Exam
24	lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain	Lecture	MSB101.3	Mid Term, Quiz & End Sem Exam
25	lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain	Lecture	MSB101.3	Quiz & End Sem Exam
26	control of fatty acid oxidation	Lecture	MSB101.3	Quiz & End Sem Exam
27	biosynthesis of fatty acids, fatty acid desaturation	Lecture	MSB101.3	Quiz & End Sem Exam
28	control of fatty acid synthesis	Lecture	MSB1013	Quiz & End Sem Exam
29	variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.	Lecture	MSB101.3	Quiz & End Sem Exam
30	variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.	Lecture	MSB101.3	Quiz & End Sem Exam
31	Utilization of ammonia, transamination	Lecture	MSB101.4	Quiz & End Sem Exam
32	Biosynthetic of amino acids, amino acids degradation	Lecture	MSB101.4	Quiz & End Sem Exam
33	detoxification and excretion of ammonia	Lecture	MSB101.4	Quiz & End Sem Exam
34	urea cycle, transport of ammonia to liver	Lecture	MSB101.4	Quiz & End Sem Exam
35	porphyrin and hememetabolism	Lecture	MSB101.4	Quiz & End Sem Exam
36	The succinate-glycine pathway, Biological Nitrogen fixation	Lecture	MSB101.4	Quiz & End Sem Exam
37	De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
38	De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
39	purine degradation and clinical disorders of purine metabolism (Gout, lesch – nyhan syndrome, immuno deficiency)	Lecture	MSB101.5	Quiz & End Sem Exam

40	pyrimidine breakdown, reduction of ribonucleotides to deoxyribonucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
41	pyrimidine breakdown, reduction of ribonucleotides to	Lecture	MSB101.5	Quiz & End Sem Exam

	deoxyribonucleotides			
42	thymidylate synthetase – a target enzyme for chemotheraphy	Lecture	MSB101.5	Quiz & End Sem Exam
43	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
44	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
45	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
46	Importance of secondary metabolites-terpenes, classification	Lecture	MSB101.7	Quiz & End Sem Exam
47	mevalonic acid pathway, phenolic compounds	Lecture	MSB101.7	Quiz & End Sem Exam
48	shikimic acid pathway, alkaloids	Lecture	MSB101.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB101.1.	Understand the basics of structures of biopolymers.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.2 .	Learn carbohydrate metabolism in detail by analyzing all the pathways.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1

MSB101.3.	Learn the various aspects of lipid metabolism and their regulation.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.4.	Understand the metabolism of Nitrogen and excretion of urea from body.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.5 .	Learn Nucleotide metabolism and clinical disorders of purine metabolism.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.6 .	Develop advanced knowledge of action of major hormones.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB101.7 .	Understand the principles and application of primary and secondary metabolites.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
I MID-SEMESTER (SEM –I) 2021-22</td></tr>
<tr><td colspan="7">Class: M.Sc. Biotechnology I Semester</td></tr>
<tr><td colspan="2">Subject Name:
MSB 101 ADVANCED BIOCHEMISTRY</td><td colspan="3">Time: 1.5 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4</td><td>Q.2,3</td><td>Q.4</td><td>Q.2,5,6</td><td></td><td></td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biomolecules with examples.	3
CO1	Q.2a	What do you understand by phosphorylation?	3
	Q.2b	Discuss secondary metabolites in brief.	3
CO1	Q.3	Give an account of lipid transport in body.	6
CO2	Q.4	Explain the significance of urea cycle in clinics.	3
CO2	Q.5a	What are the factors favoring nucleic acid synthesis?	3
	Q.5b	Discuss the different factors affecting cholesterol synthesis.	3
CO2	Q 6	Phosphofructokinase I is the pace maker of glycolysis. Why?	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Biochemistry**/Course code **MSB-101** is level **3** for the academic year 2020-21.

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Advanced Microbial Technology
Course Code : MSB102, Credits : 03, Session : 2021-22(Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To acquaint the students to understand the basic concept of microbiology and role of various microorganisms in different biotechnological applications, various techniques for their cultivation and control.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB102.1. Study morphology, classification, forms, of bacteria, archaebacteria, mycoplasma and PPLO. Different types of media & their preparations. Isolation of pure cultures, maintenance and preservation. Culture characteristics and Bacterial growth, growth curve, batch and continuous cultures di auxic and synchronous growth enumeration of cells by direct and indirect methods.

MSB102.2. Able to understand the Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals, antiviral etc.

MSB102.3. Know about the Molecular classification of microbes, microbial genetics, prokaryotic gene organization, DNA, replication, transcription and translation. Microbial regulation of gene expression: trp and lac operon. Gene Transfer and Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics and Reproductive cycles of bacteriophage, T4 phage and lambda.

MSB102.4. Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms. Applications of microbiology in effective diagnosis, treatment and prevention of infectious disease.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate the most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need for professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize students to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical

techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology,

advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Introduction to Microbiology: Bacteria Morphology and classification. Abnormal forms of bacteria, archaebacteria, mycoplasma and PPLO, cultivation of bacteria nutritional requirements of microorganism, physical requirements, different types of media & their preparations. Isolation of pure cultures, maintenance and preservation of the pure cultures. Culture characteristics Bacterial growth Growth curve, batch and continuous cultures di-auxic and synchronous growth enumeration of cells by direct and indirect methods.

Module II: Control of Microorganisms: Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals, antiviral etc.

Module III: Microbial Genetics: Molecular classification of microbes, The Basics of microbial genetics, prokaryotic gene organization. The basic principles of microbial DNA, replication, transcription and translation. Microbial regulation of gene expression: the trp and lac operon. Gene Transfer Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics Reproductive cycles of bacteriophage, T4 and lambda.

Module IV: Medical Microbiology: Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms (bacteria, fungi, parasites, and viruses), applications of the basic principles of microbiology in effective diagnosis, treatment and prevention of infectious disease.

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill
- General Microbiology, R.Y. Stanier, J.L. Ingraham, M. L. Wheelis and P.R. Painter,

Macmillian

- Principles of Microbiology, R.M. Atlas, Wm C. Brown Publisher.
- The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing Benjamin Cummings.
- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin& Cummings.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction to Microbiology	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
2	Discovery of Microbial World	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
3	Spontaneous Generation	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
4	Role of microbes in disease causation	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
5	Development of Pure Culture	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
6	Methods in Microbiology	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
7	Principle of Microbial Nutrition	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
8	Culture Media Types	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
9	Theory of Sterilization	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
10	Practice of Sterilization	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
11	Concept of Sterilization	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam

12	Disinfection	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam

13	Methods of Control	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
14	Chemotherapeutics	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
15	Mode of Action of Antibiotics	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
16	Penicillin and Ampicillin	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
17	Sulfonamide and Vanomycin	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
18	Streptomycin and Tatracycline	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
19	Chloramphenicol	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
20	Antifungals and Antivirals	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
21	Basics of Microbial Genetics and Prokaryotic gene organization	Lecture	MSB 102.3	Quiz & End Sem Exam
22	Principles of Microbial DNA	Lecture	MSB 102.3	Quiz & End Sem Exam
23	Replication, Transcription, Translation	Lecture	MSB 102.3	Quiz & End Sem Exam
24	Regulation of Gene Expression: Trp and Lac Operon	Lecture	MSB 102.3	Quiz & End Sem Exam
25	Transformation, Transduction, Conjugation	Lecture	MSB 102.3	Quiz & End Sem Exam
26	Plasmids and Transposons	Lecture	MSB 102.3	Quiz & End Sem Exam
27	Viral Genetics	Lecture	MSB 102.3	Quiz & End Sem Exam
28	Reproductive Cycles of Bacteriophage, T4 and Lambda	Lecture	MSB 102.3	Quiz & End Sem Exam

29	Normal Microflora of Host	Lecture	MSB 102.4	Quiz & End Sem Exam

30	Host Parasite Interactions	Lecture	MSB 102.4	Quiz & End Sem Exam
31	Mechanisms of Pathogenesis	Lecture	MSB 102.4	Quiz & End Sem Exam
32	Clinical manifestations associated to medically important pathogens	Lecture	MSB 102.4	Quiz & End Sem Exam
33	Applications of Microbiology	Lecture	MSB 102.4	Quiz & End Sem Exam
34	Diagnosis of Diseases	Lecture	MSB 102.4	Quiz & End Sem Exam
35	Treatment of different microbial diseases	Lecture	MSB 102.4	Quiz & End Sem Exam
36	Prevention of different microbial diseases	Lecture	MSB 102.4	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4

MSB 102.1	Study morphology, classification, forms of bacteria, archaebacteria, mycoplasma and PPLO. Different types of media & their preparations. Isolation of pure cultures, maintenance and preservation. Culture characteristics and Bacterial growth, growth curve, batch and continuous cultures di auxic and synchronous growth Eneumeration of	3	2	2	2	2	2	2	2	2	1	3	2	2	2

	cells by direct and indirect methods.														
MSB 102.2	Able to understand the Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals antiviral	3	2	2	2	2	2	2	2	2	1	3	2	2	2
MSB 102.3	Know about the Molecular classification of microbes, microbial genetics, prokaryotic gene organization, DNA, replication, transcription and translation. Microbial regulation of gene expression: trp and lac operon. Gene Transfer and Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics and Reproductive cycles of bacteriophage, T4 phage and lambda.	3	2	2	2	2	2	2	2	2	1	3	2	2	2

MSB 102.4	Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms (bacteria, fungi, parasites, and viruses),	3	2	2	2	2	2	2	2	2	1	3	2	2	2

	applications of the basic principles of microbiology in effective diagnosis, treatment and prevention of infectious disease.													

Sample Question Paper

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
MID-SEMESTER 2021-22</td></tr>
<tr><td colspan="7">Class: M.Sc. (Biotech) I Semester</td></tr>
<tr><td colspan="2">Subject Name:
MSB 102
Advanced Microbial Technology</td><td colspan="3">Time: 2 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q. 1,4</td><td>Q. 2,3</td><td>Q. 4</td><td>Q. 2,5,6</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to
CO1: List the broad perspective of microbiology and microbial technology.
CO2: Apply the knowledge to different types of microbes
(Bacteria, Virus, Algae, Fungus and Protozoa).</td></tr>
</table>

<table>
<tr><th>CO Map</th><th>Question No.</th><th>Question</th><th>Marks</th></tr>
<tr><td>CO1</td><td>Q.1</td><td>Explain in brief the microbial nutritional requirement.</td><td>3</td></tr>
<tr><td rowspan="2">CO1</td><td>Q.2a</td><td>What are different sterilization techniques?</td><td>3</td></tr>
<tr><td>Q.2b</td><td>How the mode of action of Penicillin and chloramphenicol are different from each other?</td><td>3</td></tr>
<tr><td>CO1</td><td>Q.3</td><td>How Lactose Operon works in presence and absence of Lactose as a positive or negative regulation?</td><td>6</td></tr>
<tr><td>CO2</td><td>Q.4</td><td>Explain the application of microbiology in effective diagnosis, treatment and prevention of infectious diseases.</td><td>3</td></tr>
</table>

Attainments		Rubric
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Microbial Technology/MSB 102** is **level 3** for the academic year 2021-22.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess

technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MSB120	3	3	3	3	-	1	2	-	2	2

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY LAB
Course Code : MSB 120, Credits: 02, Session :2021-22 (Odd Sem.), Class : M.Sc. 1^{st} Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend advanced understanding of the qualitative and quantitative estimation of proteins and nucleic acids.

B. Course Outcomes: At the end of the course, students will be able to:

MSB120.1. Understand the practical based learning of estimation of proteins.

MSB120.2. Understand the practical based learning of enzyme activity.

MSB120.3. Understand the practical based learning of estimation of DNA & RNA.

MSB120.4. Understand the practical based learning of estimation of carbohydrate.

MSB120.5. Understand the practical based learning of estimation of lipid.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Proteins
Identification of protein by Biuret test.
Quantization of protein by Bradford method
Separation of proteins by SDS-PAGE
Module II: Enzyme
Enzyme activity study of serum alkaline phosphates.
Module III: Nucleic Acid
Biochemical estimation of DNA
Biochemical estimation of RNA
Separation of DNA on Agarose gel.
Module IV: Carbohydrate
Biochemical estimation of blood sugar
Module V: Lipids
Blood Cholesterol estimation.

G. Examination Scheme:

IA	EE

Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
4	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
5	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
6	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
7	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
8	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
9	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
10	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
11	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
12	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
13	Biochemical estimation of DNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
14	Biochemical estimation of DNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam

15	Biochemical estimation of RNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
16	Biochemical estimation of RNA	Practical	MSB120.3	Class Test

				(Practical Based) & End Sem Exam
17	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
18	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
19	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
20	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
21	Biochemical estimation of blood sugar	Practical	MSB120.4	Class Test (Practical Based) & End Sem Exam
22	Biochemical estimation of blood sugar	Practical	MSB120.4	Class Test (Practical Based) & End Sem Exam
23	Blood Cholesterol estimation	Practical	MSB120.5	Class Test (Practical Based) & End Sem Exam
24	Blood Cholesterol estimation	Practical	MSB120.5	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB120.1.	Understand the practical based learning of estimation of proteins.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.2.	Understand the practical based learning of enzyme activity.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.3.	Understand the practical based learning of estimation of DNA & RNA.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.4.	Understand the practical based learning of estimation of carbohydrate.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.5.	Understand the practical based learning of estimation of lipid.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Biochemistry Lab**/Course code **MSB-120** is level **3** for the academic year 2020-21.

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics,

advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MSB201	3	3	2	3	1	3	2	2	2	1

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED MOLECULAR BIOLOGY
Course Code : MSB 201, Credits: 04, Session :2021-22 (Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The objective of the course is to provide a clear understanding of DNA (genetic material) so that they can manipulate it and understand basic tools and techniques involved in its manipulation. Strong foundation in molecular biology enables the students to familiarize themselves with Genetic engineering technology.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB201.1. Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes.

MSB201.2. Learn the advanced mechanism of transcription in prokaryotes and eukaryotes.

MSB201.3. Develop understanding of various post-transcriptional processes in cell.

MSB201.4. Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes.

MSB201.5. Understand about the advances of gene expression regulation.

MSB201.6. Develop advanced knowledge of various mechanisms of gene silencing.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal

and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: DNA replication and repair

DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork; termination of replication DNA repair, photo reaction, base excision repair, nucleotide excision repair, transcription coupled repair, mismatch repair , error pone repair recombinational repair.

Module II: Transcription of DNA

Transcription in prokaryotes and eukaryotes, RNA polymerase – Composition and function; transcription mechanism; transcription factor and their role, inhibition of RNA synthesis.

Module III: Processing of RNA

Procession of ribosomal and transfer RNA"s processing of mRNA-5'cap formation; 3' polyadenylation ; RNA splicing , RNA editing , RNA degradation.

Module IV: Translation

Translation mechanism in prokaryotes and eukaryotes; ribosomes, initiation of translation, elongation, termination, amino acid activation; translational recoding inhibitors, post translation modification of protein.

Module V: Regulation of gene expression

Regulation in prokaryotes – repressors and negative control, positive control, role of c AMP, Ampreceptor protein, lac, tryp, His and

ara operons, Regulation in Eukaryotes=promoters and enhancers, transcriptional regulatory protein, transcriptional activators, eukaryotic repressor.

Module VI: Gene Silencing

RNAi (SiRNA and MiRNA) molecular mechanism and current application in gene silencing, Antisense RNA technology, Biochemistry of ribozyme, Hammer head, hairpin ribozymes. Application of antisense and ribozymes in genetic engineering.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education

References:

- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Biology of the Cell by Alberts Bruce, Bray Demos, and Watson James D.
- Gene VIII, Benjamin Lewin 2005, Oxford University Press
- Molecular Cell Biology, H. Lodish, A. Berk, S. Zipursky, P Matsundaira, D. Baltimore and J.E. Barnell, W.H. Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing.

Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley and Sons Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
2	DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
3	termination of replication DNA repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
4	photo reaction	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
5	base excision repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
6	nucleotide excision repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
7	transcription coupled repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
8	mismatch repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
9	error pone repair, recombinational repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
10	Transcription in prokaryotes and eukaryotes	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
11	Transcription in prokaryotes and eukaryotes	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
12	RNA polymerase – Composition and function	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
13	transcription mechanism	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
14	transcription mechanism	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
15	transcription factor and their role	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
16	inhibition of RNA synthesis	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
17	Procession of ribosomal and transfer RNA	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
18	Procession of ribosomal and transfer RNA	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam

19	processing of mRNA-5’cap formation	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
20	3’ polyadenylation	Lecture	MSB201.3	Mid Term, Quiz

				& End Sem Exam
21	RNA splicing	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
22	RNA editing	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
23	RNA degradation	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
24	Translation mechanism in prokaryotes and eukaryotes	Lecture	MSB201.4	Mid Term, Quiz & End Sem Exam
25	Translation mechanism in prokaryotes and eukaryotes	Lecture	MSB201.4	Quiz & End Sem Exam
26	ribosomes, initiation of translation	Lecture	MSB201.4	Quiz & End Sem Exam
27	Elongation	Lecture	MSB201.4	Quiz & End Sem Exam
28	termination	Lecture	MSB2014	Quiz & End Sem Exam
29	amino acid activation	Lecture	MSB201.4	Quiz & End Sem Exam
30	inhibitors, post translation modification of protein	Lecture	MSB201.4	Quiz & End Sem Exam
31	Regulation in prokaryotes	Lecture	MSB201.5	Quiz & End Sem Exam
32	repressors and negative control	Lecture	MSB201.5	Quiz & End Sem Exam
33	positive control, role of cAMP	Lecture	MSB201.5	Quiz & End Sem Exam
34	Ampreceptor protein	Lecture	MSB201.5	Quiz & End Sem Exam
35	Lac operon	Lecture	MSB201.5	Quiz & End Sem Exam
36	Tryp operon	Lecture	MSB201.5	Quiz & End Sem Exam
37	His operon	Lecture	MSB201.5	Quiz & End Sem Exam
38	His operon	Lecture	MSB201.5	Quiz & End Sem Exam
39	Regulation in Eukaryotes=promoters and enhancers	Lecture	MSB201.5	Quiz & End Sem Exam
40	transcriptional regulatory protein	Lecture	MSB201.5	Quiz & End Sem Exam

41	transcriptional activators, eukaryotic repressor	Lecture	MSB201.5	Quiz & End Sem Exam
42	RNAi (SiRNA and MiRNA)	Lecture	MSB201.6	Quiz & End Sem

				Exam
43	RNAi (SiRNA and MiRNA)	Lecture	MSB201.6	Quiz & End Sem Exam
44	molecular mechanism and current application in gene silencing	Lecture	MSB201.6	Quiz & End Sem Exam
45	Antisense RNA technology, Biochemistry of ribozyme	Lecture	MSB201.6	Quiz & End Sem Exam
46	Hammer head and hairpin ribozymes	Lecture	MSB201.6	Quiz & End Sem Exam
47	Application of antisense and ribozymes in genetic engineering	Lecture	MSB201.6	Quiz & End Sem Exam
48	Application of antisense and ribozymes in genetic engineering	Lecture	MSB201.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB201.1.	Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.2.	Learn the advanced mechanism of transcription in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.3.	Develop understanding of various post-transcriptional processes in cell.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.4.	Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.5.	Understand about the advances of gene expression regulation.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.6 **.**	Develop advanced knowledge of various mechanisms of gene silencing.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –II) 2021-22						
Class: M.Sc. Biotechnology II Semester						
Subject Name: MSB 101 ADVANCED MOLECULAR BIOLOGY		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the types of nucleic acids with examples.	3
CO1	Q.2	What do you understand by semi conservative mode of DNA replication?	6
CO1	Q.3	Give an account of transcription termination in *E. coli*.	6
CO2	Q.4	Explain the significance of poly A tail in RNA.	3
CO2	Q.5a	tRNA acts as an adapter molecule in translation. Discuss.	3
	Q.5b	Discuss the different mechanisms of antisense technology.	3
CO2	Q 6	How does post-translation modification ensure the functionality of a protein? Discuss.	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Molecular Biology** /Course code **MSB-201** is level **3** for the academic year 2020-21.

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics,

advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MSB220	3	3	2	3	1	3	2	2	2	3

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED MOLECULAR BIOLOGY LAB
Course Code : MSB 220, Credits: 02, Session :2021-22 (Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend the advanced understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:
MSB220.1. Understand the practical based learning of isolation of nucleic acids and DNA protein interaction.
MSB220.2. Understand the practical based learning in-vitro transcription, translation and repair mechanism.
MSB220.3. Understand the practical based learning of PCR and Gradient PCR.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

1. Isolation of genomic DNA from prokaryotic and Eukaryotes.
2. Isolation of plasmid.
3. Study of DNA protein interaction.
4. Study of in vitro transcription.
5. Study of DNA methylation.
6. Study of DNA repair mechanism.
7. Invitro study of translation
8. Isolation of RNA
9. PCR and Gradient PCR

G. Examination Scheme:

IA			**EE**			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:

Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of genomic DNA from prokaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
2	Isolation of genomic DNA from prokaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of genomic DNA from eukaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
4	Isolation of genomic DNA from eukaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
5	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
6	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
7	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
8	Study of DNA protein interaction	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
9	Study of DNA protein interaction	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
10	Study of in vitro transcription	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
11	Study of in vitro transcription	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
12	Study of DNA methylation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
13	Study of DNA methylation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
14	Study of DNA repair mechanism	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam

15	Study of DNA repair mechanism	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
16	Invitro study of translation	Practical	MSB220.2	Class Test

				(Practical Based) & End Sem Exam
17	Invitro study of translation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
18	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
19	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
20	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
21	PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
22	PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
23	Gradient PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
24	Gradient PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB220.1.	Understand the practical based learning of isolation of nucleic acids and DNA protein interaction.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB220.2.	Understand the practical based learning in-vitro transcription, translation and repair mechanism.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB220.3.	Understand the practical based learning of PCR and Gradient PCR.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology Lab**/Course code **MSB-220** is level **3** for the academic year 2020-21.

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

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PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

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PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess

technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
III SEM	MSB302	3	3	2	3	1	3	2	2	2	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENZYME TECHNOLOGY
Course Code : MSB 302, Credits: 03, Session :2021-22 (Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The course aims to provide an understanding of the principles and application of proteins, secondary metabolites and enzyme biochemistry in therapeutic applications and clinical diagnosis. The theoretical understanding of biochemical systems would certainly help to interpret the results of laboratory experiments.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB302.1. Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action.

MSB302.2. Understand about various modes of inhibition of enzyme actions with examples.

MSB302.3. Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc.

MSB302.4. Learn enzyme reactors and various parameters for bio-process design.

MSB302.5. Learn about the concepts of bio-process design.

MSB302.6. Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal

and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Enzymes

Introduction and scope, Nomenclature, Mechanism of Catalysis, enzyme catalysis in organic media, Industrial applications.

Module II: Enzyme Kinetics

Single substrate steady state kinetics; King-Altman's method; Inhibitors and activators; Multi-substrate systems; Effect of pH and temperature; Allosteric enzymes. Thermodynamic explanation for transition complex formation, limitations of Michaelis – Menten equation, LB plot method to study enzyme kinetics, effect of pH

And temperature on kinetics,allosteric enzyme kinetics,models as WMC, KNF with examples of ACTase and Hb.

Module III: Immobilization of Enzymes

Advantages, Carriers, adsorption, covalent coupling, cross-linking and entrapment methods, Micro-environmental effects

Module IV: Enzyme Reactors

Reactors for batch/continuous enzymatic processing, Choice ot reactor type: idealized enzyme reactor systems; Mass Transfer in Enzyme Reactors: Steady state analysis of mass transfer and biochemical reaction in enzyme reactors.

Module V: Bio-process Design

Physical parameters, reactor operational stability; Immobilized cells.

Module VI: Challenges and future trends

Catalytic antibodies and Non-protein biomolecules as catalysts, Biocatalysts from Extreme Thermoph!lic and Hyperthermophilic

Archaea and Bacteria.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Enzyme Technology, M.F. Chaplin and C. Bucke, Cambridge University Press.

References:

- Biotechnological Innovations in Chemical Synthesis, R.C.B. Currell, V.D. Mieras, Biotol Partners Staff, Butterworth Heinemann.
- Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis, R.A. Copeland, John Wiley and Sons Inc.
- Enzymes Biochemistry, Biotechnology, Clinical Chemistry, Trevor Palner
- Enzyme Kinetics: Behaviour and Analysis of Rapid Equilibrium and Steady State Enzyme Systems, I.H. Segel, Wiley-Interscience
- Industrial Enzymes & their applications, H. Uhlig, John Wiley and Sons Inc

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction and scope	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
2	Nomenclature	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
3	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
4	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
5	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
6	enzyme catalysis in organic media	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
7	Industrial applications	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
8	Single substrate steady state kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
9	Single substrate steady state kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
10	King-Altman's method	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
11	Inhibitors and activators	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
12	Multi-substrate systems	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam

13	Effect of pH and temperature	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
14	Allosteric enzymes	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam

15	Thermodynamic explanation for transition complex formation	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
16	limitations of Michaelis – Menten equation	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
17	LB plot method to study enzyme kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
18	effect of pH and temperature on kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
19	allosteric enzyme kinetics	Lecture	MSB302.2	Quiz & End Sem Exam
20	models as WMC, KNF with examples of ACTase and Hb	Lecture	MSB302.2	Quiz & End Sem Exam
21	models as WMC, KNF with examples of ACTase and Hb	Lecture	MSB302.2	Quiz & End Sem Exam
22	Advantages, Carriers, adsorption	Lecture	MSB302.3	Quiz & End Sem Exam
23	covalent coupling, cross-linking and entrapment methods	Lecture	MSB302.3	Quiz & End Sem Exam
24	covalent coupling, cross-linking and entrapment methods	Lecture	MSB302.3	Quiz & End Sem Exam
25	Micro-environmental effects	Lecture	MSB302.3	Quiz & End Sem Exam
26	Reactors for batch/continuous enzymatic processing	Lecture	MSB302.4	Quiz & End Sem Exam
27	Choice of reactor type: idealized enzyme reactor systems	Lecture	MSB302.4	Quiz & End Sem Exam
28	Mass Transfer in Enzyme Reactors	Lecture	MSB302.4	Quiz & End Sem Exam
29	Steady state analysis of mass transfer	Lecture	MSB302.4	Quiz & End Sem Exam
30	biochemical reaction in enzyme reactors	Lecture	MSB302.4	Quiz & End Sem Exam
31	Physical parameters	Lecture	MSB302.5	Quiz & End Sem Exam
32	reactor operational stability	Lecture	MSB302.5	Quiz & End Sem Exam
33	Immobilized cells	Lecture	MSB302.5	Quiz & End Sem Exam
34	Catalytic antibodies and Non-protein biomolecules as catalysts	Lecture	MSB302.6	Quiz & End Sem Exam
35	Biocatalysts from Extreme Thermophilic bacteria	Lecture	MSB302.6	Quiz & End Sem Exam
36	Hyperthermophilic Archaea and Bacteria	Lecture	MSB302.6	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB302.1.	Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB302.2.	Understand about various modes of inhibition of enzyme actions with examples.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB302.3.	Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB302.4.	Learn enzyme reactors and various parameters for bio-process design.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB302.5.	Learn about the concepts of bio-process design.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB302.6.	Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1

Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2021-22		
Class: M.Sc. Biotechnology III Semester		
Subject Name: MSB 302 ENZYME TECHNOLOGY	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss in brief about the nomenclature of Enzymes.	3
CO1	Q.2	Explain the Lineweaver Burk plot & its significance.	6
CO1	Q.3	Give a brief account on enzyme kinetics.	6
CO2	Q.4	Briefly discuss the properties of an inhibitor.	3
CO2	Q.5a	Discuss the acid-base catalysis in brief.	3
	Q.5b	What is reversible inhibition? Discuss in brief.	3
CO2	Q 6	Discuss the Michaelis-Menten equation. Derive the double reciprocal plot with this equation.	6

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Enzyme Technology**/Course code **MSB-302** is level **3** for the academic year 2020-21.

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2020-21

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess

technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
III SEM	MSB321	3	3	2	3	1	3	2	2	2	1

AMITY UNIVERSITY

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Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENZYME TECHNOLOGY LAB
Course Code : MSB 321, Credits: 01, Session :2021-22 (Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend advanced understanding of isolation, recovery, and immobilization of enzymes.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB321.1. Understand the practical based learning of Isolation of industrially important microorganisms and growth curve.

MSB321.2. Understand the practical based learning ethanol production, production of antibiotics and fermentation.

MSB321.3. Understand the practical based learning of downstream processing.

MSB321.4. Understand the practical based learning of enzyme assay, enzyme purification and kinetics.

MSB321.5. Understand the practical based learning of enzyme production and immobilization.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Isolation of industrially important microorganisms for microbial processes.
Determination of Thermal Death Point and Thermal death time of microorganisms for design of a sterilizer
Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.

Module II
Comparative studied of ethanol production using different substrates.
Microbial production of antibiotics (Penicillin)
Production and estimation of alkaline protease
Sauer Krant fermentation

Module III: Downstream processing
Conventional filtration
Protein precipitation and recovery
Aqueous two-phase separation
Ion exchange chromatography
Gel filtration

Membrane based filtration i.e. Micro filtration and cross filtration in cross flow Modules.

Module IV

Isolation of Enzymes from plant and microbial sources.

Enzyme assay; activity and specific activity – determination of amylase, nitrate reductase, cellulose, protease.

Purification of Enzyme by ammonium sulphate fractionation.
Enzyme Kinetics: Effect of varying substrate concentration on enzyme activity
Effect of Temperature and pH on enzyme activity.

Module V

Production of enzyme on industrial scale using solid and state fermentation
Enzyme immobilization

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of industrially important microorganisms for microbial processes.	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
2	Determination of Thermal Death Point and Thermal death time of microorganisms for design of a sterilizer	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
3	Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
4	Comparative studied of ethanol production using different substrates. Microbial production of antibiotics (Penicillin)	Practical	MSB321.2	Class Test (Practical Based) & End Sem Exam
5	Production and estimation of alkaline protease Sauer Krant fermentation	Practical	MSB321.2	Class Test (Practical Based) & End Sem Exam

6	Conventional filtration Protein precipitation and recovery	Practical	MSB321.3	Class Test (Practical Based) & End Sem Exam
7	Aqueous two-phase separation	Practical	MSB321.3	Class Test

	Ion exchange chromatography Gel filtration			(Practical Based) & End Sem Exam
8	Membrane based filtration i.e. Micro filtration and cross filtration in cross flow Modules.	Practical	MSB321.3	Class Test (Practical Based) & End Sem Exam
9	Isolation of Enzymes from plant and microbial sources. Enzyme assay; activity and specific activity – determination of amylase, nitrate reductase, cellulose, protease.	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
10	Purification of Enzyme by ammonium sulphate fractionation. Enzyme Kinetics: Effect of varying substrate concentration on enzyme activity	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
11	Effect of Temperature and pH on enzyme activity	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
12	Production of enzyme on industrial scale using solid and state fermentation Enzyme immobilization	Practical	MSB321.5	Class Test (Practical Based) & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB321.1.	Understand the practical based learning of Isolation of industrially important microorganisms and growth curve.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.2.	Understand the practical based learning ethanol production, production of antibiotics and fermentation.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.3.	Understand the practical based learning of downstream processing.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.4.	Understand the practical based learning of enzyme assay, enzyme purification and kinetics.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.5.	Understand the practical based learning of enzyme production and immobilization.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Enzyme Technology Lab**/Course code **MSB-321** is level **3** for the academic year 2020-21.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
I	MTB 123	3	3	3	1	1	-	-	1	2	1	3	2	1	1

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOINFORMATICS LAB
Course Code : MTB 123, Crédits : 01, Session :2020-21(Odd Sem.), Class : M.Tech 1st Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to demonstrate the techniques and software's used for sequence analysis, alignment, structure prediction of the proteins and other compounds, docking and finding the phylogenetic relationships.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MTB 123.1. Understand about Retrieving of nucleotide and protein sequence through NCBI database.

MTB 123.2. Understand the nucleotide and protein sequence alignment methods through different types of algorithm and able to make phylogenetic tree.

MTB 123.3. Experimental understanding of different structure of protein.

MTB 123.4. Experimental prediction of the databases related to Phylogenetic.

MTB 123.5. Describe the molecular docking and visualization of structure.

MTB 123.6. Experimental demonstration of finding of transcription regulatory signals.

c. Programme Outcomes:

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of

biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.
PO8: Ability to communicate effectively and develop scientific writing.
PO9. Inculcation of ability to think independently for problem solving.
PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.
PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**
Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal	Mid Term 1	CT	15%

Evaluation	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a	A	5%

	student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.		
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Basics of sequence analysis Retrieving a sequence-nucleic acid/Protein
Module II
Local and Global Alignment- concepts Pair wise sequence alignment, multiple sequence alignment Dynamic Programming – Smith Watermann Algorithm Needleman Wunsch Algorithm
Module III
Motif and pattern searching, Structure prediction, Protein structure classification resources, Structure superposition tools, Energy minimization and simulated annealing
Module IV
Phylogenetic prediction and analysis
Module V
Docking small molecules/peptides in active site of protein. Use of automated docking procedures. Free energy calculation.
Module VI
Finding transcription regulatory signals

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Essentials of Genomics and Bioinformaticsby C.W. Sensen, John Wiley and Sons
- Bioinformatics: Sequence and Genome Analysis by D.W. Mount, Cold Spring Harbor Laboratory Press.
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by A.D. Baxevanis and B.F.F Ouellette, Wiley – interscience.

References:

- Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology by D. Gusfield, Cambridge University Press

- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by G. Von Heijne and G. Von Heijne, Academic Press.
- Computational Molecular Biology: An Algorithmic Approach by P.A. Pevzner, MIT Press
- Computer Methods for Macromolecular Sequence Analysis by R.F. Doolittle, J.N, Abelson, M.I. Simon, Academic press
- Essentials of Genomics and Bioinformatics C.W. Sensen, John Wiley and Sons Inc.
- Introduction to Computational Biology: Maps, Sequences and Genomes by M. Waterman, Chapman and Hall
- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by G. V. Heijne and G.V. Heijne, Academic Press

I. **Lecture Plan**

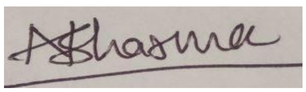
Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Basics of sequence analysis Retrieving a sequence- Protein	Practical	MTB 123.1	Mid Term-1, Quiz & End Sem Exam
2	Basics of sequence analysis Retrieving a sequence-nucleic acid	Practical	MTB 123.1	Mid Term-1, Quiz & End Sem Exam
3	Local Alignment	Practical	MTB 123.2	Mid Term-1, Quiz & End Sem Exam
4	Global Alignment	Practical	MTB 123.2	Mid Term-1, Quiz & End Sem Exam
5	Pair wise sequence alignment	Practical	MTB 123.2	Mid Term-1, Quiz & End Sem Exam
6	Multiple sequence alignment	Practical	MTB 123.2	End Sem Exam
7	Motif and pattern searching	Practical	MTB 123.3	End Sem Exam
8	Structure prediction, Protein structure classification resources	Practical	MTB 123.3	End Sem Exam
9	Structure superposition tools, Energy minimization and simulated annealing	Practical	MTB 123.3	End Sem Exam
10	Phylogenetic prediction and analysis	Practical	MTB 123.4	End Sem Exam
11	Docking	Practical	MTB 123.3	End Sem Exam
12	Finding transcription regulatory signals	Practical	MTB 123.3	End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 123.1.	Understand about Retrieving of nucleotide and protein sequence through NCBI database.	3	3	1	3	1				2	1	3	2	1	1
MTB 123.2.	Understand the nucleotide and protein sequence alignment methods through different types of algorithm and able to make phylogenetic tree.	3	3	1	3	1				2	1	3	2	1	1
MTB 123.3.	Experimental understanding of different structure of protein.	3	3	1	3	1				1	1	3	2	1	1
MTB 123.4.	Experimental prediction of the databases related to Phylogenetic	3	3	2	3	2				1	1	3	2	1	1
MTB 123.5.	Describe the molecular docking and visualization of structure.	2	3	1	2	3				2	1	3	2	1	1
MTB 123.6.	Experimental demonstration of finding of transcription regulatory signals.	2	3	1	2	3				2	1	3	2	1	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course *Advanced Immunology lab*/Course code *MTB 320* is level 3 for the academic year 2020-21.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
I	MTB 104	3	3	3	1	1	-	-	1	2	1	3	2	1	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOINFORMATICS
Course Code : MTB 104, Crédits : 04, Session :2020-21(Odd Sem.), Class : M.Tech 1st Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe data models and database management systems with an emphasis on biologically important techniques to store various data on DNA sequencing structures, genetic mapping, phylogenetic analysis. Multiple sequence alignment, protein structure prediction, and comparative genome analysis.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MTB 104.1. Understand about nucleotide and protein sequence retrieval, submission through NCBI database.

MTB 104.2. Understand the nucleotide and protein sequence alignment methods through different types of algorithm used.

MTB 104.3. Predict the phylogenetic tree and evolutionary relationship.

MTB 104.4. Predict the databases related to functional gene sequences and their analysis through identification and classification

MTB 104.5. Describe the molecular modeling using protein databank, docking and visualization of structure.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with

detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9. Inculcation of ability to think independently for problem solving.

PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%

Total			**100%**

F. Syllabus

Module I: Introduction and overview

The NCBI, sequence databases, sequence retrieval, sequence file formats, submitting DNA, protein sequences and sequence assembly.

Module II

Exact string matching -classical comparison based methods, semi numerical string matching, suffix trees -construction and application, Databases and rapid sequence analysis –Blast and Fasta , sequence comparison by statistical content; Dynamic programming alignment -The number of alignments, shortest and longest paths in a network, global distance and similarity alignments, Fitting one sequence onto the other, trace backs, parametric sequence comparison

Module III

Global and local alignments, scoring matrices-pam and blosum and gap penalties, filtering, position specific scoring matrices, internet resources , uses of multiple sequence alignment programs and methods pattern searching programs, family and superfamily representation & profit analysis.

Module IV

Trees-representation of sequences, tree interpretation, Distance – additive, ultrameric and nonadditive distances, tree building methods, phylogenetic analysis, parsimony, Bootstrap, maximum likelihood trees , estimating the rate of change, likelihood and trees; analysis software.

Module V

Annotation, ESTs – databases, comparative genome analysis clustering, gene discovery, protein identification, physical properties, motifs and patterns, structure, folding classes, structure classification; Structure databases– PDB and MMDB, visualizing structural information, Docking of Molecules, structure prediction in proteins, prediction of buried residues in proteins, RNA secondary structure –minimum free-energy structures, Genome analysis, genome rearrangements with inversions, gene identification, gene expression, expression analysis, gene identification and functional classification.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Essentials of Genomics and Bioinformaticsby C.W. Sensen, John Wiley and Sons
- Bioinformatics: Sequence and Genome Analysis by D.W. Mount, Cold Spring Harbor Laboratory Press.
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by A.D. Baxevanis and B.F.F Ouellette, Wiley – interscience.

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- Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology by D. Gusfield, Cambridge University Press
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- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by G. V. Heijne and G.V. Heijne, Academic Press

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	The NCBI, sequence databases, sequence retrieval, sequence file formats	Lecture	MTB 104.1.	Mid Term-1, Quiz & End Sem Exam
2	Submitting DNA, protein sequences and sequence assembly.	Lecture	MTB 104.1.	Mid Term-1, Quiz & End Sem Exam
3	Exact string matching - classical comparison based methods, semi numerical string matching, suffix trees - construction and application	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
4	Databases and rapid sequence analysis –Blast and Fasta	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
5	Sequence comparison by statistical content;	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
6	Dynamic programming alignment -The number of alignments, shortest and longest paths in a network, global distance and similarity alignments,	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
7	Fitting one sequence onto the other, trace backs, parametric sequence comparison	Lecture	MTB 104.2	Mid Term-1, Quiz & End Sem Exam
8	Global and local alignments	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam
9	Scoring matrices-pam and blosum	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam
10	Gap penalties, filtering, position specific scoring matrices,	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam
11	Internet resources,	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam

12	Uses of multiple sequence alignment programs and methods pattern searching programs, family and superfamily	Lecture	MTB 104.3	Mid Term-1, Quiz & End Sem Exam

	representation & profit analysis.			
13	Trees-representation of sequences	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
14	Tree interpretation, Distance – additive, ultrameric and nonadditive distances, tree building methods,	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
15	Phylogenetic analysis, parsimony,	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
16	Phylogenetic analysis, parsimony,	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
17	Bootstrap, maximum likelihood trees , estimating the rate of change, likelihood and trees;	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
18	Bootstrap, maximum likelihood trees , estimating the rate of change, likelihood and trees;	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
19	Analysis software	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
20	Analysis software	Lecture	MTB 104.4	Mid Term-1, Quiz & End Sem Exam
21	Annotation, ESTs – databases,	Lecture	MTB 104.5	Mid Term-2, Quiz & End Sem Exam
22	comparative genome	Lecture	MTB 104.5	Mid Term-2, Quiz & End Sem Exam
23	analysis clustering,	Lecture	MTB 104.5	Mid Term-2, Quiz & End Sem Exam
24	gene discovery,	Lecture	MTB 104.5	Quiz & End Sem Exam
25	protein identification,	Lecture	MTB 104.5	Quiz & End Sem Exam
26	Physical properties,	Lecture	MTB 104.5	Quiz & End Sem Exam

27	Motifs and patterns,	Lecture	MTB 104.5	Quiz & End Sem Exam
28	Structure, folding classes,	Lecture	MTB 104.5	Quiz & End

				Sem Exam
29	structure classification; Structure databases– PDB and MMDB,	Lecture	MTB 104.5	Quiz & End Sem Exam
30	Visualizing structural information,	Lecture	MTB 104.5	Quiz & End Sem Exam
31	Docking of Molecules,	Lecture	MTB 104.5	Quiz & End Sem Exam
32	Structure prediction in proteins,	Lecture	MTB 104.5	Quiz & End Sem Exam
33	Prediction of buried residues in proteins,	Lecture	MTB 104.5	Quiz & End Sem Exam
34	RNA secondary structure –	Lecture	MTB 104.5	Quiz & End Sem Exam
35	minimum free	Lecture	MTB 104.5	Quiz & End Sem Exam
36	minimum free	Lecture	MTB 104.5	Quiz & End Sem Exam
37	Genome analysis	Lecture	MTB 104.5	Quiz & End Sem Exam
38	Genome analysis	Lecture	MTB 104.5	Quiz & End Sem Exam
39	Genome rearrangements with inversions	Lecture	MTB 104.5	Quiz & End Sem Exam
40	Genome rearrangements with inversions	Lecture	MTB 104.5	Quiz & End Sem Exam
41	Gene identification,	Lecture	MTB 104.5	Quiz & End Sem Exam
42	Gene identification,	Lecture	MTB 104.5	Quiz & End Sem Exam
43	Gene expression,	Lecture	MTB 104.5	Quiz & End Sem Exam
44	Gene expression	Lecture	MTB 104.5	Quiz & End Sem Exam
45	Gene expression	Lecture	MTB 104.5	Quiz & End Sem Exam
45	Expression analysis,	Lecture	MTB 104.5	Quiz & End Sem Exam
46	Expression analysis,	Lecture	MTB 104.5	Quiz & End Sem Exam
47	Gene identification and functional classification.	Lecture	MTB 104.5	Quiz & End Sem Exam
48	Gene identification and functional classification.	Lecture	MTB 104.5	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 104.1	Understand about nucleotide and protein sequence retrieval, submission through NCBI database.	3	3	1	3	1				2	1	3	2	1	1
MTB 104.2	Understand the nucleotide and protein sequence alignment methods through different types of algorithm used.	3	3	1	3	1				2	1	3	2	1	1
MTB 104.3	Predict the phylogenetic tree and evolutionary relationship.	3	3	1	3	1				1	1	3	2	1	1
MTB 104.4	Predict the databases related to functional gene sequences and their analysis through identification and classification	3	3	2	3	2				1	1	3	2	1	1
MTB 104.5	Describe the molecular modeling using protein databank, docking and visualization of structure.	2	3	1	2	3				2	1	3	2	1	1


AMITY INSTITUTE OF BIOTECHNOLOGY
AUNP

Sample Question Paper

Amity Institute Biotechnology 2020-21						
Class: M.Tech. Biotechnology I Semester						
Subject Name: Computational Biology		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand and explain the development of computational biology.
- Describe the fundamentals of bioinformatics databases and their application.
- Understand and explain the use of various computational methods for phylogentic studies.
- Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling.
- Explain the applications of computational biology in different fields of sciences.

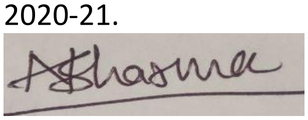
CO Map	Question No.	Question	Marks
CO1	Q.1	Bioinformatics is the integrated field of science" Explain this statement with suitable examples.	6
CO2	Q.2	What is a primary sequence database? Give any five examples of primary databases with features.	6
	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	Compare the Global and Local alignment methods with suitable example of matrix.	6
CO4	Q.5	Give the description of commonly used secondary databases of nucleic acid and protein.	6
CO3	Q.6	Write any five applications of bioinformatics in biological sciences and agriculture.	6

	Q.7	BLAST is a popular program for exploring protein family relationship. Discuss the types and applications of BLAST program.	10
CO4	Q.8	What is Neighbor-joining and UPGMA method? How it is useful in	10

		constructing phylogenetic tree.	
CO3	Q.9	What is sequence alignment? Write the difference between pairwise and multiple sequence alignment.	10
CO3	Q.10	A. Consider the following multiple sequence alignment: A.TCGGTAGGCT B. ACCGTTCCAT C. ACCCAAGGCT D. ATGGTAGGCT How many rooted and un-rooted phylogenies can you construct out of the taxa shown in the alignment? Explain any one method to construct a phylogenetic tree. B. Explain dendogram, cladogram and phylogram. How many different unrooted and rooted trees topologies are possible for 3, 4 and 5 species?	20

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Bioinformatics***/Course code ***MTB 104*** is level **3** for the academic year 2020-21.



		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
III	MTB 301	3	3	3	1	1	-	-	1	2	1	3	2	1	1

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY
Course Code : MTB 301, Crédits : 03, Session :2020-21(Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The aim to teach immunology and immuno technology to the students for their better understanding of immune system, types and mechanism of immunity, immune responses, their tolerance and suppression as well as tools and techniques involved in diagnosis and identification of immune related diseases.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MTB 301.1. Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.

MTB 301.2. Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.

MTB 301.3. Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.

MTB 301.4. the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9. Inculcation of ability to think independently for problem solving.

PO10. Ability to design and conduct experiments in biotechnology and analyze data**.**

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Types of immunity - innate, aquired, passive and active physiology of immune response – MI and CMI specificity and memory. Antigen, antibody reactions. Antigens types Hapten, immunoglobuin structure, distribution and function

Module II

Molecular biology of Ig synthesis, Lymphoid tissues – ontogeny and physiology of immuno system - origin and development, differentiation of lymphocytes. Lymphocyte subpopulation of mouse and man. Structure and function of class I and II molecules antigen distribution in population – HLA in human health and diseases. Transplantation immunity – organ transplantation and HLA tissue typing.

Module III

Cell mediated cytotoxicity. Hypersensitivity reactions, cellular interaction in immune response. Antigen recognition. T.B. cell receptors, MHC restriction, Lymphocyte activation clonal proliferation, differentiation. Interleukins and their roles. The complement systems mode of activation, classical and alternate pathway biological functions.

Module IV

Introduction to tumor immunology, autoimmune disorders and immunology of infectious diseases. Antigen antibody reactions in vitro methods agglutination precipitation, complement fixation, immunofluorescence, immunoelectrophoresis, ELISA, Radio immuno assays, In vitro methods, skin tests and immune complex tissue demonstrations. Applications of these methods in diagnosis of microbial infections, Vaccines

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE

Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;

A: Attendance

H. Suggested Text/Reference Books:

Text:

- Kuby Immunology, R.A. Goldsby, T.J. Kindt and B.A. Obsorne, Freeman
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company

References:

- Immunology (Sixth Edition), Roitt, Brostoff, Male, Panima Publication
- Fundamentals of Immunology, W. Paul, Lippincot Williams and Wilkins
- Immunology, W.L. Anderson, Frence Creek Publishing (Blackwell)
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.
- Immunology, Poitt, Mosby – Yearbook Inc.
- Perkin Elmer Antibody Manual
- Production of Monoclonal Antibodies – Detailed Protocol, G.K. Lewis, University of Maryland

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Type of immunity	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
2	Antigen and haptens	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
3	Antibody : function and structure	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
4	Types of antibody and their functions	Lecture	MTB 301.1.	Mid Term-1, Quiz & End Sem Exam
5	Synthesis of Ig molecule	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
6	Light Chain gene rearrangement	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
7	Heavy Chain gene rearrangement	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
8	Antibody Diversity	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
9	Primary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
10	Primary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
11	Secondary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam

12	Secondary lymphoid organs	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
13	MHC I: Structure, types and function	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam

14	MHC II: Structure, types and function	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
15	Transplantation Immunology	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
16	Cell mediated cytotoxicity	Lecture	MTB 301.2	Mid Term-1, Quiz & End Sem Exam
17	Hypersensitivity : Types and function.	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
18	Hypersensitivity : Types and function.	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
19	Complement system: Types and importance	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
20	Complement system: Types and importance and Regulation	Lecture	MTB 301.3	Mid Term-1, Quiz & End Sem Exam
21	Lymphocyte activation and clonal proliferation	Lecture	MTB 301.3	Mid Term-2, Quiz & End Sem Exam
22	Antigen recognition and T.B. cell receptor	Lecture	MTB 301.3	Mid Term-2, Quiz & End Sem Exam
23	Revision of module I and II	Lecture	MTB 301.3	Mid Term-2, Quiz & End Sem Exam
24	Introduction of tumor immunology	Lecture	MTB 301.3	Quiz & End Sem Exam
25	Tumor immunology	Lecture	MTB 301.4	Quiz & End Sem Exam
26	Autoimmune disorder: Organ specific	Lecture	MTB 301.4	Quiz & End Sem Exam
27	Autoimmune disorder: systemic	Lecture	MTB 301.4	Quiz & End Sem Exam
28	Autoimmunity : mechanism and regulation	Lecture	MTB 301.4	Quiz & End Sem Exam
29	Agglutination reaction	Lecture	MTB 301.4	Quiz & End Sem Exam
30	Precipitation reaction	Lecture	MTB 301.4	Quiz & End Sem Exam
31	Complement fixation	Lecture	MTB 301.4	Quiz & End Sem Exam
32	Immunofluorescence and immunoelectrophoresis	Lecture	MTB 301.4	Quiz & End Sem Exam
33	ELISA and RIA	Lecture	MTB 301.4	Quiz & End Sem Exam
34	Skin test and immune complex tissue demonstration	Lecture	MTB 301.4	Quiz & End Sem Exam
35	Application of these methods in diagnosis of microbial infection, Vaccines	Lecture	MTB 301.4	Quiz & End Sem Exam

36	Immunofluorescence and immunoelectrophoresis	Lecture	MTB 301.4	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 301.1	Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.	3	3	3	1	1	-	-	1	2	1	3	2	1	1
MTB 301.2	Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MTB 301.3	Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

MTB 301.4	the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer,	3	3	3	1	1	-	-	1	2	1	3	1	3	1

	including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.														

Sample Question Paper

Amity Institute Biotechnology 2020-21
Class: M.Tech. Biotechnology IIISemester

Subject Name: ADVANCED IMMUNOLOGY	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
- Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
- Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
- the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

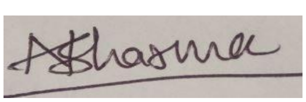
CO Map	Question No.	Question	Marks
CO1	Q.1	Specific immunity exhibits four characteristic attributes, which are mediated by lymphocytes. List these four attributes and briefly explain how they arise.	6

CO2	Q.2	Draw a schematic diagram of a typical IgG molecule and label each of the following parts: H chains, L chains, inter-chain disulfide bonds, intra-chain disulfide bonds, hinge, Fab, Fc, and all the domains. Indicate which domains are involved in antigen binding.	6

	Q.3	What is multiple sequence alignment? Explain about sum of pair method of MSA.	6
CO4	Q.4	What is antigen? Discuss about the typing procedures for HLA antigens.	6
CO4	Q.5	Describe one advantage and one disadvantage of N-nucleotide addition during the rearrangement of immunoglobulin heavy-chain gene segments.	6
CO3	Q.6	Explain why NK cells from a given host will kill many types of virus-infected cells but do not kill normal cells from that host.	6
	Q.7	Discuss about that the role of cell-Mediated Immunity is Important for Viral Control and Clearance.	10
CO4	Q.8	What is the mechanism of tumor generation and how does normal cells are differentiated from transformed cells?	10
CO3	Q.9	Describe the main stages of leukocyte migration from the blood to a site of inflammation.	10
CO3	Q.10	What are the hallmark features of adaptive immunity? An individual has a mutation severely inhibiting the natural function of the transporter associated with antigen processing (TAP). Which antigen processing pathway would be rendered inefficient? What classes of agents would the individual have a problem attacking and why?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Advanced Immunology***/Course code ***MTB 301*** is level **3** for the academic year 2020-21.



AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED IMMUNOLOGY LAB
Course Code : MTB 320, Crédits : 01, Session :2020-21(Odd Sem.), Class : M.Tech. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The objective is to describe the immunological questions through experimentation. The aim is also to explain the antigen antibody interaction patterns through various experiments.

B. **Course Outcomes:** After successful completion of the course student will be able to:

MTB 320.1. Demonstrate detailed knowledge of purification of immunologlobulin, cells and antigen antibody interaction.

MTB 320.2. Apply knowledge and incorporate experimental understanding of the agglutination mechanism.

MTB 320.3. Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

The course aims to provide an advanced understanding of the core principles and topics of

Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research

project. Therefore, the programme envisaged the following main objectives:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9. Inculcation of ability to think independently for problem solving.

PO10. Ability to design and conduct experiments in biotechnology and analyze data.

D. **Programme Specific Outcomes:**

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. **Assessment Plan:**

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Class Test (Practical Based)	CT	15%
	Mid Term Viva	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			100%

IA			EE			
Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

F. **Syllabus**

Course Contents:

1. Purification of immunoglobin G.
2. Study of antigen- antibody pattern (ODD).
3. Study of sandwich ELISA.
4. Study of haemeagglutination.
5. Study of immunoelectrophoresis.
6. Isolation and identification of rosette cells.
7. Antigen capture ELISA

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;

A: Attendance

H. Suggested Text/Reference Books:

- Manual of Molecular and Clinical Laboratory Immunology, 8th Edition Barbara Detrick (Editor), John L. Schmitz (Editor), Robert G. Hamilton (Editor) ISBN: 978-1-555-81871-5 May 2016 ASM Press
- Immunology Laboratory Manual Published by LAP LAMBERT Academic Publishing (2018) ISBN 10: 6138386175 ISBN 13: 9786138386179

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Purification of Immunoglobulin G	Lecture	MTB 320.1	Mid Term-1, Quiz & End Sem Exam
2	Radial Immuno Diffusion Test	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam
3	Double Immuno Diffusion Test	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam
4	Study of sandwich ELISA	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam

5	Study of DOT ELISA	Lecture	MTB 320.2	Mid Term-1, Quiz & End Sem Exam
6	Study of heamagglutination (Blood group)	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam

7	Rh factor determination	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
8	Study of heamagglutination (Widal test)	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
9	Study of immunoelectrophoresis	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
10	Study of rocket immunoelectrophoresis	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
11	Isolation and identification of rostte cells	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam
12	Revision and discussion	Lecture	MTB 320.3	Mid Term-1, Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MTB 320.1	Demonstrate detailed knowledge of purification of immunoglobulin, cells and antigen antibody interaction.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MTB 320.2	Apply knowledge and incorporate experimental understanding of the agglutination mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MTB 320.3	Apply knowledge and incorporate experimental understanding of immunoeletrophoresis mechanism.	3	3	3	1	1	-	-	1	2	1	3	1	3	1

Sample Question Paper

Amity Institute Biotechnology 2020-21						
Class: M.Tech. Biotechnology III Semester						
Subject Name: Advanced Immunology Lab		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.3 & Q.4	Q.1		Q.2		

Student will be able to:

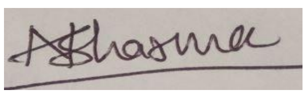
- Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies.
- Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions.
- Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity.
- the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

CO Map	Question No.	Question	Marks
CO1	Q.1	Perform Dot Elisa for detection of antigen-antibody interaction.	35
CO2	Q.2	Perform hemagglutination (Blood group) test.	15
	Q.3	*Viva-voce*	10

CO 3	Q.4	Record	10

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course *Advanced Immunology lab*/Course code *MTB 320* is level 3 for the academic year 2020-21.



AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Physiology- I
Course Code : BMB 305, Crédits : 03, Session : 2021-22 (Third Sem.), Class : B.Sc. M.Sc dual degree 2nd Year
Faculty Name : **Dr. Asha Singh**

Introduction: The objective of this course is to provide the knowledge about animal physiology that shall be useful to understand and apply different concepts of biotechnology. The knowledge gained from animal physiology-I will be helpful for students to realize the significance of physiology towards its importance in modern biotechnology.

A. Course Outcomes: At the end of the course, students will be able to:

BMB305.1 Learn about basic knowledge anatomical and physiological aspects of Respiratory System.

BMB305.2. Gain knowledge about role of various chemical secretions in body and understand the basics of regulatory mechanisms & functioning of digestive systems.

BMB305.3. Generate path for further research and innovation by understanding the important phenomenon of hemodynamic & living system.

BMB305.4. Enhance new collaborative approaches with modern fields of biotechnology and neuromuscular system.

B. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

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PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

C. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25%includesalltypesofleaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

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E. Syllabus

Module I:

Physiology of Respiratory System: Organs for respiration in mammals, Mechanism of respiration, Physiology of respiration (transport of gases and chloride shift), Properties and function of respiratory pigments.

Module II:

Physiology of Digestive System *Composition and function of saliva, Mechanical and chemical digestion, Functions of pancreatic juices and biles, Absorption and distribution of food*

Module III:

Physiology of Cardiovascular System Blood composition and Hemopoisis, Blood Groups and Blood Transfusion, Blood Clotting, Hemodynamics, Cardiac Cycle and its regulation,

Module IV:

Physiology of Neuromuscular System *Contraction and relaxation of muscle, Sarcomere, Cori‟s cycle, Organization of Nervous System, Neuron, Nerve Impulse, Synaptic Transmission, Neurotransmitters.*

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- • Guyton, A.C. and Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. / W.B. Saunders Company.
- Tortora, G.J. and Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons, Inc.
- Ganong, H, Review of Medial Physiology 14th edition, Appleton &Lange Publisher, New York
- Shier, D., Butler, J. and Lewis, R., Hole‟s Human Anatomy and Physiology, (10th Edition) 2003. WCB/McGraw Hill, Boston.
- T. C. Majpuria. A text book of zoology.
- V.K Tiwari, A Text book of Zoology
- Ramesh Gupta, A Text book of Zoology

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Physiology of Respiratory System: Introduction	Lecture	BMB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
2	Organs for respiration in mammals	Lecture	BMB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
3	Mechanism of respiration	Lecture	BMB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
4	*Physiology of respiration*	Lecture	BMB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
5	transport of gases	Lecture	BMB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
6	Respiratory pigments: Introduction	Lecture	BMB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
7	Properties of Respiratory pigments	Lecture	BMB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
8	Functions of Respiratory pigments	Lecture	BMB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
9	Respiratory pigments	Lecture	BMB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
10	Digestive System: Introduction	Lecture	BMB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

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11	Physiology of Digestive System	Lecture	BMB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
12	Composition and	Lecture	BMB305.2.	Mid Term-1, Quiz,

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	function of saliva,			Home assignments, Seminar & End Sem Exam
13	Mechanical digestion	Lecture	BMB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
14	chemical digestion	Lecture	BMB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
15	*Functions of pancreatic juices*	Lecture	BMB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
16	*Functions of* biles *juices*	Lecture	BMB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
17	Absorption of food	Lecture	BMB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
18	Distribution of food	Lecture	BMB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
19	Cardiovascular System: Introduction	Lecture	BMB305.3 .	Home assignments, Quiz, Seminar & End Sem Exam
20	Physiology of Cardiovascular System	Lecture	BMB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
21	Blood composition	Lecture	BMB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
22	Hemopoisis	Lecture	BMB305.3.	Home assignments, Quiz, Seminar & End Sem Exam

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23	Blood Groups	Lecture	BMB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
24	Blood Transfusion	Lecture	BMB305.3.	Home assignments, Quiz, Seminar &

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				End Sem Exam
25	Blood Clotting	Lecture	BMB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
26	Hemodynamics	Lecture	BMB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
27	Cardiac Cycle: Introduction	Lecture	BMB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
28	Cardiac Cycle regulation	Lecture	BMB305.4 .	Home assignments, Quiz, Seminar & End Sem Exam
29	Neuromuscular System	Lecture	BMB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
30	Physiology of Neuromuscular System	Lecture	BMB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
31	Contraction of muscle	Lecture	BMB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
32	Relaxation of muscle	Lecture	BMB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
33	Sarcomere,	Lecture	BMB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
34	Cori‟s cycle,	Lecture	BMB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
35	Organization of Nervous System	Lecture	BMB305.4.	Home assignments, Quiz, Seminar & End Sem Exam

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36	Neuron, Nerve Impulse, Synaptic Transmission, Neurotransmitters.	Lecture	BMB305.4.	Home assignments, Quiz, Seminar & End Sem Exam

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I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BMB305.1	Learn about basic knowledge anatomical and physiological aspects of Respiratory System.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	
BMB305.2 .	Gain knowledge about role of various chemical secretions in body and understand the basics of regulatory mechanisms & functioning of digestive systems.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BMB305.3 .	Generate path for further research and innovation by understanding the important phenomenon of hemodynamic & living system.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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BMB305.4 .	Enhance new collaborative approaches with modern fields of biotechnology and neuromuscular system.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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Sample Question Paper

Amity Institute of Biotechnology Amity University Madhya Pradesh						
Class: B.Sc. M.Sc. Dual Biotechnology 3rd Semester						
Subject Name: BMB 305 Animal Physiology-I		Time:3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	
Student will be able to						

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss about the various organs of respiration in animals.	6
CO1	Q.2	What are respiratory pigments, discuss their importance.	6
	Q.3	What is saliva, discuss about its composition and function.	6
CO1	Q.4	Discuss about Hamburger phenomenon.	6
CO2	Q.5	Describe in detail about intestinal digestion.	6
	Q6	What is the difference between the phenomenon of breathing and cellular respiration?	6
CO2	Q.7	Explain about the transportation of Gases.	10
CO2	Q.8	Explain about the various enzymes used in the process of digestion.	10
CO3	Q.9	What is dentition, discuss about its type and function in man.	10
CO3	Q.10	(a) Elucidate the detail structure of nerve cell. (b) Describe the different modes of impulse conduction.	20

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Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Physiology-*I*** /Course code ***BMB 305*** is level **3** for the academic year ***2021-22***.

Asha Singh

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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Physiology- I
Course Code : BSB 305, Crédits : 03, Session : 2020 (Third Sem.), Class : B.Sc. (Biotechnology) 2nd Year
Faculty Name : **Dr. Asha Singh**

Introduction: The objective of this course is to provide the knowledge about animal physiology that shall be useful to understand and apply different concepts of biotechnology. The knowledge gained from animal physiology-I will be helpful for students to realize the significance of physiology towards its importance in modern biotechnology.

A. Course Outcomes: At the end of the course, students will be able to:

BSB305.1 Learn about basic knowledge anatomical and physiological aspects of Respiratory System.

BSB305.2. Gain knowledge about role of various chemical secretions in body and understand the basics of regulatory mechanisms & functioning of digestive systems.

BSB305.3. Generate path for further research and innovation by understanding the important phenomenon of hemodynamic & living system.

BSB305.4. Enhance new collaborative approaches with modern fields of biotechnology and neuromuscular system.

B. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students  **understand:** Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course

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structure,

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Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

C. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25%includesalltypesofleaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

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E. Syllabus

Module I:

Physiology of Respiratory System: Organs for respiration in mammals, Mechanism of respiration, Physiology of respiration (transport of gases and chloride shift), Properties and function of respiratory pigments.

Module II:

Physiology of Digestive System *Composition and function of saliva, Mechanical and chemical digestion, Functions of pancreatic juices and biles, Absorption and distribution of food*

Module III:

Physiology of Cardiovascular System Blood composition and Hemopoisis, Blood Groups and Blood Transfusion, Blood Clotting, Hemodynamics, Cardiac Cycle and its regulation,

Module IV:

Physiology of Neuromuscular System *Contraction and relaxation of muscle, Sarcomere, Cori‟s cycle, Organization of Nervous System, Neuron, Nerve Impulse, Synaptic Transmission, Neurotransmitters.*

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- • Guyton, A.C. and Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. / W.B. Saunders Company.
- Tortora, G.J. and Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons, Inc.
- Ganong, H, Review of Medial Physiology 14th edition, Appleton &Lange Publisher, New York
- Shier, D., Butler, J. and Lewis, R., Hole‟s Human Anatomy and Physiology, (10th Edition) 2003. WCB/McGraw Hill, Boston.
- T. C. Majpuria. A text book of zoology.
- V.K Tiwari, A Text book of Zoology
- Ramesh Gupta, A Text book of Zoology

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H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Physiology of Respiratory System: Introduction	Lecture	BSB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
2	Organs for respiration in mammals	Lecture	BSB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
3	Mechanism of respiration	Lecture	BSB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
4	*Physiology of respiration*	Lecture	BSB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
5	transport of gases	Lecture	BSB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
6	Respiratory pigments: Introduction	Lecture	BSB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
7	Properties of Respiratory pigments	Lecture	BSB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
8	Functions of Respiratory pigments	Lecture	BSB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
9	Respiratory pigments	Lecture	BSB305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
10	Digestive System: Introduction	Lecture	BSB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

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11	Physiology of Digestive System	Lecture	BSB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
12	Composition and	Lecture	BSB305.2.	Mid Term-1, Quiz,

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	function of saliva,			Home assignments, Seminar & End Sem Exam
13	Mechanical digestion	Lecture	BSB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
14	chemical digestion	Lecture	BSB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
15	*Functions of pancreatic juices*	Lecture	BSB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
16	*Functions of* biles *juices*	Lecture	BSB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
17	Absorption of food	Lecture	BSB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
18	Distribution of food	Lecture	BSB305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
19	Cardiovascular System: Introduction	Lecture	BSB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
20	Physiology of Cardiovascular System	Lecture	BSB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
21	Blood composition	Lecture	BSB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
22	Hemopoisis	Lecture	BSB305.3.	Home assignments, Quiz, Seminar & End Sem Exam

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23	Blood Groups	Lecture	BSB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
24	Blood Transfusion	Lecture	BSB305.3.	Home assignments, Quiz, Seminar &

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				End Sem Exam
25	Blood Clotting	Lecture	BSB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
26	Hemodynamics	Lecture	BSB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
27	Cardiac Cycle: Introduction	Lecture	BSB305.3.	Home assignments, Quiz, Seminar & End Sem Exam
28	Cardiac Cycle regulation	Lecture	BSB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
29	Neuromuscular System	Lecture	BSB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
30	Physiology of Neuromuscular System	Lecture	BSB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
31	Contraction of muscle	Lecture	BSB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
32	Relaxation of muscle	Lecture	BSB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
33	Sarcomere,	Lecture	BSB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
34	Cori‟s cycle,	Lecture	BSB305.4.	Home assignments, Quiz, Seminar & End Sem Exam
35	Organization of Nervous System	Lecture	BSB305.4.	Home assignments, Quiz, Seminar & End Sem Exam

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36	Neuron, Nerve Impulse, Synaptic Transmission, Neurotransmitters.	Lecture	BSB305.4.	Home assignments, Quiz, Seminar & End Sem Exam

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I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BSB305.1	Learn about basic knowledge anatomical and physiological aspects of Respiratory System.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	
BSB305.2.	Gain knowledge about role of various chemical secretions in body and understand the basics of regulatory mechanisms & functioning of digestive systems.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BSB305.3.	Generate path for further research and innovation by understanding the important phenomenon of hemodynamic & living system.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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BSB305.4.	Enhance new collaborative approaches with modern fields of biotechnology and neuromuscular system.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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Sample Question Paper

Amity Institute of Biotechnology Amity University Madhya Pradesh						
Class: B.Sc. (H) Biotechnology 3rd Semester						
Subject Name: BSB 305 Animal Physiology-I		Time:3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	
Student will be able to						

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss about the various organs of respiration in animals.	6
CO1	Q.2	What are respiratory pigments, discuss their importance.	6
	Q.3	What is saliva, discuss about its composition and function.	6
CO1	Q.4	Discuss about Hamburger phenomenon.	6
CO2	Q.5	Describe in detail about intestinal digestion.	6
	Q6	What is the difference between the phenomenon of breathing and cellular respiration.	6
CO2	Q.7	Explain about the transportation of Gases.	10
CO2	Q.8	Explain about the various enzymes used in the process of digestion.	10
CO3	Q.9	What is dentition, discuss about its type and function in man.	10
CO3	Q.10	(a) Elucidate the detail structure of nerve cell. (b) Describe the different modes of impulse conduction.	20

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Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Physiology-*I*** /Course code ***BSB 305*** is level **3** for the academic year ***2021-22***.

Asha Singh

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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Physiology- I
Course Code : BSC 302, Crédits : 03, Session : 2021-22 (Third Sem.), Class : B.Sc. (Biology) 2nd Year
Faculty Name : **Dr. Asha Singh**

Introduction: The objective of this course is to provide the knowledge about animal physiology that shall be useful to understand and apply different concepts of biotechnology. The knowledge gained from animal physiology-I will be helpful for students to realize the significance of physiology towards its importance in modern biotechnology.

A. **Course Outcomes:** At the end of the course, students will be able to:

BSC302.1 Learn about basic knowledge anatomical and physiological aspects of Respiratory System.

BSC302.2. Gain knowledge about role of various chemical secretions in body and understand the basics of regulatory mechanisms & functioning of digestive systems.

BSC302.3. Generate path for further research and innovation by understanding the important phenomenon of hemodynamic & living system.

BSC302.4. Enhance new collaborative approaches with modern fields of biotechnology and neuromuscular system.

B. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological

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tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear **instructions.**

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

C. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	Description	Code	Weightag

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			e %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25%includesalltypesofleaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. **Syllabus**

Module I:

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Physiology of Respiratory System: Organs for respiration in mammals, Mechanism of respiration, Physiology of respiration (transport of gases and chloride shift), Properties and function of respiratory pigments.

Module II:

Physiology of Digestive System *Composition and function of saliva, Mechanical and chemical digestion, Functions of pancreatic juices and biles, Absorption and distribution of food*

Module III:

Physiology of Cardiovascular System Blood composition and Hemopoisis, Blood Groups and Blood Transfusion, Blood Clotting, Hemodynamics, Cardiac Cycle and its regulation,

Module IV:

Physiology of Neuromuscular System *Contraction and relaxation of muscle, Sarcomere, Cori"s cycle, Organization of Nervous System, Neuron, Nerve Impulse, Synaptic Transmission, Neurotransmitters.*

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- • Guyton, A.C. and Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. / W.B. Saunders Company.
- Tortora, G.J. and Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons, Inc.
- Ganong, H, Review of Medial Physiology 14th edition, Appleton &Lange Publisher, New York
- Shier, D., Butler, J. and Lewis, R., Hole"s Human Anatomy and Physiology, (10th Edition) 2003. WCB/McGraw Hill, Boston.
- T. C. Majpuria. A text book of zoology.
- V.K Tiwari, A Text book of Zoology
- Ramesh Gupta, A Text book of Zoology

H. Lecture Plan

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Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Physiology of Respiratory System: Introduction	Lecture	BSC305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
2	Organs for respiration in mammals	Lecture	BSC305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
3	Mechanism of respiration	Lecture	BSC305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
4	*Physiology of respiration*	Lecture	BSC305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
5	transport of gases	Lecture	BSC305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
6	Respiratory pigments: Introduction	Lecture	BSC305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
7	Properties of Respiratory pigments	Lecture	BSC305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
8	Functions of Respiratory pigments	Lecture	BSC305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
9	Respiratory pigments	Lecture	BSC305.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
10	Digestive System: Introduction	Lecture	BSC305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

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11	Physiology of Digestive System	Lecture	BSC305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
12	Composition and function of saliva,	Lecture	BSC305.2.	Mid Term-1, Quiz, Home assignments,

				Seminar & End Sem Exam
13	Mechanical digestion	Lecture	BSC305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
14	chemical digestion	Lecture	BSC305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
15	*Functions of pancreatic juices*	Lecture	BSC305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
16	*Functions of* biles *juices*	Lecture	BSC305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
17	Absorption of food	Lecture	BSC305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
18	Distribution of food	Lecture	BSC305.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
19	Cardiovascular System: Introduction	Lecture	BSC305.3.	Home assignments, Quiz, Seminar & End Sem Exam
20	Physiology of Cardiovascular System	Lecture	BSC305.3.	Home assignments, Quiz, Seminar & End Sem Exam
21	Blood composition	Lecture	BSC305.3.	Home assignments, Quiz, Seminar & End Sem Exam
22	Hemopoisis	Lecture	BSC305.3.	Home assignments, Quiz, Seminar & End Sem Exam

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23	Blood Groups	Lecture	BSC305.3.	Home assignments, Quiz, Seminar & End Sem Exam
24	Blood Transfusion	Lecture	BSC305.3.	Home assignments, Quiz, Seminar & End Sem Exam

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25	Blood Clotting	Lecture	BSC305.3.	Home assignments, Quiz, Seminar & End Sem Exam
26	Hemodynamics	Lecture	BSC305.3.	Home assignments, Quiz, Seminar & End Sem Exam
27	Cardiac Cycle: Introduction	Lecture	BSC305.3.	Home assignments, Quiz, Seminar & End Sem Exam
28	Cardiac Cycle regulation	Lecture	BSC305.4.	Home assignments, Quiz, Seminar & End Sem Exam
29	Neuromuscular System	Lecture	BSC305.4.	Home assignments, Quiz, Seminar & End Sem Exam
30	Physiology of Neuromuscular System	Lecture	BSC305.4.	Home assignments, Quiz, Seminar & End Sem Exam
31	Contraction of muscle	Lecture	BSC305.4.	Home assignments, Quiz, Seminar & End Sem Exam
32	Relaxation of muscle	Lecture	BSC305.4.	Home assignments, Quiz, Seminar & End Sem Exam
33	Sarcomere,	Lecture	BSC305.4.	Home assignments, Quiz, Seminar & End Sem Exam
34	Cori‟s cycle,	Lecture	BSC305.4.	Home assignments, Quiz, Seminar & End Sem Exam
35	Organization of Nervous System	Lecture	BSC305.4.	Home assignments, Quiz, Seminar & End Sem Exam

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36	Neuron, Nerve Impulse, Synaptic Transmission, Neurotransmitters.	Lecture	BSC305.4.	Home assignments, Quiz, Seminar & End Sem Exam

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I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BSC305.1	Learn about basic knowledge anatomical and physiological aspects of Respiratory System.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	
BSC305.2.	Gain knowledge about role of various chemical secretions in body and understand the basics of regulatory mechanisms & functioning of digestive systems.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BSC305.3.	Generate path for further research and innovation by understanding the important phenomenon of hemodynamic & living system.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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BSC305.4.	Enhance new collaborative approaches with modern fields of biotechnology and neuromuscular system.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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Sample Question Paper

Amity Institute of Biotechnology Amity University Madhya Pradesh		
Class: B.Sc. Biology 3rd Semester		
Subject Name: BSC 302 Animal Physiology-I	Time:3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	

Student will be able to

CO Map	Question No.	Question	Marks
CO1 CO1	Q.1	Discuss about the various organs of respiration in animals.	6
	Q.2	What are respiratory pigments, discuss their importance.	6
	Q.3	What is saliva, discuss about its composition and function.	6
CO1	Q.4	Discuss about Hamburger phenomenon.	6
CO2	Q.5	Describe in detail about intestinal digestion.	6
	Q6	What is the difference between the phenomenon of breathing and cellular respiration.	6
CO2	Q.7	Explain about the transportation of Gases.	10
CO2	Q.8	Explain about the various enzymes used in the process of digestion.	10
CO3	Q.9	What is dentition, discuss about its type and function in man.	10
CO3	Q.10	(a) Elucidate the detail structure of nerve cell. (b) Describe the different modes of impulse conduction.	20

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Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Physiology-*I*** /Course code **BSC 302** is level **3** for the academic year **2021-22**.

Asha Singh

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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Physiology- II
Course Code : BMB 405, Crédits : 03, Session : 2021-22 (Forth Sem.), Class : B.Sc. M.Sc dual degree 2nd Year
Faculty Name : Dr. Asha Singh

Introduction: The objective of this course is to provide the knowledge about animal physiology that shall be useful to understand and apply different concepts of biotechnology. The knowledge gained from subjects will be helpful for students to realize the significance of physiology towards its importance in advance biotechnology.

A. Course Outcomes: At the end of the course, students will be able to:

BMB405.1 Learn about anatomical and physiological aspects of Major organ system of mammals. Understands functioning and role of different hormone of body.

BMB405.2. Develops knowledge and metabolic pathways about endocrinology, excretory system, reproductive system and developmental biology.

BMB405.3. Leads to enhance interest in research in advanced reproductive biotechnology.

BMB405.4. Enhance new collaborative approaches with modern fields of developmental biology.

B. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create,

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select, and apply appropriate techniques, resources,

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and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

C. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightag e %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/H A	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25%includesalltypesofleaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I:

Module 1: Endocrine Physiology: Endocrine glands in mammals
- General anatomy and physiology Pituitary,
- General anatomy and physiology of Thyroid,
- General anatomy and physiology Parathyroid,
- General anatomy and physiology Pancreatic islets
- *General anatomy and physiology Adrenal*

Module II:

Excretory System:
- General morphology and characteristics of Mammalian Kidney (Rabbit).
- Structure & Function of Tubular reabsorption and Secretion.

• *Structure & Function of Nephron, Glomerular filtration.*

Module III:

Reproductive System:
• Structure & Function of Testes & Ovary of Rabbit.
• Spermatogenesis and its hormonal regulation
• Oogenesis and its hormonal Regulation
• Ovulation and fertilization

Module IV:

Developmental Biology:
• Gametogenesis, structure of sperm and ovum, Egg types, Egg membrane
• Cleavage: types.
• Formation of blastula in chick
• Fate Map, Morphogenetic Movement & Gastrulation in Chick.
• *Extra embryonic membranes in chick*

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Guyton, A.C. and Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. / W.B. Saunders Company.
- Tortora, G.J. and Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons, Inc.
- Ganong, H, Review of Medial Physiology 14th edition, Appleton &Lange Publisher, New York
- Shier, D., Butler, J. and Lewis, R., Hole‟s Human Anatomy and Physiology, (10th Edition) 2003. WCB/McGraw Hill, Boston.
- T. C. Majpuria. A text book of zoology.
- V.K Tiwari, A Text book of Zoology
- Ramesh Gupta, A Text book of Zoology

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Endocrine glands in mammals: Introduction	Lecture	BMB405.1	Mid Term-1, Quiz, Home assignments,

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				Seminar & End Sem Exam
2	General anatomy of Pituitary	Lecture	BMB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
3	Physiology of Pituitary	Lecture	BMB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
4	*General anatomy and physiology of Thyroid,*	Lecture	BMB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
5	General anatomy and physiology Parathyroid,	Lecture	BMB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
6	General anatomy Pancreatic islets	Lecture	BMB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
7	Physiology Pancreatic islets	Lecture	BMB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
8	General anatomy of Adrenal gland	Lecture	BMB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
9	Physiology of Adrenal gland	Lecture	BMB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
10	Excretory System: Introduction	Lecture	BMB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
11	General morphology Mammalian Kidney (Rabbit).	Lecture	BMB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
12	Characteristics of Mammalian Kidney (Rabbit).	Lecture	BMB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

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13	Structure of Tubular reabsorption and Secretion.	Lecture	BMB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

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14	Function of Tubular reabsorption	Lecture	BMB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
15	Function of Tubular Secretion.	Lecture	BMB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
16	Structure of Nephron	Lecture	BMB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
17	Function of Nephron	Lecture	BMB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
18	Glomerular filtration.	Lecture	BMB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
19	Reproductive System:: Introduction	Lecture	BMB405.3 .	Home assignments, Quiz, Seminar & End Sem Exam
20	Structure of Testes of Rabbit.	Lecture	BMB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
21	Function of Testes of Rabbit.	Lecture	BMB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
22	Structure of ovary of Rabbit.	Lecture	BMB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
23	Functions of ovary of Rabbit.	Lecture	BMB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
24	Spermatogenesis	Lecture	BMB405.3.	Home assignments, Quiz, Seminar & End Sem Exam

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25	Hormonal regulation of Spermatogenesis	Lecture	BMB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
26	Oogenesis and its hormonal Regulation	Lecture	BMB405.3.	Home assignments,

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				Quiz, Seminar & End Sem Exam
27	Ovulation and fertilization	Lecture	BMB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
28	Developmental Biology : Introduction	Lecture	BMB405.4 .	Home assignments, Quiz, Seminar & End Sem Exam
29	Gametogenesis	Lecture	BMB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
30	structure of sperm and ovum	Lecture	BMB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
31	Egg types, Egg membrane	Lecture	BMB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
32	Cleavage: types	Lecture	BMB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
33	Formation of blastula in chick	Lecture	BMB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
34	Fate Map	Lecture	BMB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
35	Morphogenetic Movement & Gastrulation in Chick.	Lecture	BMB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
36	Extra embryonic membranes in chick	Lecture	BMB405.4.	Home assignments, Quiz, Seminar & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

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CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME

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														SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BMB405.1	Learn about anatomical and physiological aspects of Major organ system of mammals. Understands functioning and role of different hormone of body.	3	2	2	2	1				2	1			3	2	
BMB405.2.	Gain knowledge about role of various chemical secretions in body and understand the basics of regulatory mechanisms & functioning of digestive systems.	3	2	2	2	1				2	1			3	2	1
BMB405.3.	Leads to enhance interest in research in advanced reproductive biotechnology.	3	2	2	2	1				2	1			3	2	1
BMB405.4.	Enhance new collaborative approaches with modern fields of developmental biology.	3	3	2	2	1				2	1			3	2	1

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Sample Question Paper

Amity Institute of Biotechnology Amity University Madhya Pradesh						
Class: B.Sc. M.Sc. Dual Degree 4th Semester						
Subject Name: BMB 405 Animal Physiology-II		Time:3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	
Student will be able to						

CO Map	Question No.	Question	Marks
CO1	Q.1	Give an account on mechanism of steroid hormone action.	6
CO1	Q.2	Give an account on the role of Thyroid gland.	6
	Q.3	Discuss about the role of kidney in the body of man.	6
CO1	Q.4	Write various characteristic features of hormones.	6
CO2	Q.5	Mention about the various types of excretory products found in animals.	6
	Q6	Write a note on Cushing Syndrome, its cause and symptoms.	6
CO2	Q.7	Discuss in detail about the abnormalities caused due to malfunctioning of Adrenal gland.	10

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CO2	Q.8	Discuss in detail the process of selective reabsorption, also describe about the role of proximal convulated tubules in it.	10
CO3	Q.9	Describe structure and irregularities of Adenohypophysis.	10
CO3	Q.10	Describe in detail account the following phenomena: (i) Fertilization (ii) Cleavage	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Physiology-*II*** /Course code ***BMB 405*** is level ***3*** for the academic year ***2021-22***.

Asha Singh

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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Physiology- II
Course Code : BSB 405, Crédits : 03, Session : 2021 -22 (Forth Sem.), Class : B.Sc. (Biotechnology) 2nd Year
Faculty Name : Dr. Asha Singh

Introduction: The objective of this course is to provide the knowledge about animal physiology that shall be useful to understand and apply different concepts of biotechnology. The knowledge gained from subjects will be helpful for students to realize the significance of physiology towards its importance in advance biotechnology.

A. Course Outcomes: At the end of the course, students will be able to:

BSB405.1 Learn about anatomical and physiological aspects of Major organ system of mammals. Understands functioning and role of different hormone of body.

BSB405.2. Develops knowledge and metabolic pathways about endocrinology, excretory system, reproductive system and developmental biology.

BSB405.3. Leads to enhance interest in research in advanced reproductive biotechnology.

BSB405.4. Enhance new collaborative approaches with modern fields of developmental biology.

B. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of

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several techniques

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involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

C. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

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Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25%includesalltypesofleaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I:

Module 1: Endocrine Physiology: Endocrine glands in mammals

- General anatomy and physiology Pituitary,
- General anatomy and physiology of Thyroid,
- General anatomy and physiology Parathyroid,
- General anatomy and physiology Pancreatic islets
- *General anatomy and physiology Adrenal*

Module II:

Excretory System:

- General morphology and characteristics of Mammalian Kidney (Rabbit).
- Structure & Function of Tubular reabsorption and Secretion.
- *Structure & Function of Nephron, Glomerular filtration.*

Module III:

Reproductive System:

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- Structure & Function of Testes & Ovary of Rabbit.
- Spermatogenesis and its hormonal regulation
- Oogenesis and its hormonal Regulation
- Ovulation and fertilization

Module IV:

Developmental Biology:
- Gametogenesis, structure of sperm and ovum, Egg types, Egg membrane
- Cleavage: types.
- Formation of blastula in chick
- Fate Map, Morphogenetic Movement & Gastrulation in Chick.
- *Extra embryonic membranes in chick*

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Guyton, A.C. and Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. / W.B. Saunders Company.
- Tortora, G.J. and Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons, Inc.
- Ganong, H, Review of Medial Physiology 14th edition, Appleton &Lange Publisher, New York
- Shier, D., Butler, J. and Lewis, R., Hole‟s Human Anatomy and Physiology, (10th Edition) 2003. WCB/McGraw Hill, Boston.
- T. C. Majpuria. A text book of zoology.
- V.K Tiwari, A Text book of Zoology
- Ramesh Gupta, A Text book of Zoology

H. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspon ding CO**	**Mode of Assessing CO**
1	Endocrine glands in mammals: Introduction	Lecture	BSB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

2	General anatomy of Pituitary	Lecture	BSB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem

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				Exam
3	Physiology of Pituitary	Lecture	BSB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
4	*General anatomy and physiology of Thyroid,*	Lecture	BSB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
5	General anatomy and physiology Parathyroid,	Lecture	BSB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
6	General anatomy Pancreatic islets	Lecture	BSB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
7	Physiology Pancreatic islets	Lecture	BSB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
8	General anatomy of Adrenal gland	Lecture	BSB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
9	Physiology of Adrenal gland	Lecture	BSB405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
10	Excretory System: Introduction	Lecture	BSB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
11	General morphology Mammalian Kidney (Rabbit).	Lecture	BSB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
12	Characteristics of Mammalian Kidney (Rabbit).	Lecture	BSB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
13	Structure of Tubular reabsorption and Secretion.	Lecture	BSB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

14	Function of Tubular reabsorption	Lecture	BSB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

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15	Function of Tubular Secretion.	Lecture	BSB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
16	Structure of Nephron	Lecture	BSB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
17	Function of Nephron	Lecture	BSB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
18	Glomerular filtration.	Lecture	BSB405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
19	Reproductive System:: Introduction	Lecture	BSB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
20	Structure of Testes of Rabbit.	Lecture	BSB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
21	Function of Testes of Rabbit.	Lecture	BSB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
22	Structure of ovary of Rabbit.	Lecture	BSB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
23	Functions of ovary of Rabbit.	Lecture	BSB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
24	Spermatogenesis	Lecture	BSB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
25	Hormonal regulation of Spermatogenesis	Lecture	BSB405.3.	Home assignments, Quiz, Seminar & End Sem Exam

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26	Oogenesis and its hormonal Regulation	Lecture	BSB405.3.	Home assignments, Quiz, Seminar & End Sem Exam
27	Ovulation and fertilization	Lecture	BSB405.3.	Home assignments,

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				Quiz, Seminar & End Sem Exam
28	Developmental Biology : Introduction	Lecture	BSB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
29	Gametogenesis	Lecture	BSB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
30	structure of sperm and ovum	Lecture	BSB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
31	Egg types, Egg membrane	Lecture	BSB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
32	Cleavage: types	Lecture	BSB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
33	Formation of blastula in chick	Lecture	BSB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
34	Fate Map	Lecture	BSB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
35	Morphogenetic Movement & Gastrulation in Chick.	Lecture	BSB405.4.	Home assignments, Quiz, Seminar & End Sem Exam
36	Extra embryonic membranes in chick	Lecture	BSB405.4.	Home assignments, Quiz, Seminar & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

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CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PS	PS	PS

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		1	2	3	4	5	6	7	8	9	10	11	12	O1	O2	O3
BSB405.1	Learn about anatomical and physiological aspects of Major organ system of mammals. Understands functioning and role of different hormone of body.	3	2	2	2	1				2	1			3	2	
BSB405.2.	Gain knowledge about role of various chemical secretions in body and understand the basics of regulatory mechanisms & functioning of digestive systems.	3	2	2	2	1				2	1			3	2	1
BSB405.3.	Leads to enhance interest in research in advanced reproductive biotechnology.	3	2	2	2	1				2	1			3	2	1
BSB405.4.	Enhance new collaborative approaches with modern fields of developmental biology.	3	3	2	2	1				2	1			3	2	1

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Sample Question Paper

Amity Institute of Biotechnology
Amity University Madhya Pradesh

Class: B.Sc. (H) Biotechnology 4th Semester

Subject Name: BSB 405 Animal Physiology-II	Time:3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	

Student will be able to

CO Map	Question No.	Question	Marks
CO1	Q.1	Give an account on mechanism of steroid hormone action.	6
CO1	Q.2	Give an account on the role of Thyroid gland.	6
	Q.3	Discuss about the role of kidney in the body of man.	6
CO1	Q.4	Write various characteristic features of hormones.	6
CO2	Q.5	Mention about the various types of excretory products found in animals.	6
	Q6	Write a note on Cushing Syndrome, its cause and symptoms.	6
CO2	Q.7	Discuss in detail about the abnormalities caused due to malfunctioning of Adrenal gland.	10
CO2	Q.8	Discuss in detail the process of selective reabsorption, also describe about the role of proximal convulated tubules in it.	10
CO3	Q.9	Describe structure and irregularities of Adenohypophysis.	10

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CO3	Q.10	Describe in detail account the following phenomena: (i) Fertilization (ii) Cleavage	20

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Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Physiology-*II*** /Course code ***BSB 405*** is level **3** for the academic year ***2021-22***.

Asha Singh

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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Physiology- II
Course Code : BSC 402, Crédits : 03, Session : 2021-22 (Forth Sem.), Class : B.Sc. (Biology) 2nd Year
Faculty Name : Dr. Asha Singh

Introduction: The objective of this course is to provide the knowledge about animal physiology that shall be useful to understand and apply different concepts of biotechnology. The knowledge gained from subjects will be helpful for students to realize the significance of physiology towards its importance in advance biotechnology.

A. Course Outcomes: At the end of the course, students will be able to:

BSC402.1 Learn about anatomical and physiological aspects of Major organ system of mammals. Understands functioning and role of different hormone of body.

BSC402.2. Develops knowledge and metabolic pathways about endocrinology, excretory system, reproductive system and developmental biology.

BSC402.3. Leads to enhance interest in research in advanced reproductive biotechnology.

BSC402.4. Enhance new collaborative approaches with modern fields of developmental biology.

B. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of

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several techniques

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involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

C. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

S

Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25%includesalltypesofleaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I:

Module 1: Endocrine Physiology: Endocrine glands in mammals
- General anatomy and physiology Pituitary,
- General anatomy and physiology of Thyroid,
- General anatomy and physiology Parathyroid,
- General anatomy and physiology Pancreatic islets
- *General anatomy and physiology Adrenal*

Module II:

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- *Structure & Function of Nephron, Glomerular filtration.*

Module III:

Reproductive System:

- Structure & Function of Testes & Ovary of Rabbit.
- Spermatogenesis and its hormonal regulation
- Oogenesis and its hormonal Regulation
- Ovulation and fertilization

Module IV:

Developmental Biology:
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- Formation of blastula in chick
- Fate Map, Morphogenetic Movement & Gastrulation in Chick.
- *Extra embryonic membranes in chick*

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Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Guyton, A.C. and Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. / W.B. Saunders Company.
- Tortora, G.J. and Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons, Inc.
- Ganong, H, Review of Medial Physiology 14th edition, Appleton &Lange Publisher, New York
- Shier, D., Butler, J. and Lewis, R., Hole‟s Human Anatomy and Physiology, (10th Edition) 2003. WCB/McGraw Hill, Boston.
- T. C. Majpuria. A text book of zoology.
- V.K Tiwari, A Text book of Zoology
- Ramesh Gupta, A Text book of Zoology

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Endocrine glands in mammals: Introduction	Lecture	BSC405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

2	General anatomy of Pituitary	Lecture	BSC405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem

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				Exam
3	Physiology of Pituitary	Lecture	BSC405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
4	*General anatomy and physiology of Thyroid,*	Lecture	BSC405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
5	General anatomy and physiology Parathyroid,	Lecture	BSC405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
6	General anatomy Pancreatic islets	Lecture	BSC405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
7	Physiology Pancreatic islets	Lecture	BSC405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
8	General anatomy of Adrenal gland	Lecture	BSC405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
9	Physiology of Adrenal gland	Lecture	BSC405.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
10	Excretory System: Introduction	Lecture	BSC405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
11	General morphology Mammalian Kidney (Rabbit).	Lecture	BSC405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
12	Characteristics of Mammalian Kidney (Rabbit).	Lecture	BSC405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
13	Structure of Tubular reabsorption and Secretion.	Lecture	BSC405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

14	Function of Tubular reabsorption	Lecture	BSC405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

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15	Function of Tubular Secretion.	Lecture	BSC405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
16	Structure of Nephron	Lecture	BSC405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
17	Function of Nephron	Lecture	BSC405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
18	Glomerular filtration.	Lecture	BSC405.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
19	Reproductive System:: Introduction	Lecture	BSC405.3.	Home assignments, Quiz, Seminar & End Sem Exam
20	Structure of Testes of Rabbit.	Lecture	BSC405.3.	Home assignments, Quiz, Seminar & End Sem Exam
21	Function of Testes of Rabbit.	Lecture	BSC405.3.	Home assignments, Quiz, Seminar & End Sem Exam
22	Structure of ovary of Rabbit.	Lecture	BSC405.3.	Home assignments, Quiz, Seminar & End Sem Exam
23	Functions of ovary of Rabbit.	Lecture	BSC405.3.	Home assignments, Quiz, Seminar & End Sem Exam
24	Spermatogenesis	Lecture	BSC405.3.	Home assignments, Quiz, Seminar & End Sem Exam
25	Hormonal regulation of Spermatogenesis	Lecture	BSC405.3.	Home assignments, Quiz, Seminar & End Sem Exam

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26	Oogenesis and its hormonal Regulation	Lecture	BSC405.3.	Home assignments, Quiz, Seminar & End Sem Exam
27	Ovulation and fertilization	Lecture	BSC405.3.	Home assignments,

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				Quiz, Seminar & End Sem Exam
28	Developmental Biology : Introduction	Lecture	BSC405.4.	Home assignments, Quiz, Seminar & End Sem Exam
29	Gametogenesis	Lecture	BSC405.4.	Home assignments, Quiz, Seminar & End Sem Exam
30	structure of sperm and ovum	Lecture	BSC405.4.	Home assignments, Quiz, Seminar & End Sem Exam
31	Egg types, Egg membrane	Lecture	BSC405.4.	Home assignments, Quiz, Seminar & End Sem Exam
32	Cleavage: types	Lecture	BSC405.4.	Home assignments, Quiz, Seminar & End Sem Exam
33	Formation of blastula in chick	Lecture	BSC405.4.	Home assignments, Quiz, Seminar & End Sem Exam
34	Fate Map	Lecture	BSC405.4.	Home assignments, Quiz, Seminar & End Sem Exam
35	Morphogenetic Movement & Gastrulation in Chick.	Lecture	BSC405.4.	Home assignments, Quiz, Seminar & End Sem Exam
36	Extra embryonic membranes in chick	Lecture	BSC405.4.	Home assignments, Quiz, Seminar & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

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CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		P O	P O	P O	P O	P O	P O	P O	P O	P O	P O	P O	P O	P S	P S	P S

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		1	2	3	4	5	6	7	8	9	10	11	12	O1	O2	O3
BSC405.1	Learn about anatomical and physiological aspects of Major organ system of mammals. Understands functioning and role of different hormone of body.	3	2	2	2	1				2	1			3	2	
BSC405.2.	Gain knowledge about role of various chemical secretions in body and understand the basics of regulatory mechanisms & functioning of digestive systems.	3	2	2	2	1				2	1			3	2	1
BSC405.3.	Leads to enhance interest in research in advanced reproductive biotechnology.	3	2	2	2	1				2	1			3	2	1
BSC405.4.	Enhance new collaborative approaches with modern fields of developmental biology.	3	3	2	2	1				2	1			3	2	1

Sample Question Paper

Amity Institute of Biotechnology Amity University Madhya Pradesh		
Class: B.Sc. Biology 4th Semester		
Subject Name: BSC 402 Animal Physiology-II	Time:3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	

Student will be able to

CO Map	Question No.	Question	Marks
CO1	Q.1	Give an account on mechanism of steroid hormone action.	6
CO1	Q.2	Give an account on the role of Thyroid gland.	6
	Q.3	Discuss about the role of kidney in the body of man.	6
CO1	Q.4	Write various characteristic features of hormones.	6
CO2	Q.5	Mention about the various types of excretory products found in animals.	6
	Q6	Write a note on Cushing Syndrome, its cause and symptoms.	6
CO2	Q.7	Discuss in detail about the abnormalities caused due to malfunctioning of Adrenal gland.	10
CO2	Q.8	Discuss in detail the process of selective reabsorption, also describe about the role of proximal convulated tubules in it.	10
CO3	Q.9	Describe structure and irregularities of Adenohypophysis.	10

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CO3	Q.10	Describe in detail account the following phenomena: (i) Fertilization (ii) Cleavage	20

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Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Physiology-*II*** /Course code ***BSC 402*** is level **3** for the academic year ***2021-22***.

Asha Singh

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AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Sciences – I
Course Code : BMB 104, Crédits : 03, Session :2021-22 (Odd Sem.), Class : B.Sc. M.Sc dual degree 1st Year
Faculty Name : Dr. Asha Singh

A. Introduction: The objective of this course is to familiarize the student's with animal sciences through intensive coursework and participation in research and/or hands-on experience with animals. The overarching goal is to provide students with the knowledge and skills necessary to excel in professional schools, graduate school, or employment in our discipline.

B. Course Outcomes: At the end of the course, students will be able to:

BMB104.1 Learn about characteristics and variation among different phylum of Invertebrates from Protozoa to Echinodermata.
BMB104.2. Differentiate lower invertebrates and develop scientific & conservative outlook for research and innovation.
BMB104.3. Get knowledge of type study of coelenterate and Helminthes classification, morphology, reproduction and economic importance.
BMB104.4. Differentiate higher invertebrates and their type study along with composting study.
BMB104.5. Generate written and verbal communication skills over the subject.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

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PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance isrequiredtobemaintainedbyastudentto be qualified for taking up the EndSemester examination. The allowanceof 25%includesalltypesofleaves includingmedicalleaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Diversity among Invertebrates

Concept of species, Binomial nomenclature, classification-Hierarchy. Salient features and out line classification of various phyla of lower and higher invertebrates upto class with suitable examples (According to Parker and Haswell latest edition).

Module II:

-Protozoa: Type study of plasmodium.
-Porifera: Type of Sycon.

Module III:

-Coelnterata: Type study of *Ovelia.*
-Helminthes: Type Study of *Liverfluke.*

Module IV: **Higher Invertebrates**

Annelida: Type study of *Pheretima (Earth worm) and Vermicomposting*,
-Arthropoda: Type Study of *Prawn*

Module V:

Mollusca: Type Study of *Pila*
Echinodermata: External features of Star fish and Echinoderm larvae,
Hemichordata: General Characteristics and relationship with nonchordates and chordates,

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External morphology (Balanoglossus), structure and significance of Tornaria Larva

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Jordan, E.K. and Verma, P.S., Invertebrate Zoology. S. Chand & Co. New Delhi.
- Kotpal, R.L., Refer to the series on Protozoa, porifera, Coelentrta, Annelida, Arthropoda, Mollusca, Echinodermata. Rastogi Publication, Merrut.
- Borradile, L.A. and Potts, F.A., Invertebrate Zoology, Cambridge Press, UK.
- Dhami, P.S. and Dhami, J.K., Invertebrate Zoology, S Chand & Co. New Delhi.
- Kotpal R.L., Text book of zoology: Invertebrates, Rastogi publication.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Diversity among Invertebrates:	Lecture	BMB104.1	Mid Term-1, Quiz & End Sem Exam
2	Concept of species,Binomial nomenclature,	Lecture	BMB104.1	Mid Term-1, Quiz & End Sem Exam
3	classification-Hierarchy.	Lecture	BMB104.1	Mid Term-1, Quiz & End Sem Exam
4	Salient features of lower invertebrates	Lecture	BMB104.1	Mid Term-1, Quiz & End Sem Exam
5	Salient features of higher invertebrates	Lecture	BMB104.1	Mid Term-1, Quiz & End Sem Exam
6	Out line classification of lower invertebrates upto class	Lecture	BMB104.1	Mid Term-1, Quiz & End Sem Exam

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7	Out line classification of higher invertebrates upto class	Lecture	BMB104.1	Mid Term-1, Quiz & End Sem Exam
8	suitable examples of lower and higher	Lecture	BMB104.1	Mid Term-1, Quiz & End Sem

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	invertebrates			Exam
9	Protozoa: Introduction	Lecture	BMB104.2 .	Mid Term-1, Quiz & End Sem Exam
10	Protozoa: Classification	Lecture	BMB104.2.	Mid Term-1, Quiz & End Sem Exam
11	Type study of Plasmodium.	Lecture	BMB104.2.	Mid Term-1, Quiz & End Sem Exam
12	Type study of Plasmodium.	Lecture	BMB104.2.	Mid Term-1, Quiz & End Sem Exam
13	Porifera: Introduction	Lecture	BMB104.2.	Mid Term-1, Quiz & End Sem Exam
14	Porifera: Classification	Lecture	BMB104.2.	Mid Term-1, Quiz & End Sem Exam
15	Porifera: Type of Sycon	Lecture	BMB104.2.	Mid Term-1, Quiz & End Sem Exam
16	Porifera: Type of Sycon	Lecture	BMB104.2.	Mid Term-1, Quiz & End Sem Exam
17	Coelnterata:Introdu ction	Lecture	BMB104.3 .	Mid Term-1, Quiz & End Sem Exam
18	Coelnterata: Classification	Lecture	BMB104.3 .	Mid Term-1, Quiz & End Sem Exam
19	Type study of Ovelia.	Lecture	BMB104.3 .	Mid Term-1, Quiz & End Sem Exam
20	Helminthes: Type Study of Liverfluke.	Lecture	BMB104.3 .	Mid Term-1, Quiz & End Sem Exam
21	Annelida: Introduction	Lecture	BMB104.4 .	Quiz & End Sem Exam
22	Annelida: Classification	Lecture	BMB104.4 .	Quiz & End Sem Exam
23	Type study of Pheretima (Earth worm)	Lecture	BMB104.4 .	Quiz & End Sem Exam

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24	*Type study of Pheretima (Earth worm)*	Lecture	BMB104.4 .	Quiz & End Sem Exam
25	Vermicomposting	Lecture	BMB104.4 .	Quiz & End Sem Exam

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26	Arthropoda: Introduction	Lecture	BMB104.4 .	Quiz & End Sem Exam
27	Arthropoda: Classification	Lecture	BMB104.4 .	Quiz & End Sem Exam
28	*Type Study of Prawn*	Lecture	BMB104.4 .	Quiz & End Sem Exam
29	Mollusca: Introduction	Lecture	BMB104.5 .	Quiz & End Sem Exam
30	Mollusca: Classification	Lecture	BMB104.5 .	Quiz & End Sem Exam
31	Type Study of Pila	Lecture	BMB104.5 .	Quiz & End Sem Exam
32	Echinodermata: Introduction	Lecture	BMB104.5 .	Quiz & End Sem Exam
33	External features of Star fish	Lecture	BMB104.5 .	Quiz & End Sem Exam
34	Echinoderm larvae,	Lecture	BMB104.5 .	Quiz & End Sem Exam
35	Hemichordata: General Characteristics and relationship with nonchordates and chordates,	Lecture	BMB104.5 .	Quiz & End Sem Exam
36	External morphology (Balanoglossus), structure and significance of Tornaria Larva	Lecture	BMB104.5 .	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

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BMB104.1	Learn about characteristics and variation among different phylum of Invertebrates from Protozoa to Echinodermata.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	

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BMB104.2 .	Get knowledge of type study of typical invertebrate classification, morphology, reproduction and economic importance.	3	2	3	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BMB104.3 .	Differentiate lower and higher invertebrates and develop scientific outlook for research and innovation.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BMB104.4 .	Develop conservative outlook for animals.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BMB104.5 .	Generate written and verbal communication skills over the subject.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	

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SampleQuestionPaper

Amity Institute of Biotechnology Amity University Madhya Pradesh						
Class: B.Sc. M.Sc. Dual Degree Biotechnology 1st Semester						
Subject Name: BMB 104 Animal Sciences-I		Time:3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	
Student will be able to						

CO Map	Question No.	Question	Marks
CO1	Q.1	Give an account on fresh water sponges with examples.	6
CO1	Q.2	Discuss about Taxonomy and its significance.	6
	Q.3	Give an account on class Ciliata with examples.	6
CO1	Q.4	Write about canal system of Sycon and its importance.	6
CO2	Q.5	Mention about infective stage of Plasmodium vivax.	6
	Q6	What is taxonomic hierarchy? Write its importance.	6
CO2	Q.7	Discuss about characteristic features of phylum Mollusca and describe about class Cephalopoda in detail.	10
CO2	Q.8	Write a detail account on malaria, its causative agent and preventive measures.	10
CO3	Q.9	Classify phylum Platyhelminthes upto classes with examples.	10
CO3	Q.10	What are Protozoans? Classify them upto (a) Subphylum with examples (b) Classes with examples	20

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Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Sciencs-I** /Course code ***BMB 104*** is level ***3*** for the academic year ***2021-22***.

AshaSingh

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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Sciences – I
Course Code : BSB 104, Crédits : 03, Session :2021-22 (Odd Sem.), Class : B.Sc. (Biotechnology) 1st Year
Faculty Name : Dr. Asha Singh

A. Introduction: The objective of this course is to familiarize the student's with animal sciences through intensive coursework and participation in research and/or hands-on experience with animals. The overarching goal is to provide students with the knowledge and skills necessary to excel in professional schools, graduate school, or employment in our discipline.

B. Course Outcomes: At the end of the course, students will be able to:

BSB104.1 Learn about characteristics and variation among different phylum of Invertebrates from Protozoa to Echinodermata.

BSB104.2. Differentiate lower invertebrates and develop scientific & conservative outlook for research and innovation.

BSB104.3. Get knowledge of type study of coelenterate and Helminthes classification, morphology, reproduction and economic importance.

BSB104.4. Differentiate higher invertebrates and their type study along with composting study.

BSB104.5. Generate written and verbal communication skills over the subject.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic

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theory,

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Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightag e %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-	S/V/Q/H	10%

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	Voce/Quiz/Home Assignment	A	
Attendance	A minimum of 75% Attendance isrequiredtobemaintainedbyastude ntto be qualified for taking up the EndSemester examination. The allowanceof 25%includesalltypesofleaves includingmedicalleaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Diversity among Invertebrates

Concept of species, Binomial nomenclature, classification-Hierarchy. Salient features and out line classification of various phyla of lower and higher invertebrates upto class with suitable examples (According to Parker and Haswell latest edition).

Module II:

-Protozoa: Type study of plasmodium.

-Porifera: Type of Sycon.

Module III:

-Coelnterata: Type study of *Ovelia.*

-Helminthes: Type Study of *Liverfluke.*

Module IV: **Higher Invertebrates**

Annelida: Type study of *Pheretima (Earth worm) and Vermicomposting*,

-Arthropoda: Type Study of *Prawn*

Module V:

Mollusca: Type Study of *Pila*

Echinodermata: External features of Star fish and Echinoderm larvae,

Hemichordata: General Characteristics and relationship with nonchordates and chordates, External morphology (Balanoglossus), structure and significance of Tornaria Larva

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE

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Weightage (%)	5	15	10	70

S

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Jordan, E.K. and Verma, P.S., Invertebrate Zoology. S. Chand & Co. New Delhi.
- Kotpal, R.L., Refer to the series on Protozoa, porifera, Coelentrta, Annelida, Arthropoda, Mollusca, Echinodermata. Rastogi Publication, Merrut.
- Borradile, L.A. and Potts, F.A., Invertebrate Zoology, Cambridge Press, UK.
- Dhami, P.S. and Dhami, J.K., Invertebrate Zoology, S Chand & Co. New Delhi.
- Kotpal R.L., Text book of zoology: Invertebrates, Rastogi publication.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Diversity among Invertebrates:	Lecture	BSB104.1	Mid Term-1, Quiz & End Sem Exam
2	Concept of species,Binomial nomenclature,	Lecture	BSB104.1	Mid Term-1, Quiz & End Sem Exam
3	classification-Hierarchy.	Lecture	BSB104.1	Mid Term-1, Quiz & End Sem Exam
4	Salient features of lower invertebrates	Lecture	BSB104.1	Mid Term-1, Quiz & End Sem Exam
5	Salient features of higher invertebrates	Lecture	BSB104.1	Mid Term-1, Quiz & End Sem Exam
6	Out line classification of lower invertebrates upto class	Lecture	BSB104.1	Mid Term-1, Quiz & End Sem Exam
7	Out line classification of higher invertebrates upto class	Lecture	BSB104.1	Mid Term-1, Quiz & End Sem Exam
8	suitable examples of lower and higher invertebrates	Lecture	BSB104.1	Mid Term-1, Quiz & End Sem Exam

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9	Protozoa: Introduction	Lecture	BSB104.2.	Mid Term-1, Quiz & End Sem Exam
10	Protozoa: Classification	Lecture	BSB104.2.	Mid Term-1, Quiz & End Sem Exam

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11	Type study of Plasmodium.	Lecture	BSB104.2.	Mid Term-1, Quiz & End Sem Exam
12	Type study of Plasmodium.	Lecture	BSB104.2.	Mid Term-1, Quiz & End Sem Exam
13	Porifera: Introduction	Lecture	BSB104.2.	Mid Term-1, Quiz & End Sem Exam
14	Porifera: Classification	Lecture	BSB104.2.	Mid Term-1, Quiz & End Sem Exam
15	Porifera: Type of Sycon	Lecture	BSB104.2.	Mid Term-1, Quiz & End Sem Exam
16	Porifera: Type of Sycon	Lecture	BSB104.2.	Mid Term-1, Quiz & End Sem Exam
17	Coelnterata:Introduction	Lecture	BSB104.3.	Mid Term-1, Quiz & End Sem Exam
18	Coelnterata: Classification	Lecture	BSB104.3.	Mid Term-1, Quiz & End Sem Exam
19	Type study of Ovelia.	Lecture	BSB104.3.	Mid Term-1, Quiz & End Sem Exam
20	Helminthes: Type Study of Liverfluke.	Lecture	BSB104.3.	Mid Term-1, Quiz & End Sem Exam
21	Annelida: Introduction	Lecture	BSB104.4.	Quiz & End Sem Exam
22	Annelida: Classification	Lecture	BSB104.4.	Quiz & End Sem Exam
23	Type study of Pheretima (Earth worm)	Lecture	BSB104.4.	Quiz & End Sem Exam
24	*Type study of Pheretima (Earth worm)*	Lecture	BSB104.4.	Quiz & End Sem Exam
25	Vermicomposting	Lecture	BSB104.4.	Quiz & End Sem Exam
26	Arthropoda: Introduction	Lecture	BSB104.4.	Quiz & End Sem Exam

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27	Arthropoda: Classification	Lecture	BSB104.4.	Quiz & End Sem Exam
28	*Type Study of Prawn*	Lecture	BSB104.4.	Quiz & End Sem Exam
29	Mollusca:	Lecture	BSB104.5.	Quiz & End Sem

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	Introduction			Exam
30	Mollusca: Classification	Lecture	BSB104.5.	Quiz & End Sem Exam
31	Type Study of Pila	Lecture	BSB104.5.	Quiz & End Sem Exam
32	Echinodermata: Introduction	Lecture	BSB104.5.	Quiz & End Sem Exam
33	External features of Star fish	Lecture	BSB104.5.	Quiz & End Sem Exam
34	Echinoderm larvae,	Lecture	BSB104.5.	Quiz & End Sem Exam
35	Hemichordata: General Characteristics and relationship with nonchordates and chordates,	Lecture	BSB104.5.	Quiz & End Sem Exam
36	External morphology (Balanoglossus), structure and significance of Tornaria Larva	Lecture	BSB104.5.	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BSB104.1	Learn about characteristics and variation among different phylum of Invertebrates from Protozoa to Echinodermata.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	

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BSB104.2.	Get knowledge of type study of typical invertebrate classification, morphology, reproduction and	3	2	3	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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	economic importance.															
BSB104.3.	Differentiate lower and higher invertebrates and develop scientific outlook for research and innovation.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BSB104.4.	Develop conservative outlook for animals.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BSB104.5.	Generate written and verbal communication skills over the subject.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	

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SampleQuestionPaper

Amity Institute of Biotechnology Amity University Madhya Pradesh						
Class: B.Sc. (H) Biotechnology 1st Semester						
Subject Name: BSB 104 Animal Sciences-I		Time:3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	
Student will be able to						

CO Map	Question No.	Question	Marks
CO1	Q.1	Give an account on fresh water sponges with examples.	6
CO1	Q.2	Discuss about Taxonomy and its significance.	6
	Q.3	Give an account on class Ciliata with examples.	6
CO1	Q.4	Write about canal system of Sycon and its importance.	6
CO2	Q.5	Mention about infective stage of Plasmodium vivax.	6
	Q6	What is taxonomic hierarchy? Write its importance.	6
CO2	Q.7	Discuss about characteristic features of phylum Mollusca and describe about class Cephalopoda in detail.	10
CO2	Q.8	Write a detail account on malaria, its causative agent and preventive measures.	10
CO3	Q.9	Classify phylum Platyhelminthes upto classes with examples.	10
CO3	Q.10	What are Protozoans? Classify them upto (a) Subphylum with examples (b) Classes with examples	20

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Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Sciencs-I** /Course code ***BSB 104*** is level ***3*** for the academic year ***2021-22***.

Asha Singh

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AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Sciences – I
Course Code : BSC 102, Crédits : 03, Session :2021-22 (Odd Sem.), Class : B.Sc. (Biology) 1st Year
Faculty Name : Dr. Asha Singh

A. Introduction: The objective of this course is to familiarize the student's with animal sciences through intensive coursework and participation in research and/or hands-on experience with animals. The overarching goal is to provide students with the knowledge and skills necessary to excel in professional schools, graduate school, or employment in our discipline.

B. Course Outcomes: At the end of the course, students will be able to:
BSC102.1 Learn about characteristics and variation among different phylum of Invertebrates from Protozoa to Echinodermata.
BSC102.2. Differentiate lower invertebrates and develop scientific & conservative outlook for research and innovation.
BSC102.3. Get knowledge of type study of coelenterate and Helminthes classification, morphology, reproduction and economic importance.
BSC102.4. Differentiate higher invertebrates and their type study along with composting study.
BSC104.5. Generate written and verbal communication skills over the subject.

C. Programme Outcomes:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques,

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resources,

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and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance isrequiredtobemaintainedbyastudentto be qualified for taking up the EndSemester examination. The allowanceof 25%includesalltypesofleaves includingmedicalleaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Diversity among Invertebrates

Concept of species, Binomial nomenclature, classification-Hierarchy. Salient features and out line classification of various phyla of lower and higher invertebrates upto class with suitable examples (According to Parker and Haswell latest edition).

Module II:

-Protozoa: Type study of plasmodium.
-Porifera: Type of Sycon.

Module III:

-Coelnterata: Type study of *Ovelia.*
-Helminthes: Type Study of *Liverfluke.*

Module IV: **Higher Invertebrates**

Annelida: Type study of *Pheretima (Earth worm) and Vermicomposting*,
-Arthropoda: Type Study of *Prawn*

Module V:

Mollusca: Type Study of *Pila*
Echinodermata: External features of Star fish and Echinoderm larvae,
Hemichordata: General Characteristics and relationship with nonchordates and chordates,External morphology (Balanoglossus), structure and significance of Tornaria Larva

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

- Jordan, E.K. and Verma, P.S., Invertebrate Zoology. S. Chand & Co. New Delhi.
- Kotpal, R.L., Refer to the series on Protozoa, porifera, Coelentrta, Annelida, Arthropoda, Mollusca, Echinodermata. Rastogi Publication, Merrut.
- Borradile, L.A. and Potts, F.A., Invertebrate Zoology, Cambridge Press, UK.
- Dhami, P.S. and Dhami, J.K., Invertebrate Zoology, S Chand & Co. New Delhi.
- Kotpal R.L., Text book of zoology: Invertebrates, Rastogi publication.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Diversity among Invertebrates:	Lecture	BSC104.1	Mid Term-1, Quiz & End Sem Exam
2	Concept of species,Binomial nomenclature,	Lecture	BSC104.1	Mid Term-1, Quiz & End Sem Exam
3	classification- Hierarchy.	Lecture	BSC104.1	Mid Term-1, Quiz & End Sem Exam
4	Salient features of lower invertebrates	Lecture	BSC104.1	Mid Term-1, Quiz & End Sem Exam
5	Salient features of higher invertebrates	Lecture	BSC104.1	Mid Term-1, Quiz & End Sem Exam
6	Out line classification of lower invertebrates upto class	Lecture	BSC104.1	Mid Term-1, Quiz & End Sem Exam
7	Out line classification of higher invertebrates upto class	Lecture	BSC104.1	Mid Term-1, Quiz & End Sem Exam

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8	suitable examples of lower and higher	Lecture	BSC104.1	Mid Term-1, Quiz & End Sem

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	invertebrates			Exam
9	Protozoa: Introduction	Lecture	BSC104.2.	Mid Term-1, Quiz & End Sem Exam
10	Protozoa: Classification	Lecture	BSC104.2.	Mid Term-1, Quiz & End Sem Exam
11	Type study of Plasmodium.	Lecture	BSC104.2.	Mid Term-1, Quiz & End Sem Exam
12	Type study of Plasmodium.	Lecture	BSC104.2.	Mid Term-1, Quiz & End Sem Exam
13	Porifera: Introduction	Lecture	BSC104.2.	Mid Term-1, Quiz & End Sem Exam
14	Porifera: Classification	Lecture	BSC104.2.	Mid Term-1, Quiz & End Sem Exam
15	Porifera: Type of Sycon	Lecture	BSC104.2.	Mid Term-1, Quiz & End Sem Exam
16	Porifera: Type of Sycon	Lecture	BSC104.2.	Mid Term-1, Quiz & End Sem Exam
17	Coelnterata:Introduction	Lecture	BSC104.3.	Mid Term-1, Quiz & End Sem Exam
18	Coelnterata: Classification	Lecture	BSC104.3.	Mid Term-1, Quiz & End Sem Exam
19	Type study of Ovelia.	Lecture	BSC104.3.	Mid Term-1, Quiz & End Sem Exam
20	Helminthes: Type Study of Liverfluke.	Lecture	BSC104.3.	Mid Term-1, Quiz & End Sem Exam
21	Annelida: Introduction	Lecture	BSC104.4.	Quiz & End Sem Exam
22	Annelida: Classification	Lecture	BSC104.4.	Quiz & End Sem Exam
23	Type study of Pheretima (Earth worm)	Lecture	BSC104.4.	Quiz & End Sem Exam

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24	*Type study of Pheretima (Earth worm)*	Lecture	BSC104.4.	Quiz & End Sem Exam
25	Vermicomposting	Lecture	BSC104.4.	Quiz & End Sem Exam

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26	Arthropoda: Introduction	Lecture	BSC104.4.	Quiz & End Sem Exam
27	Arthropoda: Classification	Lecture	BSC104.4.	Quiz & End Sem Exam
28	*Type Study of Prawn*	Lecture	BSC104.4.	Quiz & End Sem Exam
29	Mollusca: Introduction	Lecture	BSC104.5.	Quiz & End Sem Exam
30	Mollusca: Classification	Lecture	BSC104.5.	Quiz & End Sem Exam
31	Type Study of Pila	Lecture	BSC104.5.	Quiz & End Sem Exam
32	Echinodermata: Introduction	Lecture	BSC104.5.	Quiz & End Sem Exam
33	External features of Star fish	Lecture	BSC104.5.	Quiz & End Sem Exam
34	Echinoderm larvae,	Lecture	BSC104.5.	Quiz & End Sem Exam
35	Hemichordata: General Characteristics and relationship with nonchordates and chordates,	Lecture	BSC104.5.	Quiz & End Sem Exam
36	External morphology (Balanoglossus), structure and significance of Tornaria Larva	Lecture	BSC104.5.	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

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BSC104.1	Learn about characteristics and variation among different phylum of Invertebrates from Protozoa to Echinodermata.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	

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BSC104.2.	Get knowledge of type study of typical invertebrate classification, morphology, reproduction and economic importance.	3	2	3	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BSC104.3.	Differentiate lower and higher invertebrates and develop scientific outlook for research and innovation.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BSC104.4.	Develop conservative outlook for animals.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BSC104.5.	Generate written and verbal communication skills over the subject.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	

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Sample Question Paper

Amity Institute of Biotechnology Amity University Madhya Pradesh						
Class: B.Sc. Biology 1st Semester						
Subject Name: BSC 102 Animal Sciences-I		Time:3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	
Student will be able to						

CO Map	Question No.	Question	Marks
CO1	Q.1	Give an account on fresh water sponges with examples.	6
CO1	Q.2	Discuss about Taxonomy and its significance.	6
	Q.3	Give an account on class Ciliata with examples.	6
CO1	Q.4	Write about canal system of Sycon and its importance.	6
CO2	Q.5	Mention about infective stage of Plasmodium vivax.	6
	Q6	What is taxonomic hierarchy? Write its importance.	6
CO2	Q.7	Discuss about characteristic features of phylum Mollusca and describe about class Cephalopoda in detail.	10
CO2	Q.8	Write a detail account on malaria, its causative agent and preventive measures.	10
CO3	Q.9	Classify phylum Platyhelminthes upto classes with examples.	10
CO3	Q.10	What are Protozoans? Classify them upto (a) Subphylum with examples (b) Classes with examples	20

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Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Sciencs-I** /Course code **BSC 102** is level **3** for the academic year ***2021-22***.

Asha Singh

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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Sciences – II
Course Code : BSC 202, Crédits : 03, Session :2021-22(Second Sem.), Class : B.Sc. (Biology) 1st Year
Faculty Name : Dr. Asha Singh

Introduction: The objective of this course is to provide the conceptual knowledge about Vertebrates, which includes from Pisces to Mammals. This paper will be helpful to understand the variations from one class to another. The knowledge gained from this subject will be helpful for students to realize the significance of animal sciences towards its applications in modern biotechnology.

A. Course Outcomes: At the end of the course, students will be able to:

BSC204.1 Develop knowledge about Chordates with reference to salient features and outline classification.

BSC204.2. gain knowledge about comparative account of lower vertebrates and their type study of animal.

BSC204.3. Learn about the comparative account of vertebrates and their organ system and generates interdisciplinary & collaborative approach.

BSC204.4. Learn about anatomical & physiological variability among vertebrate's organ system.

B. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological

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tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

C. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightag e %**
Continuous Internal Evaluation	Mid Term 1	CT	15%

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	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25%includesalltypesofleaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

D. Syllabus

Module I: Salient features and outline classification of Phylum Chordata upto order with suitable *examples (According to Parker and Haswell latest edition)*

Module II:

- Urochordata: Type Study of *Herdmania* (Including development)
- Cephalochordata: Type Study of *Amphioxus*. Affinities of *Amphioxus*
- *Petromyzon*: External Features
- Comparison between *Petromyzon* and *Myxine*

Module III:

Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)

- Integumentary system
- Skeletal System: Girdles only
- Digestive system

Module IV:

Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)

- Respiratory System
- Circulatory System: Heart and Aortic Arches only
- Nervous System; Brain only

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• *Urinogenital System*

E. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

F. Suggested Text/Reference Books:

- T. C. Majpuria. A text book of zoology.
- V.K Tiwari, A Text book of Zoology
- Ramesh Gupta, A Text book of Zoology

G. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Salient features and outline classification of Phylum Chordata upto order with suitable Examples: Introduction	Lecture	BSC204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
2	Out line classification of Phylum Chordata, Hemichordata & Tunicata	Lecture	BSC204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
3	Out line classification of Phylum Cephalochordata & Agnatha	Lecture	BSC204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
4	*Out line classification of* Gnathostomata & Elasmobranchi	Lecture	BSC204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
5	Out line classification of Osteichthyes (Bony Fishes)	Lecture	BSC204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

6	Out line classification of Amphibians	Lecture	BSC204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
7	Out line	Lecture	BSC204.1	Mid Term-1, Quiz,

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	classification of Reptilian			Home assignments, Seminar & End Sem Exam
8	Out line classification of Aves	Lecture	BSC204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
9	Out line classification of Mammalians	Lecture	BSC204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
10	Out line classification of Urochordata:	Lecture	BSC204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
11	Type Study of *Herdmania*	Lecture	BSC204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
12	*Herdmania* development stages	Lecture	BSC204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
13	Cephalochordata: Type Study of *Amphioxus*	Lecture	BSC204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
14	Affinities of *Amphioxus*	Lecture	BSC204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
15	*Petromyzon*: External Features	Lecture	BSC204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
16	*Myxine:* External Features	Lecture	BSC204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
17	Comparison between *Petromyzon* and *Myxine*	Lecture	BSC204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

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18	Comparison between *Petromyzon* and *Myxine*	Lecture	BSC204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
19	Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)	Lecture	BSC204.3.	Home assignments, Quiz, Seminar &

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				End Sem Exam
20	Integumentary system: Fish, Amphibia, Reptiles,	Lecture	BSC204.3.	Home assignments, Quiz, Seminar & End Sem Exam
21	Integumentary system: Birds and Mammals	Lecture	BSC204.3.	Home assignments, Quiz, Seminar & End Sem Exam
22	Skeletal System: Girdles only (Fish, Amphibia, Reptiles)	Lecture	BSC204.3.	Home assignments, Quiz, Seminar & End Sem Exam
23	Skeletal System: Girdles only (Birds and Mammals)	Lecture	BSC204.3.	Home assignments, Quiz, Seminar & End Sem Exam
24	Digestive system : Basics	Lecture	BSC204.3.	Home assignments, Quiz, Seminar & End Sem Exam
25	Digestive system: (Fish, Amphibia)	Lecture	BSC204.3.	Home assignments, Quiz, Seminar & End Sem Exam
26	Digestive system: (Reptiles)	Lecture	BSC204.3.	Home assignments, Quiz, Seminar & End Sem Exam
27	Digestive system: (Birds and Mammals)	Lecture	BSC204.3.	Home assignments, Quiz, Seminar & End Sem Exam
28	Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)	Lecture	BSC204.4.	Home assignments, Quiz, Seminar & End Sem Exam
29	Respiratory System: (Fish, Amphibia, Reptiles)	Lecture	BSC204.4.	Home assignments, Quiz, Seminar & End Sem Exam
30	Respiratory System: (Birds and Mammals)	Lecture	BSC204.4.	Home assignments, Quiz, Seminar & End Sem Exam

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31	Circulatory System: Heart and Aortic Arches only: (Fish, Amphibia, Reptiles)	Lecture	BSC204.4.	Home assignments, Quiz, Seminar & End Sem Exam

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32	Circulatory System: Heart and Aortic Arches only: (Birds and Mammals)	Lecture	BSC204.4.	Home assignments, Quiz, Seminar & End Sem Exam
33	Nervous System; Brain only: (Fish, Amphibia, Reptiles)	Lecture	BSC204.4.	Home assignments, Quiz, Seminar & End Sem Exam
34	Nervous System; Brain only: (Birds and Mammals)	Lecture	BSC204.4.	Home assignments, Quiz, Seminar & End Sem Exam
35	Urinogenital System: (Fish, Amphibia, Reptiles)	Lecture	BSC204.4.	Home assignments, Quiz, Seminar & End Sem Exam
36	Urinogenital System: (Birds and Mammals)	Lecture	BSC204.4.	Home assignments, Quiz, Seminar & End Sem Exam

H. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BSC204.1	Develop knowledge about Chordates with reference to salient features and outline classification.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	

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BSC204.2.	Gain knowledge about comparative account of lower vertebrates and their type study of animal.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BSC204.3.	Learn about the comparative account of	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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	vertebrates and their organ system and generates interdisciplinary & collaborative approach.															
BSC204.4.	Learn about anatomical & physiological variability among vertebrate's organ system.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

Sample Question Paper

<table>
<tr><td colspan="8">Amity Institute of Biotechnology
Amity University Madhya Pradesh</td></tr>
<tr><td colspan="8">Class: B.Sc. (Biology)</td></tr>
<tr><td colspan="3">Subject Name:
BSC 202 Animal Sciences-II</td><td colspan="3">Time:3 Hrs</td><td colspan="2">Max.Marks:70</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td colspan="2">Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4</td><td>Q.2,3</td><td>Q.4</td><td>Q.2,5,6</td><td>Q. 7, 8, 9, 10</td><td colspan="2"></td></tr>
<tr><td colspan="8">Student will be able to</td></tr>
<tr><td>CO Map</td><td>Question No.</td><td colspan="5">Question</td><td>Marks</td></tr>
<tr><td>CO1</td><td>Q.1</td><td colspan="5">What are chordates, discuss about its theories of origin.</td><td>6</td></tr>
</table>

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CO1	Q.2	Write a note on morphology of feathers in birds.	6
	Q.3	Write a note on order Anura of Amphibia with examples.	6
CO1	Q.4	Write external features of Petromyzon.	6

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CO2	Q.5	Write a note on Retrogressive metamorphosis in Herdmania.	6
	Q6	Write a note on protonephridia in Amphioxus.	6
CO2	Q.7	Explain about characters and classification of class Mammalia with examples.	10
CO2	Q.8	Give a comparative account of Petromyzon and Myxine.	10
CO3	Q.9	Describe about the classification of Elasmobranchii upto orders with examples.	10
CO3	Q.10	Discuss in detail about the neural complex of Herdmania. Describe about the phenomena of retrogressive metamorphosis among Tunicates.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Sciences-II** /Course code ***BSC202*** is level **3** for the academic year ***2021-22***.

Asha Singh

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AMITY UNIVERSITY
MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Sciences – II
Course Code : BMB 204, Crédits : 03, Session: 2021-22 (Second Sem.), Class : B.Sc. M.Sc dual degree 1st Year
Faculty Name : Dr. Asha Singh

Introduction: The objective of this course is to provide the conceptual knowledge about Vertebrates, which includes from Pisces to Mammals. This paper will be helpful to understand the variations from one class to another. The knowledge gained from this subject will be helpful for students to realize the significance of animal sciences towards its applications in modern biotechnology.

A. Course Outcomes: At the end of the course, students will be able to:

BMB204.1 Develop knowledge about Chordates with reference to salient features and outline classification.

BMB204.2. gain knowledge about comparative account of lower vertebrates and their type study of animal.

BMB204.3. Learn about the comparative account of vertebrates and their organ system and generates interdisciplinary & collaborative approach.

BMB204.4. Learn about anatomical & physiological variability among vertebrate's organ system.

B. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools withan understanding of complex biological activities.

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PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

C. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home	S/V/Q/HA	10%

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	Assignment		
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25%includesalltypesofleaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Salient features and outline classification of Phylum Chordata upto order with suitable *examples (According to Parker and Haswell latest edition)*

Module II:

- Urochordata: Type Study of *Herdmania* (Including development)
- Cephalochordata: Type Study of *Amphioxus*. Affinities of *Amphioxus*
- *Petromyzon*: External Features
- Comparison between *Petromyzon* and *Myxine*

Module III:

Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)

- Integumentary system
- Skeletal System: Girdles only
- Digestive system

Module IV:

Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)

- Respiratory System
- Circulatory System: Heart and Aortic Arches only
- Nervous System; Brain only
- *Urinogenital System*

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- T. C. Majpuria. A text book of zoology.
- V.K Tiwari, A Text book of Zoology
- Ramesh Gupta, A Text book of Zoology

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Salient features and outline classification of Phylum Chordata upto order with suitable Examples: Introduction	Lecture	BMB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
2	Out line classification of Phylum Chordata, Hemichordata & Tunicata	Lecture	BMB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
3	Out line classification of Phylum Cephalochordata & Agnatha	Lecture	BMB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
4	*Out line classification of* Gnathostomata & Elasmobranchi	Lecture	BMB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
5	Out line classification of Osteichthyes (Bony Fishes)	Lecture	BMB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
6	Out line classification of Amphibians	Lecture	BMB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

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7	Out line classification of Reptilian	Lecture	BMB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
8	Out line	Lecture	BMB204.1	Mid Term-1, Quiz,

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	classification of Aves			Home assignments, Seminar & End Sem Exam
9	Out line classification of Mammalians	Lecture	BMB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
10	Out line classification of Urochordata:	Lecture	BMB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
11	Type Study of *Herdmania*	Lecture	BMB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
12	*Herdmania* development stages	Lecture	BMB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
13	Cephalochordata: Type Study of *Amphioxus*	Lecture	BMB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
14	Affinities of *Amphioxus*	Lecture	BMB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
15	*Petromyzon*: External Features	Lecture	BMB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
16	*Myxine:* External Features	Lecture	BMB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
17	Comparison between *Petromyzon* and *Myxine*	Lecture	BMB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
18	Comparison between *Petromyzon* and *Myxine*	Lecture	BMB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

19	Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)	Lecture	BMB204.3 .	Home assignments, Quiz, Seminar & End Sem Exam
20	Integumentary system: Fish, Amphibia, Reptiles,	Lecture	BMB204.3.	Home assignments, Quiz, Seminar &

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				End Sem Exam
21	Integumentary system: Birds and Mammals	Lecture	BMB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
22	Skeletal System: Girdles only (Fish, Amphibia, Reptiles)	Lecture	BMB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
23	Skeletal System: Girdles only (Birds and Mammals)	Lecture	BMB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
24	Digestive system : Basics	Lecture	BMB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
25	Digestive system: (Fish, Amphibia)	Lecture	BMB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
26	Digestive system: (Reptiles)	Lecture	BMB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
27	Digestive system: (Birds and Mammals)	Lecture	BMB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
28	Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)	Lecture	BMB204.4 .	Home assignments, Quiz, Seminar & End Sem Exam
29	Respiratory System: (Fish, Amphibia, Reptiles)	Lecture	BMB204.4.	Home assignments, Quiz, Seminar & End Sem Exam
30	Respiratory System: (Birds and Mammals)	Lecture	BMB204.4.	Home assignments, Quiz, Seminar & End Sem Exam
31	Circulatory System: Heart and Aortic Arches only: (Fish, Amphibia, Reptiles)	Lecture	BMB204.4.	Home assignments, Quiz, Seminar & End Sem Exam

32	Circulatory System: Heart and Aortic Arches only: (Birds and Mammals)	Lecture	BMB204.4.	Home assignments, Quiz, Seminar & End Sem Exam

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33	Nervous System; Brain only: (Fish, Amphibia, Reptiles)	Lecture	BMB204.4.	Home assignments, Quiz, Seminar & End Sem Exam
34	Nervous System; Brain only: (Birds and Mammals)	Lecture	BMB204.4.	Home assignments, Quiz, Seminar & End Sem Exam
35	Urinogenital System: (Fish, Amphibia, Reptiles)	Lecture	BMB204.4.	Home assignments, Quiz, Seminar & End Sem Exam
36	Urinogenital System: (Birds and Mammals)	Lecture	BMB204.4.	Home assignments, Quiz, Seminar & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BMB204.1	Develop knowledge about Chordates with reference to salient features and outline classification.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	
BMB204.2 .	Gain knowledge about comparative account of lower vertebrates and their type study of animal.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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BMB204.3 .	Learn about the comparative account of vertebrates and their organ system and generates	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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	interdisciplinary & collaborative approach.															
BMB204.4.	Learn about anatomical & physiological variability among vertebrate's organ system.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

Sample Question Paper

Amity Institute of Biotechnology Amity University Madhya Pradesh						
Class: B.Sc. M.Sc. Dual Degree Biotechnology 2nd Semester						
Subject Name: BMB 204 Animal Sciences-II		Time:3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	
Student will be able to						

CO Map	Question No.	Question	Marks
CO1	Q.1	What are chordates, discuss about its theories of origin.	6
CO1	Q.2	Write a note on morphology of feathers in birds.	6
	Q.3	Write a note on order Anura of Amphibia with examples.	6

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CO1	Q.4	Write external features of Petromyzon.	6

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CO2	Q.5	Write a note on Retrogressive metamorphosis in Herdmania.	6
	Q6	Write a note on protonephridia in Amphioxus.	6
CO2	Q.7	Explain about characters and classification of class Mammalia with examples.	10
CO2	Q.8	Give a comparative account of Petromyzon and Myxine.	10
CO3	Q.9	Describe about the classification of Elasmobranchii upto orders with examples.	10
CO3	Q.10	Discuss in detail about the neural complex of Herdmania. Describe about the phenomena of retrogressive metamorphosis among Tunicates.	20

Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Sciences-*II*** /Course code ***BMB 204*** is level **3** for the academic year ***2021-22***.

Asha Singh

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AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Animal Sciences – II
Course Code : BSB 204, Crédits : 03, Session :2021-22 (Second Sem.), Class : B.Sc. (Biotechnology) 1st Year
Faculty Name : Dr. Asha Singh

Introduction: The objective of this course is to provide the conceptual knowledge about Vertebrates, which includes from Pisces to Mammals. This paper will be helpful to understand the variations from one class to another. The knowledge gained from this subject will be helpful for students to realize the significance of animal sciences towards its applications in modern biotechnology.

A. **Course Outcomes:** At the end of the course, students will be able to:

BSB204.1 Develop knowledge about Chordates with reference to salient features and outline classification.

BSB204.2. gain knowledge about comparative account of lower vertebrates and their type study of animal.

BSB204.3. Learn about the comparative account of vertebrates and their organ system and generates interdisciplinary & collaborative approach.

BSB204.4. Learn about anatomical & physiological variability among vertebrate's organ system.

B. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomictheory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

C. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-	S/V/Q/H	10%

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	Voce/Quiz/Home Assignment	A	
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25%includesalltypesofleaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Salient features and outline classification of Phylum Chordata upto order with suitable *examples (According to Parker and Haswell latest edition)*

Module II:

- Urochordata: Type Study of *Herdmania* (Including development)
- Cephalochordata: Type Study of *Amphioxus*. Affinities of *Amphioxus*
- *Petromyzon*: External Features
- Comparison between *Petromyzon* and *Myxine*

Module III:

Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)

- Integumentary system
- Skeletal System: Girdles only
- Digestive system

Module IV:

Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)

- Respiratory System
- Circulatory System: Heart and Aortic Arches only
- Nervous System; Brain only
- *Urinogenital System*

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- T. C. Majpuria. A text book of zoology.
- V.K Tiwari, A Text book of Zoology
- Ramesh Gupta, A Text book of Zoology

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Salient features and outline classification of Phylum Chordata upto order with suitable Examples: Introduction	Lecture	BSB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
2	Out line classification of Phylum Chordata, Hemichordata & Tunicata	Lecture	BSB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
3	Out line classification of Phylum Cephalochordata & Agnatha	Lecture	BSB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
4	*Out line classification of* Gnathostomata & Elasmobranchi	Lecture	BSB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
5	Out line classification of Osteichthyes (Bony Fishes)	Lecture	BSB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
6	Out line classification of Amphibians	Lecture	BSB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

7	Out line classification of Reptilian	Lecture	BSB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
8	Out line	Lecture	BSB204.1	Mid Term-1, Quiz,

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	classification of Aves			Home assignments, Seminar & End Sem Exam
9	Out line classification of Mammalians	Lecture	BSB204.1	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
10	Out line classification of Urochordata:	Lecture	BSB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
11	Type Study of *Herdmania*	Lecture	BSB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
12	*Herdmania* development stages	Lecture	BSB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
13	Cephalochordata: Type Study of *Amphioxus*	Lecture	BSB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
14	Affinities of *Amphioxus*	Lecture	BSB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
15	*Petromyzon*: External Features	Lecture	BSB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
16	*Myxine:* External Features	Lecture	BSB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
17	Comparison between *Petromyzon* and *Myxine*	Lecture	BSB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam
18	Comparison between *Petromyzon* and *Myxine*	Lecture	BSB204.2.	Mid Term-1, Quiz, Home assignments, Seminar & End Sem Exam

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19	Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)	Lecture	BSB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
20	Integumentary system: Fish, Amphibia, Reptiles,	Lecture	BSB204.3.	Home assignments, Quiz, Seminar &

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				End Sem Exam
21	Integumentary system: Birds and Mammals	Lecture	BSB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
22	Skeletal System: Girdles only (Fish, Amphibia, Reptiles)	Lecture	BSB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
23	Skeletal System: Girdles only (Birds and Mammals)	Lecture	BSB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
24	Digestive system : Basics	Lecture	BSB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
25	Digestive system: (Fish, Amphibia)	Lecture	BSB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
26	Digestive system: (Reptiles)	Lecture	BSB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
27	Digestive system: (Birds and Mammals)	Lecture	BSB204.3.	Home assignments, Quiz, Seminar & End Sem Exam
28	Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, Birds and Mammals)	Lecture	BSB204.4.	Home assignments, Quiz, Seminar & End Sem Exam
29	Respiratory System: (Fish, Amphibia, Reptiles)	Lecture	BSB204.4.	Home assignments, Quiz, Seminar & End Sem Exam
30	Respiratory System: (Birds and Mammals)	Lecture	BSB204.4.	Home assignments, Quiz, Seminar & End Sem Exam
31	Circulatory System: Heart and Aortic Arches only: (Fish, Amphibia, Reptiles)	Lecture	BSB204.4.	Home assignments, Quiz, Seminar & End Sem Exam

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32	Circulatory System: Heart and Aortic Arches only: (Birds and Mammals)	Lecture	BSB204.4.	Home assignments, Quiz, Seminar & End Sem Exam

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33	Nervous System; Brain only: (Fish, Amphibia, Reptiles)	Lecture	BSB204.4.	Home assignments, Quiz, Seminar & End Sem Exam
34	Nervous System; Brain only: (Birds and Mammals)	Lecture	BSB204.4.	Home assignments, Quiz, Seminar & End Sem Exam
35	Urinogenital System: (Fish, Amphibia, Reptiles)	Lecture	BSB204.4.	Home assignments, Quiz, Seminar & End Sem Exam
36	Urinogenital System: (Birds and Mammals)	Lecture	BSB204.4.	Home assignments, Quiz, Seminar & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BSB204.1	Develop knowledge about Chordates with reference to salient features and outline classification.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	
BSB204.2.	Gain knowledge about comparative account of lower vertebrates and their type study of animal.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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BSB204.3.	Learn about the comparative account of vertebrates and their organ system and generates	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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	interdisciplinary & collaborative approach.															
BSB204.4.	Learn about anatomical & physiological variability among vertebrate's organ system.	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

Sample Question Paper

Amity Institute of Biotechnology Amity University Madhya Pradesh							
Class: B.Sc. (H) Biotechnology 2nd Semester							
Subject Name: BSB 204 Animal Sciences-II		Time:3 Hrs			Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating	
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10		
Student will be able to							

CO Map	Question No.	Question	Marks
CO1	Q.1	What are chordates, discuss about its theories of origin.	6
CO1	Q.2	Write a note on morphology of feathers in birds.	6
	Q.3	Write a note on order Anura of Amphibia with examples.	6

CO1	Q.4	Write external features of Petromyzon.	6

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CO2	Q.5	Write a note on Retrogressive metamorphosis in Herdmania.	6
	Q6	Write a note on protonephridia in Amphioxus.	6
CO2	Q.7	Explain about characters and classification of class Mammalia with examples.	10
CO2	Q.8	Give a comparative account of Petromyzon and Myxine.	10
CO3	Q.9	Describe about the classification of Elasmobranchii upto orders with examples.	10
CO3	Q.10	Discuss in detail about the neural complex of Herdmania. Describe about the phenomena of retrogressive metamorphosis among Tunicates.	20

Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Animal Sciences-*II*** /Course code ***BSB 204*** is level **3** for the academic year ***2021-22***.

Asha Singh

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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
III	BMB 302	3	3	3	3	1	-	-	2	2	1	3	1	-

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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MICROBIOLOGY
Course Code : BMB 302, Crédits : 04, Session :2021-22(Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: The course imparts the knowledge of different types of microorganisms that are invisible to our naked eyes. Discovery origin and evaluation of different forms of bacteria, fungi, protozoa and viruses constitute the basics of biotechnology.

B. Course Outcomes: After successful completion of the course student will be able to:

BMB 302.1. Understand the microbiological techniques for the isolation and characterization of microbes.
BMB 302.2. Understand the mechanism of different metabolic processes.
BMB 302.3. Know the physiology and survival mechanism of extremophilic bacteria.
BMB 302.4. Know the concept of virus lytic and lysogenic cycle is quite clear to students.
BMB 302.5. Understand the epidemiology and microbial pathogenesis.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.
PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.
PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

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commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.
PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/ HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the

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causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization,

Module II

Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, continuous culture, culture collection and maintenance of cultures.

Module III

Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV

Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archaea

Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles Viruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI

Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII

Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill
  Microbiology by Prescott

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- The microbes – An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

References:

- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin & Cummings
- Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
- Industrial Microbiology, Casida, New Age International
- Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC. Brown Publisher.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
2	Role of microorganisms in transformation of organic matter and in the causation of diseases,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
3	Development of pure culture methods.	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
4	Methods in Microbiology -Principles of microbial nutrition,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
5	Culture media,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
6	Culture media,	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
7	Physical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
8	Physical Sterilization	Lecture	BMB 302.1.	Mid Term-

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				1, Quiz & End Sem Exam
9	Chemical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
10	Chemical Sterilization	Lecture	BMB 302.1.	Mid Term-1, Quiz & End Sem Exam
11	Prokaryotic structure and function	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
12	Cell wall	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
13	Cell cytoplasmic membrane	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
14	Capsule	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
15	Surface appendages	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
16	Cytoplasm and cytoplasmic inclusion	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
17	Bacterial growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
18	Mathematical expression of growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam

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19	Growth curve	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
20	Measurement of growth	Lecture	BMB 302.2	Mid Term-1, Quiz & End Sem Exam
21	Synchronous growth,	Lecture	BMB 302.2	Quiz & End Sem Exam
22	Continuous culture,	Lecture	BMB 302.2	Quiz & End Sem Exam
23	Culture collection and maintenance of cultures.	Lecture	BMB 302.2	Quiz & End Sem Exam
24	Systematics and taxonomy - new approaches to bacterial taxonomy,	Lecture	BMB 302.2	Quiz & End Sem Exam
25	Classification including ribotyping, ribosomal RNA sequencing,	Lecture	BMB 302.2	Quiz & End Sem Exam
26	Characteristics of primary domains, taxonomy, nomenclature and Bergey's manual	Lecture	BMB 302.2	Quiz & End Sem Exam
27	Metabolic Diversity among microorganisms- photosynthesis in microorganisms	Lecture	BMB 302.2	Quiz & End Sem Exam
28	Role of bacteriochlorophylls	Lecture	BMB 302.2	Quiz & End Sem Exam
29	carotenoids and phycobilins	Lecture	BMB 302.2	Quiz & End Sem Exam
30	Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria,	Lecture	BMB 302.2	Quiz & End Sem Exam
31	nitrate and sulphate reduction,	Lecture	BMB 302.2	Quiz & End Sem Exam
32	methanogenesis and acetogenesis,	Lecture	BMB 302.2	Quiz & End Sem Exam
33	Fermentations,	Lecture	BMB 302.2	Quiz & End Sem Exam
34	Nitrogen fixation,	Lecture	BMB 302.2	Quiz & End Sem Exam
35	Plant microbe interactions	Lecture	BMB 302.2	Quiz & End Sem Exam
36	Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BMB 302.3	Quiz & End Sem Exam
37	*Viruses: Bacterial, animal;*	Lecture	BMB	Quiz & End Sem

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	structure of viruses;		302.4	Exam
38	*Reproduction and life cycle of RNA and DNA viruses; Viroids and prions.*	Lecture	BMB 302.4	Quiz & End Sem Exam
39	*Algae: Classification and Reproduction.*	Lecture	BMB 302.4	Quiz & End Sem Exam
40	*Fungi: Classification and Reproduction.*	Lecture	BMB 302.4	Quiz & End Sem Exam
41	Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract,	Lecture	BMB 302.5	Quiz & End Sem Exam
42	Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo) and their mode of actions,	Lecture	BMB 302.5	Quiz & End Sem Exam
43	Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission;	Lecture	BMB 302.5	Quiz & End Sem Exam
44	Sexually transmitted disease including AIDS, Food and water-borne diseases; pathogenic fungi.	Lecture	BMB 302.5	Quiz & End Sem Exam
45	Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins,	Lecture	BMB 302.5	Quiz & End Sem Exam
45	Broad spectrum antibiotics	Lecture	BMB 302.5	Quiz & End Sem Exam
46	Antifungal antibiotics	Lecture	BMB 302.5	Quiz & End Sem Exam
47	Antibiotics mode of action.	Lecture	BMB 302.5	Quiz & End Sem Exam
48	Antibiotics mode of action.	Lecture	BMB 302.5	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 302.1	Understand the microbiological techniques for the isolation and characterization of microbes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.2	Understand the mechanism of different metabolic processes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.3	Know the physiology and survival mechanism of extremophilic bacteria.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.4	Learn structure and function of the cell cytoskeleton, cilia and flagella.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 302.5	Understand the epidemiology and microbial pathogenesis	3	3	3	3	1	-	-	2	2	1	3	1	-

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Sample Question Paper

Amity Institute Biotechnology 2021-22						
Class: B.Sc.-M.Sc. (Dual Degree) Biotechnology III Semester						
Subject Name: Microbiology		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand the microbiological techniques for the isolation and characterization of microbes.
- Understand the mechanism of different metabolic processes.
- Know the physiology and survival mechanism of extremophilic bacteria.
- Know the concept of virus lytic and lysogenic cycle is quite clear to students.
- Understand the epidemiology and microbial pathogenesis.

CO Map	Question No.	Question	Marks
CO1	Q.1	Write the historical contributions of Louis Pasteur and Robert Koch in the field of microbiology.	6
CO2	Q.2	Write down the steps involved in Gram's staining procedure. Differentiate between Gram positive and gram negative bacteria.	6
	Q.3	Explain the importance of extracellular appendages present in bacteria.	6
CO4	Q.4	Describe polyphasic taxonomy and discuss some of its advantages	6
CO4	Q.5	Discuss about the mechanism of photo-phosphorylation in bacterial system.	6
CO3	Q.6	Give an outline the nitrogen fixation, and explain the roles of microorganisms in this cycle	6
	Q.7	What are the archaea? Briefly describe the major ways in which they differ from bacteria and eucaryotes.	10
CO4	Q.8	Write a note on viroids and prions with suitable example of disease.	10

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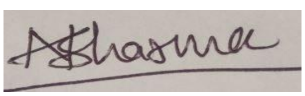
CO3	Q.9	Discuss about normal microbiota present on different body region with suitable features	10
CO3	Q.10	What is penicillinase? Explain the role of penicillin against the synthesis of bacterial cell wall. How does a low concentration of penicillin G select for penicillin-resistant bacteria?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Microbiology***/Course code ***BMB 302*** is level **3** for the academic year ***2021-22***.



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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BMB 401	3	3	3	3	1	-	-	2	2	1	3	1	-

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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **Bioinformatics**
Course Code : BMB 401, Crédits : 3, Session :2022-23 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The course involves a basic understanding of computer and bioinformatics tools and skills in the field of biology

B. **Course Outcomes:** After successful completion of the course student will be able to:

BMB 401.1. Understand and explain the structural organization and characteristics of computers and its parts

BMB 401.2. Describe the concept of use of internet in bioinformatics.

BMB 401.3. Explain the concept and organization of biological databases..

BMB 401.4. Understand and explain the structure and functions of the phylogenetic analytic tools.

BMB 401.5. Interrogate major database sources and be able to integrate this information with clinical data.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

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PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Computers
General introduction (characteristics, capabilities, generations), software, hardware : organization of hardware (input devices, memory, control unit arithmetic logic unit, output devices); software : (System software; application software, languages -low level, high level), interpreter, compiler, data processing; batch, on-line, real-time (examples from bioindustries; e.g. application of computers in co-ordination of solute concentration, ph, temperature, etc., of a fermenter in operation); internet application.

Module II: Basic Bioinformatics

Introduction to Internet, Search Engines (Google, Yahoo, Entrez etc)

Module III: Biological Databases

Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL), Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc), Cluster databases-An Introduction, Specialised databases (KEGG, etc), Database technologies (Flat-file), Structural databases (PDB)

Module IV: Phylogenetic Analysis

Trees-splits and metrices on trees, tree interpretation, Distance – additive, ultrameric and nonadditive distances,tree building methods, phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains, estimating the rate of change, likelihood and trees; analysis software.

Module V: Genome analysis

Annotation, comparison of different methods; ESTs – databases, clustering, gene discovery and identification, and functional classification. Reconstruction of metabolic pathways; Genome analysis, genome anatomy, genome rearrangements with inversions, signed inversions, gene identification, gene expression, expression analysis, gene identification and functional classification

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

• Computer Science, J.G. Brookshear, Pearson, Addison Wesley

• Introduction to Bioinformation – T.Attawood

References:

• A book on C by Kelley : Programming in C, Addison-Wesley Publishing

• Introduction to C++ for Engineers and Scientists, Prentice-Hall

• Schaum's Outline of Introduction of Computer Science, P. Cushman and R. Mata-Toledo, McGraw Hill

Trade

• Bioinformatics – Managing Scientific Data, Zoe' Lacroix and Terence Critchlow

• Bioinformatics – Sequence, Structure and Databanks, Des Higgins & Willie Taylor

• Structural Bioinformatics, Philip E. Bourne, Helge Weissig 2003

• Statistical Methods in Bioinformatics: An Introduction, G.R. Grant, W.J. Ewens, Springer Verlag

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**

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1	General introduction (characteristics, capabilities, generations),	Lecture	**BMB 401.1**.	Mid Term-1, Quiz & End Sem Exam
2	software, hardware : organization of hardware (input devices, memory, control unit	Lecture	**BMB 401.1**.	Mid Term-1, Quiz & End Sem Exam

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	arithmetic logic unit, output devices),			
3	organization of hardware	Lecture	**BMB 401.2**.	Mid Term-1, Quiz & End Sem Exam
4	*organization of software*	Lecture	**BMB 401.2**.	Mid Term-1, Quiz & End Sem Exam
5	Interpreter, compiler, data processing; batch, on-line, real-time	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
6	Introduction and application of Internet	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
7	Search Engines (Google, Yahoo, Entrez etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
8	Revision	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
9	Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
10	Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
11	Cluster data bases-An Introduction. Specialized databases (KEGG, etc)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
12	Database technologies (Flat-file)	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
13	Revision	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
14	Introduction of phylogenetics analysis	Lecture	**BMB 401.3**	Mid Term-1, Quiz & End Sem Exam
15	Trees-splits and metrices on trees, tree interpretation	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
16	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
17	phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
18	Estimating the rate of change, likelihood and trees; analysis software	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam

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19	Annotation, comparison of different methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
20	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BMB 401.4**	Mid Term-1, Quiz & End Sem Exam
21	Revision	Lecture	**BMB 401.4**	Quiz & End Sem

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				Exam
22	ESTs – databases, clustering	Lecture	**BMB 401.4**	Quiz & End Sem Exam
23	Gene discovery	Lecture	**BMB 401.4**	Mid Term-2, Quiz & End Sem Exam
24	Identification and classification	Lecture	**BMB 401.5**	Quiz & End Sem Exam
25	Revision	Lecture	**BMB 401.5**	Quiz & End Sem Exam
26	Reconstruction of metabolic pathways	Lecture	**BMB 401.5**	Quiz & End Sem Exam
27	Genome analysis, genome anatomy	Lecture	**BMB 401.4**	Quiz & End Sem Exam
28	Genome rearrangements with inversions	Lecture	**BMB 401.4**	Quiz & End Sem Exam
29	signed inversions, gene identification	Lecture	**BMB 401.4**	Quiz & End Sem Exam
30	Reconstruction of metabolic pathways	Lecture	**BMB 401.4**	Quiz & End Sem Exam
31	Genome analysis, genome anatomy	Lecture	**BMB 401.4**	Quiz & End Sem Exam
32	Gene expression	Lecture	**BMB 401.4**	Quiz & End Sem Exam
33	Gene expression analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
34	Gene identification methods	Lecture	**BMB 401.1**	Quiz & End Sem Exam
35	Functional classification	Lecture	**BMB 401.1**	Quiz & End Sem Exam
36	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
37	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
38	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam
39	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam
40	Gene expression	Lecture	**BMB 401.1**	Quiz & End Sem Exam
41	Gene expression analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
42	Gene identification methods	Lecture	**BMB 401.1**	Quiz & End Sem Exam
43	Functional classification	Lecture	**BMB 401.1**	Quiz & End Sem Exam
44	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam
45	Application of genome analysis	Lecture	**BMB 401.1**	Quiz & End Sem Exam

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45	Revision	Lecture	**BMB 401.1**	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 401.1	Understand and explain the structural organization and characteristics of computers and its parts	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.2	Describe the concept of use of internet in bioinformatics.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.3	Explain the concept and organization of biological databases	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.4	Understand and explain the structure and functions of the phylogenetic analytic tools.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.5	Interrogate major database sources and be able to integrate this information with clinical data.	3	3	3	3	1	-	-	2	2	1	3	1	-

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Sample Question Paper

Amity Institute Biotechnology 2021-22		
Class: B.Sc. Biotechnology IV Semester		
Subject Name: **Bioinformatics**	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand the basic knowledge of computer hardware and software.
- Understand the advanced techniques of bioinformatics.
- Understand the application of bioinformatics in different area.
- Understand the role of computational biology in drug designing.
- Understand the importance of phylogenetic analysis in species development.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about the importance of input and output device of computer. Also differentiate between input and output devices.	6
CO2	Q.2	Discuss about the anatomy of E. mail and www.	6
	Q.3	Explain about the different databases present in NCBI. Give a comparison between protein databases and nucleotide databases with examples.	6
CO4	Q.4	Discuss about the different terminology used in phylogenetic tree with the suitable diagram.	6
CO4	Q.5	Write about the genome of between prokaryotic and eukaryotic organism.	6
CO3	Q.6	Discuss a general classification of computer generations with suitable examples, merits and demerits	6
	Q.7	What is topology of computer networking? Write advantages and disadvantages of different topology networking.	10
CO4	Q.8	Write a detail note on RCSB, Genbank, and DDBJ with advantages.	10
CO3	Q.9	What is sequence similarity? Explain about the different quantitative methods of sequence similarity	10

CO3	Q.10	. A. Explain the different methods used for gene prediction. Discuss one of the methods in detail with suitable diagram. B. By writing the corresponding match states into columns we get the following alignment: ATGA AGTA	20

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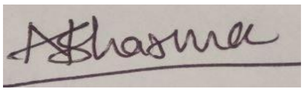
		What is its score under the following scoring scheme? Match +2, Mismatch -1 and Gap +1.Explain with global alignment algorithm.	

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Bioinformatics** /Course code ***BMB 401*** is level **2** for the academic year ***2021-22***.



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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BMB 403	3	3	3	3	1	-	-	2	2	1	3	1	-

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **IMMUNOLOGY & IMMUNOTECHNOLOGY**
Course Code : BMB 403, Crédits : 04, Session :2022-23 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. Course Outcomes: After successful completion of the course student will be able to:

BMB 403.1. Understand and explain the phylogeny of immune system, types of immunity, immune response.

BMB 403.2. Describe the concept of clonal selection theory, humoral and cell mediated immunity.

BMB 403.3. Understand and explain the structure and functions of the organs and cells of the immune system.

BMB 403.4. Understand the mechanism of antigen-antibody interaction.

BMB 403.5. Describe the structure of antibodies, their types and functions in immunity.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

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commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I :

Descriptors/Topics

Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.

Module II:

Descriptors/Topics

The organs and cells of the immune

system.Module III :

Descriptors/Topics
Histocompatibility: structure of MHC class I, II & III antigens & their mode of antigen presentation, MHC restriction; Antigens & antigenicity;

Module IV :
Descriptors/Topics
Antibody structure in relation to function and antigen-binding; Types of antibodies and their structures: isotypes, allotypes, idiotypes. Antibodies in targeting therapeutic agents. Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application

Module V :
Descriptors/Topics
Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.

Module VI :
Descriptors/Topics
Measurement of antigen – antibody interaction: agglutination, precipitation immunodiffusion, immuno-electrophoresis, ELISA, RIE

Module VII :
Descriptors/Topics
Tissue and organ transplantation

Module VIIII :
Descriptors/Topics
Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.
Autoimmunity and autoimmune diseases: Hashimoto’s thyroiditis; Myasthenia gravis; Rheumatoid Arthritis, Pernicious anemia, Asthma.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Freeman

References:
- Immunology, Roitt, Mosby – Yearbook Inc.
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.1**.	Mid Term-1, Quiz & End Sem Exam
2	Innate and specific immunity. Humoral immunity,	Lecture	**BMB 403.1**.	Mid Term-1, Quiz & End Sem Exam
3	Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.2**.	Mid Term-1, Quiz & End Sem Exam
4	Cell-mediated immunity and Clonal selection theory.	Lecture	**BMB 403.2**.	Mid Term-1, Quiz & End Sem Exam
5	The organs of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
6	The organs of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
7	The cells of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
8	The cells of the immune system	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
9	Histocompatibility: structure of MHC class I, II & III	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
10	Histocompatibility: structure of MHC class I, II & III	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
11	Antigens	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
12	Mode of antigen presentation,	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
13	MHC restriction; Antigens & antigenicity	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam

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14	MHC restriction; Antigens & antigenicity	Lecture	**BMB 403.3**	Mid Term-1, Quiz & End Sem Exam
15	Antibody structure in relation to	Lecture	**BMB 403.4**	Mid Term-1,

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	function and antigen-binding			Quiz & End Sem Exam
16	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
17	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
18	Antibodies in targeting therapeutic agents.	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
19	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
20	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Mid Term-1, Quiz & End Sem Exam
21	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application,	Lecture	**BMB 403.4**	Quiz & End Sem Exam
22	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BMB 403.4**	Quiz & End Sem Exam
23	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.4**	Mid Term-2, Quiz & End Sem Exam
24	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam
25	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam
26	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BMB 403.5**	Quiz & End Sem Exam

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27	Measurement of antigen – antibody interaction: agglutination,	Lecture	**BMB 403.5**	Quiz & End Sem Exam
28	Precipitation	Lecture	**BMB 403.5**	Quiz & End Sem Exam
29	immunodiffusion,	Lecture	**BMB 403.5**	Quiz & End Sem

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				Exam
30	immuno-electrophoresis,	Lecture	**BMB 403.5**	Quiz & End Sem Exam
31	ELISA,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
32	RIE,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
33	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
34	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
35	Tissue and organ transplantation	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
36	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
37	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
38	Autoimmunity	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
39	Autoimmunity	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
40	Autoimmune diseases: Hashimoto’s thyroiditis;	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
41	Myasthenia gravis;	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
42	Rheumatoid Arthritis,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
43	Pernicious anemia,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
44	Pernicious anemia,	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
45	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
45	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
46	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
47	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam
48	Asthma.	Lecture	**BMB 403.1**.	Quiz & End Sem Exam

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J. **Course Articulation Matrix (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 403.1	Understand and explain the phylogeny of immune system, types of immunity, immune response.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.2	Describe the concept of clonal selection theory, humoral and cell mediated immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.3	Understand and explain the structure and functions of the organs and cells of the immune system	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.4	Understand the mechanism of antigen-antibody interaction	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.5	Describe the structure of antibodies, their types and functions in immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-

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Sample Question Paper

Amity Institute Biotechnology 2021-22						
Class: B.Sc.-M.Sc. (Dual Degree) Biotechnology IV Semester						
Subject Name: **Immunology & Immunotechnology**		Time: 3 Hrs			Max.Marks:70	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand and explain the phylogeny of immune system, types of immunity, immune response.
- Describe the concept of clonal selection theory, humoral and cell mediated immunity.
- Understand and explain the structure and functions of the organs and cells of the immune system.
- Understand the mechanism of antigen-antibody interaction.
- Describe the structure of antibodies, their types and functions in immunity.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about innate and adaptive immunity. Discuss about the different types of innate immunity with characters.	6
CO2	Q.2	Write a note on different phases of cytotoxic cell mediated targeting killing mechanism.	6
	Q.3	Write a general organization of class I and class II MHC molecules with suitable diagram.	6
CO4	Q.4	Discuss the role of IgG immunoglobulin in immune system.	6
CO4	Q.5	What is antibody diversity? Discuss the role of light chain gene rearrangement in antibody diversity.	6
CO3	Q.6	Draw a well labeled diagram of hybridoma technology with production of monoclonal antibody.	6
	Q.7	Discuss the role of innate and adaptive immunity in tissue grafting. Explain with suitable example.	10
CO4	Q.8	Give a comparison between all type of vaccine with examples and applications.	10
CO3	Q.9	Discuss about features of any two primary lymphoid organs with suitable diagram	10

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CO3	Q.10	A. Although all lymphocytes are formed in bone marrow. Explain how these cells get differentiated into B cell and T cell. B Where the CDR regions located on an antibody molecule and what are	20

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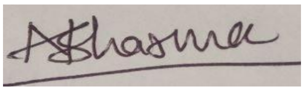
		are their functions? Discuss the ELISA method on the basis of antigen and antibody interaction.	

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Immunology and immunotechnology**/Course code ***BMB 403*** is level **2** for the academic year ***2021-22***.



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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Genetics
Course Code : BSB301, Credits : 03, Session : 2022-23 (Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : Dr. Manish Kumar

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A. **Introduction:** To acquaint the students to understand the basic concept of genetics incorporating the concepts of classical, molecular genetics. Students will learn about Mendelian Laws, Extension of Mendels Law, Multiple allele and isoallele, etc. Mutation, Mutagen, Chromosomal Aberrations, Human Genetic Disorders. Knowledge of methods of sex determination, Chromosomal non-disjunction, Chromosomal theory of inheritance, Sex linked, Sex limited and Sex limited Inheritance, Extra-chromosomal inheritance. Understanding of Population Genetics, Hardy-Weinberg Equilibrium, Gene and Genotype Frequencies.

B. **Course Outcomes:** At the end of the course, students will be able to:

   BSB301.1. Students will develop an understanding of History and scope of Genetics, Linkage, Crossing Over, Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance.

   BSB301.2. Understanding the pre-Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation.

   BSB301.3. To study the classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage.

   BSB301.4. Students will develop a basic understanding of Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders.

   BSB301.5. Knowledge of Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance.

   BSB301.6. Students will learn about extra-chromosomal inheritance, cytoplasmic inheritance, Mitochondrial and Chloroplast DNA.

   BSB301.7. Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies.

C. **Programme Outcomes:**

   PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

   PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several

aseptic procedures, isolation and identification. This course

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also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Program Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Brief history, scope and significance of Genetics. Mendelian law of inheritance. Lethality and interaction of gene. Multiple allele and isoallele. Penetrance and Expressivity. Linkage and crossing over. Mapping of genes. interference and coincidence.

Module II: Basic microbial genetics, Conjugation, transformation, transduction and their use in genetic mapping.

Module III: Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over and complementation test, Benzers work on rII locus in T4 Bacteriophage.

Module IV: Mutation; spontaneous and induced, Mutagen;chemical and physical. Chromosomal aberrations; structural and numerical. Economic importance of mutation. Genetic disorders in human; Kleinefelter, Turner, Cri-du-Chat and Down syndrome.

Module V: Sex determination in plant and animal. Non disjunction as a proof of chromosomal theory of inheritance. Sex linked, sex influenced and sex limited inheritance.

Module VI: Extra chromosomal inheritance; cytoplasmic inheritance, Mitochondrial and Chloroplast genetic system.

Module VII: Population genetics; Hardy- Weinberg equilibrium law, Gene and genotype frequencies.

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

Principles of Genetics, E. J. Gardner, John Wiley & Sons Inc.

Genetics, P.K. Gupta, Rastogi Publication.

Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, Pearson Education.

Genetics, M.W. Strickberger, Prentice Hall College Division.

Genetics, P.J. Russell, Benjamin/Cummings.

Genetics, R. Goodenough, International Thomson Publishing.

Introduction to Genetic Analysis, A.J. F. Griffiths, W.H. Freeman and Company.

Principles of Genetics, D.P. Snustad& M.J. Simmons, John Wiley and Sons Inc.

Molecular Biology of the Gene (Fifth Edition), J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison Wiesley Publishing.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Brief history, scope and significance of Genetics	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
2	Mendelian law of inheritance	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
3	Lethality and interaction of gene. Multiple allele and isoallele.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
4	Penetrance and Expressivity. Linkage and crossing over.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
5	Mapping of genes. Interference and coincidence.	Lecture	BSB301.1	Mid Term, Quiz & End Sem Exam
6	Basic microbial genetics	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam

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7	Conjugation	Lecture	BSB301.2	Mid Term, Quiz & End

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				Sem Exam
8	Transformation	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
9	Transduction	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
10	Genetic Mapping	Lecture	BSB301.2	Mid Term, Quiz & End Sem Exam
11	Classical and modern concept of gene	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
12	Pseudoallelism, position effect	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
13	Intragenic crossing over	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
14	Mapping of genes	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
15	Interference and coincidence	Lecture	BSB301.3	Mid Term, Quiz & End Sem Exam
16	Mutation; spontaneous and induced	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
17	Mutagen; chemical and physical	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
18	Chromosomal aberrations	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
19	Structural and numerical Aberration	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
20	Economic importance of mutation	Lecture	BSB301.4	Mid Term, Quiz & End Sem Exam
21	Genetic disorders in human	Lecture	BSB301.4	Quiz & End Sem Exam
22	Sex determination in plant	Lecture	BSB301.5	Quiz & End Sem Exam
23	Sex determination in animal	Lecture	BSB301.5	Quiz & End Sem Exam

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24	Non disjunction	Lecture	BSB301.5	Quiz & End Sem Exam
25	Non disjunction as a proof of chromosomal theory of inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
26	Sex linked inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
27	Sex influenced and sex limited inheritance	Lecture	BSB301.5	Quiz & End Sem Exam
28	Extra chromosomal inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
29	Cytoplasmic inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
30	Mitochondrial DNA	Lecture	BSB301.6	Quiz & End Sem Exam
31	Chloroplast genetic system	Lecture	BSB301.6	Quiz & End Sem Exam
32	Significance of Extra chromosomal inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
33	Significance of cytoplasmic inheritance	Lecture	BSB301.6	Quiz & End Sem Exam
34	Population genetics	Lecture	BSB301.7	Quiz & End Sem Exam
35	Hardy-Weinberg equilibrium law	Lecture	BSB301.7	Quiz & End Sem Exam
36	Gene and genotype frequencies	Lecture	BSB301.7	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3

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BSB301.1	History and scope of Genetics, Linkage, Crossing Over,	3	2	2	2	2	2	2	2	2	2	3	2	2

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	Gene Mapping, Interference and Coincidence. laws and concepts of Mendelian inheritance													
BSB301.2	Pre Mendelian genetic concepts, Basic Microbial Genetics such as Transformation, Transduction and Conjugation	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB301.3	Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over, Benzers work on rII Locus in T4 Phage	3	2	2	2	2	2	2	2	3	3	3	2	2
BSB301.4	Mutation-Types, Mutagen-Types, and Chromosomal aberrations-structural & numerical and human genetic disorders	3	3	2	3	2	2	2	2	2	2	3	2	2
BSB301.5	Sex determination in Plants and Animal, Chromosomal Non-Disjunction, Chromosomal Theory of Inheritance, Sex linked, Sex influenced and Sex limited inheritance	3	2	3	2	2	3	2	2	2	2	3	2	2

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BSB301.6	Extra-chromosomal inheritance, cytoplasmic inheritance,	3	3	2	3	2	2	2	2	2	2	3	2	2

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	Mitochondrial and Chloroplast DNA													
BSB301.7	Students will learn about Population Genetics, Hardy-Weinberg Equilibrium Law, Gene and Genotype Frequencies	3	2	2	3	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

<table>
<tr><td colspan="7">Amity Institute of Biotechnology
MID-SEMESTER 2022-23</td></tr>
<tr><td colspan="7">Class: B.Sc. (Biotech) III Semester</td></tr>
<tr><td colspan="2">Subject Name:
BSB 301 GENETICS</td><td colspan="3">Time: 2 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q. 1,4</td><td>Q. 2,3</td><td>Q. 4</td><td>Q. 2,5,6</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to
CO1: History and scope of Genetics
CO2: Understanding the pre Mendelian genetic concepts</td></tr>
</table>

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the scope and significance of genetics.	3
CO1	Q.2a	What are different steps involved in genetic mapping ?	3
	Q.2b	How is mechanism of conjugation is different from transformation ?	3
CO1	Q.3	How classical concept of gene is different from modern concept of gene ?	6
CO2	Q.4	Explain the significance of extra-chromosomal inheritance and cytoplasmic inheritance.	3

Attainments	**Rubric**

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Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **GENETICS/BSB 301** is **level 3** for the academic year 2022-23.

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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
III	BSB 302	3	3	3	3	1	-	-	2	2	1	3	1	-

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MICROBIOLOGY
Course Code : BSB 302, Crédits : 04, Session :2021-22(Odd Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The course imparts the knowledge of different types of microorganisms that are invisible to our naked eyes. Discovery origin and evaluation of different forms of bacteria, fungi, protozoa and viruses constitute the basics of biotechnology.

B. **Course Outcomes:** After successful completion of the course student will be able to:

BSB 302.1. Understand the microbiological techniques for the isolation and characterization of microbes.
BSB 302.2. Understand the mechanism of different metabolic processes.
BSB 302.3. Know the physiology and survival mechanism of extremophilic bacteria.
BSB 302.4. Know the concept of virus lytic and lysogenic cycle is quite clear to students.
BSB 302.5. Understand the epidemiology and microbial pathogenesis.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.
PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.
PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.
PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.
PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

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commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.
PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/ HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the

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causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization,

Module II

Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, continuous culture, culture collection and maintenance of cultures.

Module III

Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV

Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archaea

Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles Viruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI

Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII

Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott

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- The microbes – An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

References:

- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin & Cummings
- Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
- Industrial Microbiology, Casida, New Age International
- Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC. Brown Publisher.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
2	Role of microorganisms in transformation of organic matter and in the causation of diseases,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
3	Development of pure culture methods.	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
4	Methods in Microbiology -Principles of microbial nutrition,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
5	Culture media,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
6	Culture media,	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem

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				Exam
7	Physical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
8	Physical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
9	Chemical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
10	Chemical Sterilization	Lecture	BSB 302.1.	Mid Term-1, Quiz & End Sem Exam
11	Prokaryotic structure and function	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
12	Cell wall	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
13	Cell cytoplasmic membrane	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
14	Capsule	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
15	Surface appendages	Lecture	BSB 302.2	Mid Term-1,

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				Quiz & End Sem Exam
16	Cytoplasm and cytoplasmic inclusion	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
17	Bacterial growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
18	Mathematical expression of growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
19	Growth curve	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
20	Measurement of growth	Lecture	BSB 302.2	Mid Term-1, Quiz & End Sem Exam
21	Synchronous growth,	Lecture	BSB 302.2	Quiz & End Sem Exam
22	Continuous culture,	Lecture	BSB 302.2	Quiz & End Sem Exam
23	Culture collection and maintenance of cultures.	Lecture	BSB 302.2	Quiz & End Sem Exam
24	Systematics and taxonomy - new approaches to bacterial taxonomy,	Lecture	BSB 302.2	Quiz & End Sem Exam
25	Classification including ribotyping, ribosomal RNA sequencing,	Lecture	BSB 302.2	Quiz & End Sem Exam

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26	Characteristics of primary domains, taxonomy, nomenclature and Bergey's manual	Lecture	BSB 302.2	Quiz & End Sem Exam
27	Metabolic Diversity among microorganisms- photosynthesis in microorganisms	Lecture	BSB 302.2	Quiz & End Sem Exam
28	Role of bacteriochlorophylls	Lecture	BSB 302.2	Quiz & End Sem Exam
29	carotenoids and phycobilins	Lecture	BSB 302.2	Quiz & End Sem Exam
30	Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria,	Lecture	BSB 302.2	Quiz & End Sem Exam
31	nitrate and sulphate reduction,	Lecture	BSB 302.2	Quiz & End Sem Exam
32	methanogenesis and acetogenesis,	Lecture	BSB 302.2	Quiz & End Sem Exam
33	Fermentations,	Lecture	BSB 302.2	Quiz & End Sem Exam
34	Nitrogen fixation,	Lecture	BSB 302.2	Quiz & End Sem Exam
35	Plant microbe interactions	Lecture	BSB 302.2	Quiz & End Sem Exam
36	Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BSB 302.3	Quiz & End Sem Exam
37	*Viruses: Bacterial, animal; structure of viruses;*	Lecture	BSB 302.4	Quiz & End Sem Exam
38	*Reproduction and life cycle of RNA and DNA viruses; Viroids and prions.*	Lecture	BSB 302.4	Quiz & End Sem Exam
39	*Algae: Classification and Reproduction.*	Lecture	BSB 302.4	Quiz & End Sem Exam

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40	*Fungi: Classification and Reproduction.*	Lecture	BSB 302.4	Quiz & End Sem Exam
41	Host-parasite relationship - Normal micro flora of skin, oral cavity, gastrointestinal tract,	Lecture	BSB 302.5	Quiz & End Sem Exam
42	Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo) and their mode of actions,	Lecture	BSB 302.5	Quiz & End Sem Exam
43	Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission;	Lecture	BSB 302.5	Quiz & End Sem Exam
44	Sexually transmitted disease including AIDS, Food and water-borne diseases; pathogenic fungi.	Lecture	BSB 302.5	Quiz & End Sem Exam
45	Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins,	Lecture	BSB 302.5	Quiz & End Sem Exam
45	Broad spectrum antibiotics	Lecture	BSB 302.5	Quiz & End Sem Exam
46	Antifungal antibiotics;	Lecture	BSB 302.5	Quiz & End Sem Exam
47	Antibiotics mode of action.	Lecture	BSB 302.5	Quiz & End Sem Exam
48	Antibiotics mode of action.	Lecture	BSB 302.5	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB 302.1	Understand the microbiological techniques for the isolation and characterization of microbes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.2	Understand the mechanism of different metabolic processes.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.3	Know the physiology and survival mechanism of extremophilic bacteria.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.4	Learn structure and function of the cell cytoskeleton, cilia and flagella.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 302.5	Understand the epidemiology and microbial pathogenesis	3	3	3	3	1	-	-	2	2	1	3	1	-

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Sample Question Paper

Amity Institute Biotechnology 2021-22		
Class: B.Sc. Biotechnology III Semester		
Subject Name: Microbiology	Time: 3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand the microbiological techniques for the isolation and characterization of microbes.
- Understand the mechanism of different metabolic processes.
- Know the physiology and survival mechanism of extremophilic bacteria.
- Know the concept of virus lytic and lysogenic cycle is quite clear to students.
- Understand the epidemiology and microbial pathogenesis.

CO Map	Question No.	Question	Marks
CO1	Q.1	Write the historical contributions of Louis Pasteur and Robert Koch in the field of microbiology.	6
CO2	Q.2	Write down the steps involved in Gram's staining procedure. Differentiate between Gram positive and gram negative bacteria.	6
	Q.3	Explain the importance of extracellular appendages present in bacteria.	6
CO4	Q.4	Describe polyphasic taxonomy and discuss some of its advantages	6
CO4	Q.5	Discuss about the mechanism of photo-phosphorylation in bacterial system.	6
CO3	Q.6	Give an outline the nitrogen fixation, and explain the roles of microorganisms in this cycle	6
	Q.7	What are the archaea? Briefly describe the major ways in which they differ from bacteria and eucaryotes.	10
CO4	Q.8	Write a note on viroids and prions with suitable example of disease.	10

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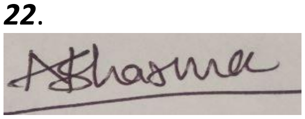
CO3	Q.9	Discuss about normal microbiota present on different body region with suitable features	10
CO3	Q.10	What is penicillinase? Explain the role of penicillin against the synthesis of bacterial cell wall. How does a low concentration of penicillin G select for penicillin-resistant bacteria?	20

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course ***Microbiology***/Course code ***BSB 302*** is level **3** for the academic year ***2021-22***.



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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BSB 401	3	3	3	3	1	-	-	2	2	1	3	1	-

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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **Bioinformatics**
Course Code : BSB 401, Crédits : 3, Session :2022-23 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. **Introduction:** The course involves a basic understanding of computer and bioinformatics tools and skills in the field of biology

B. **Course Outcomes:** After successful completion of the course student will be able to:

BMB 401.1. Understand and explain the structural organization and characteristics of computers and its parts

BMB 401.2. Describe the concept of use of internet in bioinformatics.

BMB 401.3. Explain the concept and organization of biological databases..

BMB 401.4. Understand and explain the structure and functions of the phylogenetic analytic tools.

BMB 401.5. Interrogate major database sources and be able to integrate this information with clinical data.

C. **Programme Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

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PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.
PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.
PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Computers
General introduction (characteristics, capabilities, generations), software, hardware : organization of hardware (input devices, memory, control unit arithmetic logic unit, output devices); software : (System software; application software, languages -low level, high level), interpreter, compiler, data processing; batch, on-line, real-time (examples from bioindustries; e.g. application of computers in co-ordination of solute concentration, ph, temperature, etc., of a fermenter in operation); internet application.

Module II: Basic Bioinformatics
Introduction to Internet, Search  Engines (Google, Yahoo, Entrez etc)

Module III: Biological Databases
Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL), Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc), Cluster databases-An Introduction, Specialised databases (KEGG, etc), Database technologies (Flat-file), Structural databases (PDB)

Module IV: Phylogenetic Analysis
Trees-splits and metrices on trees, tree interpretation, Distance – additive, ultrameric and nonadditive distances,tree building methods, phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains, estimating the rate of change, likelihood and trees; analysis software.

Module V: Genome analysis
Annotation, comparison of different methods; ESTs – databases, clustering, gene discovery and identification, and functional classification. Reconstruction of metabolic pathways; Genome analysis, genome anatomy, genome rearrangements with inversions, signed inversions, gene identification, gene expression, expression analysis, gene identification and functional classification

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;
A: Attendance

H. Suggested Text/Reference Books:

Text:
• Computer Science, J.G. Brookshear, Pearson, Addison Wesley
• Introduction to Bioinformation – T.Attawood
References:
• A book on C by Kelley : Programming in C, Addison-Wesley Publishing
• Introduction to C++ for Engineers and Scientists, Prentice-Hall
• Schaum's Outline of Introduction of Computer Science, P. Cushman and R. Mata-Toledo, McGraw Hill
Trade
• Bioinformatics – Managing Scientific Data, Zoe' Lacroix and Terence Critchlow
• Bioinformatics – Sequence, Structure and Databanks, Des Higgins & Willie Taylor
• Structural Bioinformatics, Philip E. Bourne, Helge Weissig 2003
• Statistical Methods in Bioinformatics: An Introduction, G.R. Grant, W.J. Ewens, Springer Verlag

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**

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1	General introduction (characteristics, capabilities, generations),	Lecture	**BSB 401.1**.	Mid Term-1, Quiz & End Sem Exam
2	software, hardware : organization of hardware (input devices, memory, control unit	Lecture	**BSB 401.1**.	Mid Term-1, Quiz & End Sem Exam

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	arithmetic logic unit, output devices),			
3	organization of hardware	Lecture	**BSB 401.2**.	Mid Term-1, Quiz & End Sem Exam
4	*organization of software*	Lecture	**BSB 401.2**.	Mid Term-1, Quiz & End Sem Exam
5	Interpreter, compiler, data processing; batch, on-line, real-time	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
6	Introduction and application of Internet	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
7	Search Engines (Google, Yahoo, Entrez etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
8	Revision	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
9	Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
10	Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
11	Cluster data bases-An Introduction. Specialized databases (KEGG, etc)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
12	Database technologies (Flat-file)	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
13	Revision	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
14	Introduction of phylogenetics analysis	Lecture	**BSB 401.3**	Mid Term-1, Quiz & End Sem Exam
15	Trees-splits and metrices on trees, tree interpretation	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
16	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
17	phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
18	Estimating the rate of change, likelihood and trees; analysis software	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam

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19	Annotation, comparison of different methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
20	Distance – additive, ultrameric and nonadditive distances, tree building methods	Lecture	**BSB 401.4**	Mid Term-1, Quiz & End Sem Exam
21	Revision	Lecture	**BSB 401.4**	Quiz & End Sem

				Exam
22	ESTs – databases, clustering	Lecture	**BSB 401.4**	Quiz & End Sem Exam
23	Gene discovery	Lecture	**BSB 401.4**	Mid Term-2, Quiz & End Sem Exam
24	Identification and classification	Lecture	**BSB 401.5**	Quiz & End Sem Exam
25	Revision	Lecture	**BSB 401.5**	Quiz & End Sem Exam
26	Reconstruction of metabolic pathways	Lecture	**BSB 401.5**	Quiz & End Sem Exam
27	Genome analysis, genome anatomy	Lecture	**BSB 401.4**	Quiz & End Sem Exam
28	Genome rearrangements with inversions	Lecture	**BSB 401.4**	Quiz & End Sem Exam
29	signed inversions, gene identification	Lecture	**BSB 401.4**	Quiz & End Sem Exam
30	Reconstruction of metabolic pathways	Lecture	**BSB 401.4**	Quiz & End Sem Exam
31	Genome analysis, genome anatomy	Lecture	**BSB 401.4**	Quiz & End Sem Exam
32	Gene expression	Lecture	**BSB 401.4**	Quiz & End Sem Exam
33	Gene expression analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
34	Gene identification methods	Lecture	**BSB 401.1**	Quiz & End Sem Exam
35	Functional classification	Lecture	**BSB 401.1**	Quiz & End Sem Exam
36	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
37	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
38	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam
39	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam
40	Gene expression	Lecture	**BSB 401.1**	Quiz & End Sem Exam
41	Gene expression analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
42	Gene identification methods	Lecture	**BSB 401.1**	Quiz & End Sem Exam
43	Functional classification	Lecture	**BSB 401.1**	Quiz & End Sem Exam
44	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam
45	Application of genome analysis	Lecture	**BSB 401.1**	Quiz & End Sem Exam

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45	Revision	Lecture	**BSB 401.1**	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB 401.1	Understand and explain the structural organization and characteristics of computers and its parts	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.2	Describe the concept of use of internet in bioinformatics.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.3	Explain the concept and organization of biological databases	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 401.4	Understand and explain the structure and functions of the phylogenetic analytic tools.	3	3	3	3	1	-	-	2	2	1	3	1	-
BSB 401.5	Interrogate major database sources and be able to integrate this information with clinical data.	3	3	3	3	1	-	-	2	2	1	3	1	-

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Sample Question Paper

Amity Institute Biotechnology 2021-22						
Class: B.Sc. Biotechnology IV Semester						
Subject Name: **Bioinformatics**		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand the basic knowledge of computer hardware and software.
- Understand the advanced techniques of bioinformatics.
- Understand the application of bioinformatics in different area.
- Understand the role of computational biology in drug designing.
- Understand the importance of phylogenetic analysis in species development.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about the importance of input and output device of computer. Also differentiate between input and output devices.	6
CO2	Q.2	Discuss about the anatomy of E. mail and www.	6
	Q.3	Explain about the different databases present in NCBI. Give a comparison between protein databases and nucleotide databases with examples.	6
CO4	Q.4	Discuss about the different terminology used in phylogenetic tree with the suitable diagram.	6
CO4	Q.5	Write about the genome of between prokaryotic and eukaryotic organism.	6
CO3	Q.6	Discuss a general classification of computer generations with suitable examples, merits and demerits	6
	Q.7	What is topology of computer networking? Write advantages and disadvantages of different topology networking.	10
CO4	Q.8	Write a detail note on RCSB, Genbank, and DDBJ with advantages.	10
CO3	Q.9	What is sequence similarity? Explain about the different quantitative methods of sequence similarity	10

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CO3	Q.10	. A. Explain the different methods used for gene prediction. Discuss one of the methods in detail with suitable diagram. B. By writing the corresponding match states into columns we get the following alignment: ATGA AGTA	20

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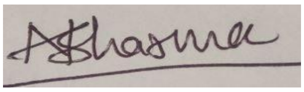
		What is its score under the following scoring scheme? Match +2, Mismatch -1 and Gap +1.Explain with global alignment algorithm.	

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Bioinformatics** /Course code ***BSB 401*** is level **2** for the academic year ***2021-22***.



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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
IV	BSB 403	3	3	3	3	1	-	-	2	2	1	3	1	-

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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **IMMUNOLOGY & IMMUNOTECHNOLOGY**
Course Code : BSB 403, Crédits : 04, Session :2022-23 (Even Sem.), Class : B.Sc. 2nd Year
Faculty Name : DR. NEHA SHARMA

A. Introduction: Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

B. Course Outcomes: After successful completion of the course student will be able to:

BSB 403.1. Understand and explain the phylogeny of immune system, types of immunity, immune response.

BSB 403.2. Describe the concept of clonal selection theory, humoral and cell mediated immunity.

BSB 403.3. Understand and explain the structure and functions of the organs and cells of the immune system.

BSB 403.4. Understand the mechanism of antigen-antibody interaction.

BSB 403.5. Describe the structure of antibodies, their types and functions in immunity.

C. Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valency, Atomic weight.

PO4. Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents,

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commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyse data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q /HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I :

Descriptors/Topics

Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.

Module II:

Descriptors/Topics

The organs and cells of the immune  system.

Module III :
Descriptors/Topics
Histocompatibility: structure of MHC class I, II & III antigens & their mode of antigen presentation, MHC restriction; Antigens & antigenicity;

Module IV :
Descriptors/Topics
Antibody structure in relation to function and antigen-binding; Types of antibodies and their structures: isotypes, allotypes, idiotypes. Antibodies in targeting therapeutic agents. Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application

Module V :
Descriptors/Topics
Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.

Module VI :
Descriptors/Topics
Measurement of antigen – antibody interaction: agglutination, precipitation immunodiffusion, immuno-electrophoresis, ELISA, RIE

Module VII :
Descriptors/Topics
Tissue and organ transplantation

Module VIIII :
Descriptors/Topics
Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.
Autoimmunity and autoimmune diseases: Hashimoto’s thyroiditis; Myasthenia gravis; Rheumatoid Arthritis, Pernicious anemia, Asthma.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Freeman

References:
- Immunology, Roitt, Mosby – Yearbook Inc.
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.

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I. **Lecture Plan**

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Historical perspective of immune system and immunity; Innate and specific immunity. Humoral immunity, Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.1**.	Mid Term-1, Quiz & End Sem Exam
2	Innate and specific immunity. Humoral immunity,	Lecture	**BSB 403.1**.	Mid Term-1, Quiz & End Sem Exam
3	Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.2**.	Mid Term-1, Quiz & End Sem Exam
4	Cell-mediated immunity and Clonal selection theory.	Lecture	**BSB 403.2**.	Mid Term-1, Quiz & End Sem Exam
5	The organs of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
6	The organs of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
7	The cells of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
8	The cells of the immune system	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
9	Histocompatibility: structure of MHC class I, II & III	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
10	Histocompatibility: structure of MHC class I, II & III	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
11	Antigens	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
12	Mode of antigen presentation,	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam
13	MHC restriction; Antigens & antigenicity	Lecture	**BSB 403.3**	Mid Term-1, Quiz & End Sem Exam

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14	MHC restriction; Antigens &	Lecture	**BSB 403.3**	Mid Term-1,

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	antigenicity			Quiz & End Sem Exam
15	Antibody structure in relation to function and antigen-binding	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
16	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
17	Types of antibodies and their structures: isotypes, allotypes, idiotypes.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
18	Antibodies in targeting therapeutic agents.	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
19	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
20	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Mid Term-1, Quiz & End Sem Exam
21	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
22	Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application	Lecture	**BSB 403.4**	Quiz & End Sem Exam
23	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.4**	Mid Term-2, Quiz & End Sem Exam
24	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam
25	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam

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26	Immunoglobulin gene: genetic basis of reaction of antibody diversity; Effect of T cell functions.	Lecture	**BSB 403.5**	Quiz & End Sem Exam
27	Measurement of antigen – antibody interaction: agglutination,	Lecture	**BSB 403.4**	Quiz & End Sem Exam

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28	Precipitation	Lecture	**BSB 403.4**	Quiz & End Sem Exam
29	immunodiffusion,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
30	immuno-electrophoresis,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
31	ELISA,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
32	RIE,	Lecture	**BSB 403.4**	Quiz & End Sem Exam
33	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
34	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
35	Tissue and organ transplantation	Lecture	**BSB 403.1**	Quiz & End Sem Exam
36	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
37	Immunity to infections of diseases; vaccines (attenuated and recombinant) and vaccination.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
38	Autoimmunity	Lecture	**BSB 403.1**	Quiz & End Sem Exam
39	Autoimmunity	Lecture	**BSB 403.1**	Quiz & End Sem Exam
40	Autoimmune diseases: Hashimoto's thyroiditis;	Lecture	**BSB 403.1**	Quiz & End Sem Exam
41	Myasthenia gravis;	Lecture	**BSB 403.1**	Quiz & End Sem Exam
42	Rheumatoid Arthritis,	Lecture	**BSB 403.1**	Quiz & End Sem Exam
43	Pernicious anemia,	Lecture	**BSB 403.1**	Quiz & End Sem Exam
44	Pernicious anemia,	Lecture	**BSB 403.1**	Quiz & End Sem Exam
45	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
45	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
46	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam

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47	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam
48	Asthma.	Lecture	**BSB 403.1**	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BMB 403.1	Understand and explain the phylogeny of immune system, types of immunity, immune response.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.2	Describe the concept of clonal selection theory, humoral and cell mediated immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.3	Understand and explain the structure and functions of the organs and cells of the immune system	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.4	Understand the mechanism of antigen-antibody interaction	3	3	3	3	1	-	-	2	2	1	3	1	-
BMB 403.5	Describe the structure of antibodies, their types and functions in immunity.	3	3	3	3	1	-	-	2	2	1	3	1	-

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Sample Question Paper

Amity Institute Biotechnology 2021-22						
Class: B.Sc. Biotechnology IV Semester						
Subject Name: **Immunology & Immunotechnology**		Time: 3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1, 5,3	Q.2,6	Q.,4,5	Q.7	Q. 8, 9,	Q. 10

Student will be able to:

- Understand and explain the phylogeny of immune system, types of immunity, immune response.
- Describe the concept of clonal selection theory, humoral and cell mediated immunity.
- Understand and explain the structure and functions of the organs and cells of the immune system.
- Understand the mechanism of antigen-antibody interaction.
- Describe the structure of antibodies, their types and functions in immunity.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain about innate and adaptive immunity. Discuss about the different types of innate immunity with characters.	6
CO2	Q.2	Write a note on different phases of cytotoxic cell mediated targeting killing mechanism.	6
	Q.3	Write a general organization of class I and class II MHC molecules with suitable diagram.	6
CO4	Q.4	Discuss the role of IgG immunoglobulin in immune system.	6
CO4	Q.5	What is antibody diversity? Discuss the role of light chain gene rearrangement in antibody diversity.	6
CO3	Q.6	Draw a well labeled diagram of hybridoma technology with production of monoclonal antibody.	6
	Q.7	Discuss the role of innate and adaptive immunity in tissue grafting. Explain with suitable example.	10
CO4	Q.8	Give a comparison between all type of vaccine with examples and applications.	10
CO3	Q.9	Discuss about features of any two primary lymphoid organs with suitable diagram	10

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CO3	Q.10	A. Although all lymphocytes are formed in bone marrow. Explain how these cells get differentiated into B cell and T cell. B Where the CDR regions located on an antibody molecule and what are are their functions? Discuss the ELISA method on the basis of antigen and antibody interaction.	20

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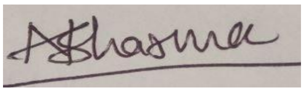
Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Immunology and immunotechnology**/Course code ***BSB 403*** is level **2** for the academic year ***2021-22***.



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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Cell Biology
Course Code : BSB101, Credits : 03, Session : 2022-23(Odd Sem.), Class : B.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To acquaint the students to understand the basic concept of cell biology and cell as a unit of living system, its various organelles, their structure, function and metabolic processes. Further, to help students to understand the concept of cellular evolution. Enable students to strengthen the cellular structure of cell organelle and their function.

B. **Course Outcomes:** At the end of the course, students will be able to:

BSB101.1. To study cell as a basic unit of life. Cell Theory. Understanding cellular organisation of Plant and animal cells. Their tissue, organ and organisational structure.

BSB101.2. To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, ribosomes, cytoskeletal, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.

BSB101.3. Students will learn about Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome and eu and hetero-chromatin.

BSB101.4. To develop deeper knowledge about Cell cycle, interphase, mitosis and meiosis.

BSB101.5. Knowledge of cell locomotion, cell senescence and apoptosis.

BSB101.6. Understanding of mechanism of cell differentiation and difference between normal and cancer cell.

C. **Programme Outcomes:**

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate

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living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO 2: Achieve the scientific acumen and ability to identify research- based problems and

develop suitable approach by designing protocols and

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their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioral attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Cell as a basic unit of living systems: The cell theory, precellular evolution; broad classification of cell types: archaebacteria, PPLOs, bacteria, eukaryotic microbes, plant and animal cells; cell, tissue, organ and organisms, different levels of organization.

Module II: Ultrastructure of the cell membrane and cell organelles**:** Ultrastructure of cell membrane and function, Structure of cell organelles; golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes; cytoskeletal structures (actin, microtubules.), mitochondria, chloroplast, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus).

Module III: Chromosomes**:** Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome organisations; eu-and heterochromatin.

Module IV: Cell division and cell cycle**:** Cell cycle, interphase, mitosis and meiosis.

Module V: Cell interaction: Cell locomotion (amoeboid, flagellar and ciliar); cell senescence and death (apoptosis).

Module VI: Cell differentiation: Mechanism of cell differention (e.g., RBC); difference between normal and cancer cells.

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.
- Cell and Molecular Biology –Sheelar & Bianchi, John Wiley
- Essential Cell Biology : An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company
- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J. Danell, W.H. Preeman and Company.
- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell Biology, Singh & Tomar
- The world of the cell Becker, Klinshmith & Harden, Pearson

H. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Correspo nding CO**	**Mode of Assessing CO**
1	Cell Theory	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
2	Precellular Evolution	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
3	Broad Classification of Cell Types	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam

4	Eukaryotic Microbes	Lecture	BSB101.1	Mid Term, Quiz & End Sem

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				Exam
5	Plant and animal cells, tissues and organs	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
6	Different levels of organization	Lecture	BSB101.1	Mid Term, Quiz & End Sem Exam
7	Ultrastructure of cell membrane and function	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
8	Structure of cell organelles	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
9	Golgi bodies, Endoplasmic Reticulum (Smooth and Rough), Ribosomes	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
10	Cytokeletal Structures (Actin and Microtubules)	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
11	Mitochondria, Chloroplast	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
12	Lysosomes and Peroxisomes	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
13	Nucleus Structure	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
14	Nuclear Membrane, Nucleoplasm, Nucleolus	Lecture	BSB101.2	Mid Term, Quiz & End Sem Exam
15	Structural organisation of chromosomes	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam

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16	Chromatids	Lecture	BSB101.3	Mid Term, Quiz & End Sem

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				Exam
17	Centromere and Telomere	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
18	Streptomycin and Tatracycline	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
19	Chromatin and Nucleosome Organization	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
20	Eu and Hetero-Chromatin	Lecture	BSB101.3	Mid Term, Quiz & End Sem Exam
21	Cell Cycle	Lecture	BSB101.4	Quiz & End Sem Exam
22	Interphase	Lecture	BSB101.4	Quiz & End Sem Exam
23	Mitosis	Lecture	BSB101.4	Quiz & End Sem Exam
24	Meiosis	Lecture	BSB101.4	Quiz & End Sem Exam
25	Cell Locomotion	Lecture	BSB101.5	Quiz & End Sem Exam
26	Amoeboid, Flagellar and Cilliar	Lecture	BSB101.5	Quiz & End Sem Exam
27	Cell Senescence	Lecture	BSB101.5	Quiz & End Sem Exam
28	Cell Death	Lecture	BSB101.5	Quiz & End Sem Exam
29	Apoptosis	Lecture	BSB101.5	Quiz & End Sem Exam
30	Cell Division	Lecture	BSB101.5	Quiz & End Sem Exam

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31	Mechanisms of Cell	Lecture	BSB101.6	Quiz &

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	Differentiation			End Sem Exam
32	RBCs	Lecture	BSB101.6	Quiz & End Sem Exam
33	Cancer	Lecture	BSB101.6	Quiz & End Sem Exam
34	Carcinogens	Lecture	BSB101.6	Quiz & End Sem Exam
35	p53 Gene and its role in cancer development	Lecture	BSB101.6	Quiz & End Sem Exam
36	Difference between normal and cancer cell	Lecture	BSB101.6	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BSB101.1	To study cell as a basic unit of life. Cell Theory. Understanding cellular organization of Plant and animal cells. Their tissue, organ and organizational structure.	3	2	2	2	2	2	2	2	2	2	3	2	3

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BSB101.2	To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, robosomes, cytoskeletal, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.	3	2	2	2	2	2	2	2	3	2	3	3	2
BSB101.3	Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome and eu and hetero-chromatin.	3	2	2	3	2	2	2	2	3	2	3	3	2
BSB101.4	To develop deeper knowledge about Cell cycle, interphase, mitosis and meiosis.	3	3	2	3	2	2	2	1	3	2	3	2	2
BSB101.5	Knowledge of cell locomotion, cell senescence and apoptosis.	3	2	2	2	2	2	2	2	2	2	3	2	2
BSB101.6	Understanding of mechanism of cell differentiation and difference between normal and cancer cell.	3	3	2	2	2	2	2	2	2	2	3	2	2

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Sample Question Paper

Amity Institute of Biotechnology MID-SEMESTER 2022-23		
Class: BSB101 (Biotech) I Semester		
Subject Name: BSB 101 Cell Biology	Time: 2 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzin g	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to
CO1: To understand cell as a basic unit of life. Cell Theory. Understanding cellular organization of Plant and animal cells, their tissue, organ and organizational structure.
CO2: To develop understanding of ultrastructure of cell membrane and its function. Structure of different cell organelles viz. endoplasmic reticulum, ribosome's, cytoskeleton, mitochondria, chloroplast, lysosomes, peroxysomes and nucleus.

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the Cell Theory.	3
CO1	Q.2a	What are different cytoskeletal structures?	3
	Q.2b	How is mode of functioning of Peroxysomes and lysosomes are different from each other ?	3
CO1	Q.3	How Nucleosome organization affects eu and heterochromatin region of DNA ?	6
CO2	Q.4	Explain the different stages of cellular reductional division i.e. Meiosis.	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **CELL BIOLOGY/BSB 101** is **level 3** for the academic year 2022-23.

Manish Km

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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Microbiology
Course Code : BTB303, Credits : 04, Session : 2022-23(Odd Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Manish Kumar

A. Introduction: This fundamental paper discusses the importance of microorganisms. The course throws light on types of microorganisms in and around humans. At the end of the course, the student has understanding on the metabolism and mechanism of microbial life. Students will gain knowledge about the different cell organelles of microorganisms and their detailed functions. Students will also study the growth and control of microbes as well as different bacteriological techniques involved in microbiology. Students will learn about the biomolecules by studying their structures and types.

B. Course Outcomes: At the end of the course, students will be able to:

BTB303.1. Students will learn about the historical perspective of microbial world, spontaneous generation, role of microbes, pure culture, microbial nutrition, culture media, and sterilization.

BTB303.2. Students will gain knowledge of prokaryotic cell, structural and functional anatomy of cell and organelles. Growth and growth curve, culture types – batch and continuous, culture collection and maintenance of cultures.

BTB303.3. Students will gain knowledge about the Systematics and taxonomy of bacteria, ribotyping, nomenclature and Bergey's manual.

BTB303.4. Students will know about the Metabolic Diversity among microorganisms, microbial photosynthesis, photosynthetic pigments, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions.

BTB303.5. Students will develop deeper understanding of Archae, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles. Viruses –

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Bacterial and Animal, their structure, reproduction. Viroids and Prions. Algae and Fungi – their reproduction and classification.

BTB303.6. Students will learn about the Host-parasite relationship, micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections, types of toxins (Exo, endo, entro) and their mechanism of action. Microbial pathogenesis and sexually transmitted disease.

BTB303.7. Students will have knowledge of Chemotherapy/antibiotics - Antimicrobial agents, sulfa drugs, penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics.

C. Programme Outcomes:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of

the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioral attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %

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Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

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F. Syllabus

Module I: Introduction and historical perspective -Discovery of the microbial world, controversy over spontaneous generation, role of microorganisms in transformation of organic matter and in the causation of diseases, development of pure culture methods. Methods in Microbiology -Principles of microbial nutrition, Culture media, Theory and practice of sterilization.

Module II: Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, Fed batch culture, continuous culture, culture collection and maintenance of cultures.

Module III: Systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual.

Module IV: Metabolic Diversity among microorganisms- photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-ironnitrite- oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module V: Archae as earliest life forms, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophilesViruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Classification and Reproduction.

Module VI: Host-parasite relationship -Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions,Microbial pathogenesis -Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VII: Chemotherapy/antibiotics -Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE

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Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott
The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.
The Microbial World, Roger Y. Stanier, Prentice Hall
Microbiology, Tortora, Funke and Chase, Benzamin& Cummings
Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
Industrial Microbiology, Casida, New Age International
Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC.Brown Publisher.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Discovery of the microbial world	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
2	Controversy over spontaneous generation	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
3	Role of microorganisms in transformation of organic matter and in the causation of diseases	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
4	Development of pure culture methods	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
5	Methods in Microbiology	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
6	Principles of microbial nutrition, Culture media	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
7	Theory and practice of sterilization	Lecture	BTB303.1	Mid Term, Quiz & End Sem Exam
8	Prokaryotic structure and function	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam

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9	Functional anatomy of bacteria: cell envelope, cell	Lecture	BTB303.2	Mid Term,

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	wall, cytoplasmic membrane, capsule			Quiz & End Sem Exam
10	Functional anatomy of bacteria: surface appendages, cytoplasm and cytoplasmic Inclusions	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
11	Growth - The definition of growth, mathematical expression of growth, growth curve	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
12	Measurement of growth, Synchronous growth	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
13	Fed batch culture, continuous culture	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
14	Culture collection and maintenance of cultures	Lecture	BTB303.2	Mid Term, Quiz & End Sem Exam
15	Systematics and taxonomy	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
16	New approaches to bacterial taxonomy	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
17	Classification including ribotyping	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
18	Ribosomal RNA sequencing	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
19	Characteristics of primary domains	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
20	Taxonomy, nomenclature	Lecture	BTB303.3	Mid Term, Quiz & End Sem Exam
21	Bergey's manual	Lecture	BTB303.3	Quiz & End Sem Exam
22	Metabolic Diversity among microorganisms	Lecture	BTB303.4	Quiz & End Sem Exam
23	Photosynthesis in microorganisms	Lecture	BTB303.4	Quiz & End Sem Exam
24	Role of bacteriochlorophylls, carotenoids and phycobilins	Lecture	BTB303.4	Quiz & End Sem Exam
25	Chemolithotrophy, hydrogen-iron-nitrite-oxidizing bacteria	Lecture	BTB303.4	Quiz & End Sem Exam

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26	Nitrate and Sulphate reduction, methanogenesis and acetogenesis	Lecture	BTB303.4	Quiz & End Sem Exam

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27	Fermentations, nitrogen fixation	Lecture	BTB303.4	Quiz & End Sem Exam
28	Plant microbe interactions (mycorrhizae)	Lecture	BTB303.4	Quiz & End Sem Exam
29	Archae as earliest life forms	Lecture	BTB303.5	Quiz & End Sem Exam
30	Thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles	Lecture	BTB303.5	Quiz & End Sem Exam
31	Viruses: Bacterial, animal	Lecture	BTB303.5	Quiz & End Sem Exam
32	Structure of viruses	Lecture	BTB303.5	Quiz & End Sem Exam
33	Reproduction and life cycle of RNA and DNA viruses	Lecture	BTB303.5	Quiz & End Sem Exam
34	Viroids and prions.	Lecture	BTB303.5	Quiz & End Sem Exam
35	Algae and Fungi: Classification and Reproduction	Lecture	BTB303.5	Quiz & End Sem Exam
36	Host-parasite relationship	Lecture	BTB303.6	Quiz & End Sem Exam
37	Normal micro flora of skin, oral cavity, gastrointestinal tract	Lecture	BTB303.6	Quiz & End Sem Exam
38	Respiratory infections; entry of pathogens into the host	Lecture	BTB303.6	Quiz & End Sem Exam
39	Types of toxins (Exo, endo, entro) and their mode of actions	Lecture	BTB303.6	Quiz & End Sem Exam
40	Microbial pathogenesis - Disease reservoirs	Lecture	BTB303.6	Quiz & End Sem Exam
41	Epidemiological terminologies; Infectious disease transmission	Lecture	BTB303.6	Quiz & End Sem Exam
42	Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi	Lecture	BTB303.6	Quiz & End Sem Exam
43	Chemotherapy/antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam
44	Antimicrobial agents, sulfa drugs	Lecture	BTB303.7	Quiz & End Sem Exam
45	Antibiotics - Penicillin and Cephalosporins	Lecture	BTB303.7	Quiz & End Sem Exam
46	Broad spectrum antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam

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47	Antifungal antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam
48	Mode of action of antibiotics	Lecture	BTB303.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BTB303.1	historical perspective of microbial world, spontaneous generation, role of microbes, pure culture, microbial nutrition, culture media, and sterilization	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.2	prokaryotic cell, structural and functional anatomy of cell and organelles. Growth and growth curve, culture types – batch and continuous, culture collection and maintenance of cultures	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.3	Systematics and taxonomy of bacteria, ribotyping, nomenclature and Bergey's manual	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

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BTB303.4	Metabolic Diversity among microorganisms, microbial photosynthesis, photosynthetic pigments, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
BTB303.5	Archaea, thermophiles, psychrophiles, halophiles, alkalophiles, acidophiles, hyperthermophiles. Viruses – Bacterial and Animal, their structure, reproduction. Viroids and Prions. Algae and Fungi – their reproduction and classification	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

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BTB303.6	Host-parasite relationship, micro flora of skin, oral cavity, gastrointestinal tract,	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

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	Respiratory infections, types of toxins (Exo, endo, entro) and their mechanism of action. Microbial pathogenesis and Sexually transmitted disease															
BTB303.7	Chemotherapy/ antibiotics - Antimicrobial agents, sulfa drugs, penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

<u>Sample Question Paper</u>

Amity Institute of Biotechnology MID-SEMESTER (SEM –III) 2022-23						
Class: B.Tech. Biotechnology III Semester						
Subject Name: BTB 303 MICROBIOLOGY		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		
Student will be able to CO1: Enumerate bacterial count their isolation and development of pure culture. CO2: Apply generation time calculation for different microbial entities.						

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CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief about microbial evolution.	3
CO1	Q.2a	What do you understand by isolation of culture?	3
	Q.2b	How are prokaryotic microbes different from eukaryotic microbes?	3
CO1	Q.3	Give an account of DNA sequencing.	6
CO2	Q.4	Explain the significance of bacterial toxins.	3
CO2	Q.5a	What are the factors favoring enteric bacteria?	3
	Q.5b	Discuss the different factors affecting the growth of bacteria.	3
CO2	Q 6	Differentiate between monoauxic and diauxic bacterial growth curve.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **MICROBIOLOGY/BTB 303** is **level 3** for the academic year 2022-23.

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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

Amity Institute of Biotechnology
Course Handout
Course : Microbiology Lab
Course Code : BTB322, Credits : 01, Session : 2022-23(Odd Sem.), Class : B.Tech 2nd Year
Faculty Name : Dr. Manish Kumar

A. Introduction: To understand the basics of microbiology and different culture techniques. Preparation of culture media – liquid, slant and solid. Growth curve and different types of staining – grams, endospore and capsule staining. Isolation and identification of rhizobium from root nodules

B. Course Outcomes: At the end of the course, students will be able to:

BTB322.1. Students will learn about preparation of solid and liquid media.

BTB322.2. Students will do isolation and maintenance of organisms by plating, streaking and serial dilution.

BTB322.3. Students will know about the preparation of slant cultures.

BTB322.4. Students will learn about growth curve measurement of bacterial population by turbidometry.

BTB322.5. Students will know about measurement of bacterial population by dilution method.

BTB322.6. Students will gain knowledge of effect of temperature, pH, carbon and nitrogen sources on growth of bacteria.

BTB322.7. Students will do microscopic examination of bacteria by gram staining.

BTB322.8. Students will learn about Endospore staining.

BTB322.9. Students will be acquainted with Capsule Staining.

BTB322.10. Students will experimentally perform isolation and identification of Rhizobium from root nodules.

C. Programme Outcomes:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of

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complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent

and life-long learning in the broadest context of

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technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Internal Examination	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%

End Semester Examination	External Examination	EE	70%

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Total			**100%**

E. Syllabus

Module I: Preparation of solid and liquid media.

Module II: Isolation and maintenance of organisms by plating, streaking and serial dilution.

Module III: Preparation of slant cultures.

Module IV: Growth curve measurement of bacterial population by turbidometry.

Module V: Measurement of bacterial population by dilution method.

Module VI: Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria.

Module VII: Microscopic examination of bacteria by gram staining.

Module VIII: Endospore staining.

Module IX: Capsule Staining.

Module X: Isolation and identification of Rhizobium from root nodules.

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian

Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott

The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

The Microbial World, Roger Y. Stanier, Prentice Hall

Microbiology, Tortora, Funke and Chase, Benzamin& Cummings

Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.

Industrial Microbiology, Casida, New Age International

Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers

Principles of

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Microbiology, R.M. Atlas, WMC.Brown Publisher.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspo nding CO	Mode of Assessing CO
1	Preparation of solid and liquid media	Practical	BTB322.1	Internal & External Exam
2	Learning about autoclave, laminar air flow	Practical	BTB322.1	Internal & External Exam
3	Isolation and maintenance of organisms by plating and streaking	Practical	BTB322.1	Internal & External Exam
4	Isolation and maintenance of organisms by serial dilution	Practical	BTB322.1	Internal & External Exam
5	Measurement of bacterial population by dilution	Practical	BTB322.1	Internal & External Exam
6	Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria	Practical	BTB322.1	Internal & External Exam
7	Microscopic examination of bacteria by gram staining	Practical	BTB322.1	Internal & External Exam
8	Endospore staining	Practical	BTB322.2	Internal & External Exam
9	Capsule staining	Practical	BTB322.2	Internal & External Exam
10	Collection of Root Nodules	Practical	BTB322.2	Internal & External Exam
11	Isolation of Rhizobium from root nodules	Practical	BTB322.2	Internal & External Exam
12	Identification of Rhizobium from root nodules	Practical	BTB322.2	Internal & External Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES	CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
BTB 322.1	Preparation of solid and liquid media	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.2	Isolation and maintenance of organisms by plating, streaking and serial dilution	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.3	Preparation of slant cultures	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.4	Growth curve measurement of bacterial population by turbidometry	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.5	Measurement of bacterial population by dilution method	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.6	Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.7	Microscopic examination of bacteria by gram staining	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.8	Endospore staining	3	2	2	2	2	2	2	2	2	2	3	2	2
BTB 322.9	Capsule Staining	3	2	2	2	3	2	2	2	2	2	3	2	2
BTB 322.10	Isolation and identification of Rhizobium from root nodules	3	2	2	2	2	2	2	2	2	2	3	2	2

Sample Question Paper

Amity Institute of Biotechnology MID-SEMESTER 2021-22		
Class: B.Tech (Biotech) III Semester		
Subject Name: BTB 322 Microbiology Lab	Time: 2 Hrs	Max. Marks: 30

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Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzin g	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		

Student will be able to
CO1: List the broad perceptive of cloud architecture and model.
CO2: Apply different cloud programming models as per need.

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss the development of pure cultures.	3
CO1	Q.2a	Differentiate between bacteria and fungi.	3
	Q.2b	Write a short note on bacterial DNA marker.	3
CO1	Q.3	Differentiate between genotype and ribotype.	6
CO2	Q.4	Explain about the capsule staining and	3

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **MICROBIOLOGY LAB/BTB 322** is **level 2** for the academic year 2022-23.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY-I
Course Code : BTB-302 Credits: 03, Session :2021-22 (Odd Sem.), Class : B. Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB302.1. Learn about chemical interactions in biological system.

BTB302.2. Develop the understanding between structure and function of carbohydrates & lipids.

BTB302.3. Learn the concept of metabolism and energy involved in metabolic pathways.

BTB302.4. Understand the metabolic pathways and regulations of carbohydrates metabolism.

BTB302.5. Learn about the digestion, transport, anabolism and catabolism of lipids in the body.

C. **Programme Outcomes:**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in

diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

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F. Syllabus

Module I

Introduction aims and scope

Chemical foundations of Biology -Properties of water, acids, bases and buffers, covalent bonds, Non-covalent interactions in biological systems.

Module II

Introduction to biomolecules - *Carbohydrates* -Sugars; Polysaccharides

Lipids -classification, structure and function. Lipids and biological membranes, Lipid linked proteins and lipoproteins, Atherosclerosis.

Module III

Metabolism and bioenergetics -First and second law, free energy and chemical equilibrium, Organic reaction mechanisms, Design of metabolism-concept of free energy, ATP-ADP cycle. Cellular energy transactions -role of mitochondria and chloroplast

Module IV

Carbohydrate metabolism-glycolysis pathway and reactions, Glycogen breakdown and synthesis, control of glycogen metabolism, glycogen storage and its diseases, Citric acid cycle -Overview, Metabolic sources of Acetyl Co-A, enzymes and regulation, The amphibolic nature of the Citric acid cycle Electron transport chain and oxidative photophosphorylation -mitochondrion and electron transport, phosphorylation and control of ATP production Gluconeogenesis, The glyoxylate pathway, Pentose phosphate pathway

Module V

Lipid metabolism -Lipid digestion, absorption and transport, fatty acid oxidation, ketone bodies, fatty acid biosynthesis, regulation of fatty acid metabolism. Cholesterol and Arachidonic Acid metabolism, Phospholipids, Sphingolipids and Glycolipids

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Harper's Biochemistry, K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw-Hill/Appleton and Lange.
- Biochemistry, L. Stryer, W.H. Freeman and Company
- Tools of Biochemistry, T.G. Cooper, John Wiley and Sons Inc.

References:

- Cellular Biophysics I & II, Thomas F. Weiss 1995, MIT Press
- Biochemical calculations, I.H. Segal. Publisher, John Wiley and Sons
- Biochemistry, C.K. Mathews, K.E. Van Holde and K.G. Ahern, Benjamin / Cummings.
- Devlin's Textbook of Biochemistry with Clinical correlations, John Wiley and Sons Inc.
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox, Worth Publishing

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction aims and scope	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
2	Chemical Foundations of Biology- Properties of water, acids, bases and buffers	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
3	Chemical Foundations of Biology- Properties of water, acids, bases and buffers	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
4	Covalent and Non-covalent interactions in biological systems	Lecture	BTB302.1	Mid Term, Quiz & End Sem Exam
5	Introduction to biomolecules- Carbohydrates, Sugars, Polysaccharides	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
6	Introduction to biomolecules- Carbohydrates, Sugars, Polysaccharides	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
7	Lipids- Classification, Structure and Function	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
8	Lipids and biological membranes	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
9	Lipid linked proteins and lipoproteins, Atherosclerosis	Lecture	BTB302.2	Mid Term, Quiz & End Sem Exam
10	Metabolism and bioenergetics- First and Second law	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
11	Free energy and chemical equilibrium	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
12	Organic reaction mechanisms	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
13	Design of metabolism-concept of free energy, ATP-ADP cycle	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
14	Cellular energy transactions- role of mitochondria and chloroplast	Lecture	BTB302.3	Mid Term, Quiz & End Sem Exam
15	Carbohydrate pathway- glycolysis pathway and reactions	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
16	Glycogen breakdown and synthesis	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
17	Glycogen breakdown and synthesis	Lecture	BTB302.4	Mid Term, Quiz & End Sem Exam
18	Control of glycogen metabolism, glycogen storage and its diseases	Lecture	BTB302.4	Quiz & End Sem Exam
19	Citric acid cycle-Overview, Metabolic sources of Acetyl Co-A	Lecture	BTB302.4	Quiz & End Sem Exam

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20	Enzymes and regulation	Lecture	BTB302.4	Quiz & End Sem Exam
21	Amphibolic nature of the Citric acid cycle	Lecture	BTB302.4	Quiz & End Sem Exam

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22	Electron transport chain	Lecture	BTB302.4	Quiz & End Sem Exam
23	Oxidative phosphorylation	Lecture	BTB302.4	Quiz & End Sem Exam
24	Mitochondrion and electron transport	Lecture	BTB302.4	Quiz & End Sem Exam
25	Phosphorylation and control of ATP production	Lecture	BTB302.4	Quiz & End Sem Exam
26	Gluconeogenesis	Lecture	BTB302.4	Quiz & End Sem Exam
27	Glyoxylate pathway	Lecture	BTB302.4	Quiz & End Sem Exam
28	Pentose phosphate pathway	Lecture	BTB302.4	Quiz & End Sem Exam
29	Lipid metabolism- Lipid digestion	Lecture	BTB302.5	Quiz & End Sem Exam
30	Absorption and transport	Lecture	BTB302.5	Quiz & End Sem Exam
31	Fatty acid oxidation, Ketone bodies	Lecture	BTB302.5	Quiz & End Sem Exam
32	Fatty acid biosynthesis	Lecture	BTB302.5	Quiz & End Sem Exam
33	Regulation of fatty acid metabolism	Lecture	BTB302.5	Quiz & End Sem Exam
34	Cholesterol and Arachidonic acid metabolism	Lecture	BTB302.5	Quiz & End Sem Exam
35	Phospholipids, Sphingolipids and Glycolipids	Lecture	BTB302.5	Quiz & End Sem Exam
36	Phospholipids, Sphingolipids and Glycolipids	Lecture	BTB302.5	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB302.1.	Learn about chemical interactions in biological system.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.2.	Develop the understanding between structure and function of carbohydrates & lipids.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.3.	Learn the concept of metabolism and energy involved in metabolic pathways.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.4.	Understand the metabolic pathways and regulations of carbohydrates metabolism.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB302.5.	Learn about the digestion, transport, anabolism and catabolism of lipids in the body.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

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Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2021-22						
Class: B.Tech. Biotechnology III Semester						
Subject Name: BTB 302 BIOCHEMISTRY-I		Time: 1.5 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biopolymers with examples.	3
CO1	Q.2a	What do you understand by proton hopping?	3
	Q.2b	How is monosaccharide different from polysaccharide?	3
CO1	Q.3	Give an account of lipid digestion in body.	6
CO2	Q.4	Explain the significance of lipoproteins in clinics.	3
CO2	Q.5a	What are the factors favoring glycogenolysis.	3
	Q.5b	Discuss the different factors affecting fat oxidation.	3
CO2	Q 6	Glycolysis and Gluconeogenesis will never occur simultaneously. Why?	6

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry-I**/Course code **BTB-302** is level **3** for the academic year 2021-22.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR BIOLOGY
Course Code : BTB-304, Credits: 04, Session :2021-22 (Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB304.1. Learn about the mechanism of replication of DNA in prokaryotes and eukaryotes.

BTB304.2. Learn and compare the mechanism of transcription in prokaryotes and eukaryotes.

BTB304.3. Learn the various post-transcriptional processes in cell.

BTB304.4. Learn about the mechanism of protein synthesis in prokaryotes and eukaryotes.

BTB304.5. Understand about gene expression regulation.

BTB304.6. Understand about various mechanisms of gene silencing.

C. **Programme Outcomes:**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: DNA Replication and repair

Nucleic Acid Structure and Functions, Mechanism of Prokaryotic and Eukaryotic DNA replication, Enzymes and accessory proteins involved in DNA replication, DNA repair Mechanism.

Module II: Transcription
Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements.

Module III: Modifications in RNA
5'-cap formation, transcription termination, 3 '-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA and mRNA stability.

Module IV: Translation
Prokaryotic and Eukaryotic translation, the translation Machinery; Mechanisms of initiation, elongation and termination, regulation of translation, co-and post-translational modifications of proteins.

Module V: Regulation of Gene Expression in prokaryotic and eukaryotic systems
Lac operon, Ara operan, regulation in Eukaryotes, Epigenetics.

Module VI: Antisense and Ribozyme technology
Molecular mechanism of antisense molecules, inhibition of spilicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of Ribozyme; Hammerhead, hairpin and other ribozymes, strategies for designing ribozymes, applications of antisense and ribozyme technologies.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education
- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Biology of the Cell. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing
- Gene VIII, Benjamin Lewin 2005, Oxford University Press

References:

- Molecular Cell Biology, H. Lodish, A.Berk, S. Zipursky, P Matsundaira, D.Baltimore and J.E. Barnell, W.H. Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Nucleic Acid Structure and Functions	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
2	Mechanism of Prokaryotic and Eukaryotic DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
3	Mechanism of Prokaryotic and Eukaryotic DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
4	Enzymes and accessory proteins involved in DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
5	Enzymes and accessory proteins involved in DNA replication	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
6	DNA repair Mechanism	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
7	DNA repair Mechanism	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
8	Tutorial	Lecture	BTB304.1	Mid Term, Quiz & End Sem Exam
9	Prokaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
10	Prokaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
11	Eukaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
12	Eukaryotic transcription	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
13	RNA polymerase	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
14	General and specific transcription factors	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
15	Regulatory elements	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
16	Tutorial	Lecture	BTB304.2	Mid Term, Quiz & End Sem Exam
17	5'-cap formation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
18	transcription termination	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
19	3'-end processing and polyadenylation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
20	3'-end processing and polyadenylation	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
21	Splicing, Editing	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam

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22	Nuclear export of mRNA and mRNA stability	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam
23	Tutorial	Lecture	BTB304.3	Mid Term, Quiz & End Sem Exam

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24	Prokaryotic and Eukaryotic translation	Lecture	BTB304.4	Mid Term, Quiz & End Sem Exam
25	Prokaryotic and Eukaryotic translation	Lecture	BTB304.4	Quiz & End Sem Exam
26	the translation Machinery	Lecture	BTB304.4	Quiz & End Sem Exam
27	Mechanisms of initiation	Lecture	BTB304.4	Quiz & End Sem Exam
28	elongation and termination	Lecture	BTB304.4	Quiz & End Sem Exam
29	regulation of translation	Lecture	BTB304.4	Quiz & End Sem Exam
30	co-and post-translational modifications of proteins	Lecture	BTB304.4	Quiz & End Sem Exam
31	Tutorial	Lecture	BTB304.4	Quiz & End Sem Exam
32	Lac operon	Lecture	BTB304.5	Quiz & End Sem Exam
33	Ara operon	Lecture	BTB304.5	Quiz & End Sem Exam
34	regulation in Eukaryotes	Lecture	BTB304.5	Quiz & End Sem Exam
35	Epigenetics	Lecture	BTB304.5	Quiz & End Sem Exam
36	Tutorial	Lecture	BTB304.5	Quiz & End Sem Exam
37	Molecular mechanism of antisense molecules	Lecture	BTB304.6	Quiz & End Sem Exam
38	Molecular mechanism of antisense molecules	Lecture	BTB304.6	Quiz & End Sem Exam
39	inhibition of spilicing, polyadenylation and translation	Lecture	BTB304.6	Quiz & End Sem Exam
40	disruption of RNA structure and capping	Lecture	BTB304.6	Quiz & End Sem Exam
41	Biochemistry of Ribozyme	Lecture	BTB304.6	Quiz & End Sem Exam
42	Hammerhead, hairpin and other ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
43	Hammerhead, hairpin and other ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
44	strategies for designing ribozymes	Lecture	BTB304.6	Quiz & End Sem Exam
45	applications of antisense	Lecture	BTB304.6	Quiz & End Sem Exam

46	ribozyme technologies	Lecture	BTB304.6	Quiz & End Sem Exam

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47	Applications of ribozyme technologies	Lecture	BTB304.6	Quiz & End Sem Exam
48	Tutorial	Lecture	BTB304.6	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB304.1.	Learn about the mechanism of replication of DNA in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.2.	Learn and compare the mechanism of transcription in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.3.	Learn the various post-transcriptional processes in cell.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.4.	Learn about the mechanism of protein synthesis in prokaryotes and eukaryotes	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.5.	Understand about gene expression regulation.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB304.6.	Understand about various mechanisms of gene silencing.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

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<u>**Sample Question Paper**</u>

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2021-22						
Class: B.Tech. Biotechnology III Semester						
Subject Name: BTB 304 MOLECULAR BIOLOGY		Time: 1.5 Hrs		Max. Marks: 30		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the nucleic acids with examples.	3
CO1	Q.2	What do you understand by semi discontinuous replication of DNA?	6
CO1	Q.3	Give an account of RNA synthesis in *E. coli*.	6
CO2	Q.4	Explain the significance of 5’-capping in RNA.	3
CO2	Q.5a	How does tRNA bring amino acid to ribosome for protein synthesis?	3
	Q.5b	Discuss the different mechanisms of gene silencing.	3
CO2	Q 6	How does cell ensure the correct incorporation of amino acids in translation?	6

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology**/Course code **BTB-304** is level **3** for the academic year 2021-22.

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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	3	3	3	3	-	1	2	2	2	3	1	2

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : MOLECULAR BIOLOGY LAB
Course Code : BTB-323, Credits: 01, Session :2021-22 (Odd Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. Course Outcomes: At the end of the course, students will be able to:

BTB323.1. Practical based understanding of preparation of genomic and plasmid DNA.

BTB323.2. Practical based understanding of isolation of RNA.

BTB323.3. Practical based understanding of RFLP analysis.

BTB323.4. Practical based understanding of gel filtration.

BTB323.5. Practical based understanding of Preparation of Competent Cells.

BTB323.6. Practical based understanding of Restriction Digestion and Ligation of DNA.

C. Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

F. Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Preparation of DNA: genomic, Plasmid

Module II

Isolation of RNA

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Module III
RFLP analysis
Module IV
Gel filtration
Module V
Preparation of Competent Cells
Module VI
Restriction Digestion and Ligation of DNA

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:

Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

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I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Preparation of DNA: genomic, Plasmid	Practical	BTB323.1	Class Test (Practical Based) & End Sem Exam
2	Preparation of DNA: genomic, Plasmid	Practical	BTB323.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of RNA	Practical	BTB323.2	Class Test (Practical Based) & End Sem Exam
4	Isolation of RNA	Practical	BTB323.2	Class Test (Practical Based) & End Sem Exam
5	RFLP analysis	Practical	BTB323.3	Class Test (Practical Based) & End Sem Exam
6	RFLP analysis	Practical	BTB323.3	Class Test (Practical Based) & End Sem Exam
7	Gel filtration	Practical	BTB323.4	Class Test (Practical Based) & End Sem Exam
8	Gel filtration	Practical	BTB323.4	Class Test (Practical Based) & End Sem Exam
9	Preparation of Competent Cells	Practical	BTB323.5	Class Test (Practical Based) & End Sem Exam
10	Preparation of Competent Cells	Practical	BTB323.5	Class Test (Practical Based) & End Sem Exam
11	Restriction Digestion and Ligation of DNA	Practical	BTB323.6	Class Test (Practical Based) & End Sem Exam
12	Restriction Digestion and Ligation of DNA	Practical	BTB323.6	Class Test (Practical Based) & End Sem Exam

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J. **Course Articulation Matrix (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB323.1.	Practical based understanding of preparation of genomic and plasmid DNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.2.	Practical based understanding of isolation of RNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.3.	Practical based understanding of RFLP analysis.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.4.	Practical based understanding of gel filtration.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.5.	Practical based understanding of Preparation of Competent Cells.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-
BTB323.6.	Practical based understanding of Restriction Digestion and Ligation of DNA.	3	3	3	3	-	1	2	-	2	2	-	2	3	3	1	-

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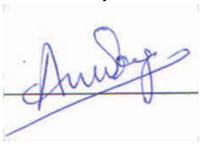
Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology Lab**/Course code **BTB-323** is level **3** for the academic year 2021-22.



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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.
[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.
[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leaderin a team, to manage projects and in multidisciplinary environments.
[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	2	3	3	3	-	1	2	2	2	3	1	2

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY - II
Course Code : BTB-401, Credits : 04, Session :2021-22 (Even Sem.), Class : B. Tech. 2^{nd} Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

B. Course Outcomes: At the end of the course, students will be able to:

BTB401.1. Understand relationships between structure and functions Amino acids and Proteins and the concept of Enzymes, their mode of action and regulation.

BTB401.2. Understand the structure and properties of Nucleic acids – DNA and RNA.

BTB401.3. Learn and understand the amino acid metabolism.

BTB401.4. Understand the metabolism of purines and pyrimidines in the body.

C. Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

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[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

Component of Evaluation	Description	Code	Weightage %
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%

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Total			**100%**

F. Syllabus

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Module I

Proteins -Amino acids and peptides - classification, chemical reactions and physical properties. Introduction to protein structure and function. Cis-trans peptide bond formation. Glycoproteins -structure and function, *Vitamins and Coenzymes*: structure and function of water soluble vitamins.
Enzymes -Introduction to kinetic and catalytic mechanisms of enzymes; Regulation of enzyme activity; Effects of physical parameters on enzyme activity, enzyme inhibitors – types of inhibition.

Module II

Nucleic acids - nitrogenous bases, nucleotides, types, structure and properties of nucleic acids

Module III

Amino acid metabolism -Amino acid deamination, urea cycle, biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine,
Tyrosine. Specialized Products of Amino Acids, Nitrogen fixation

Module IV

Nucleotide Metabolism -structure and metabolism of purines and pyrimidines, biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN; Catabolism of heam and clinical significance of bilirubin.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Harper's Biochemistry, K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw-Hill/Appleton and Lange.
- Biochemistry, L. Stryer, W.H. Freeman and Company
- Tools of Biochemistry, T.G. Cooper, John Wiley and Sons Inc.

References:

- Cellular Biophysics I & II, Thomas F. Weiss 1995, MIT Press
- Biochemical calculations, I.H. Segal. Publisher, John Wiley and Sons
- Biochemistry, C.K. Mathews, K.E. Van Holde and K.G. Ahern, Benjamin / Cummings.
- Devlin's Textbook of Biochemistry with Clinical correlations, John Wiley and Sons Inc.
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox, Worth Publishing

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I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
2	Proteins - Amino acids and peptides - classification	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
3	Proteins - Amino acids and peptides - classification	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
4	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
5	Chemical reactions and physical properties	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
6	Introduction to protein structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
7	Introduction to protein structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
8	Glycoproteins -structure and function	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
9	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
10	Vitamins and Coenzymes: structure and function of water soluble vitamins	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
11	Vitamins and Coenzymes: structure and function of water soluble vitamins	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
12	Enzymes - Introduction to kinetic mechanisms of enzymes	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
13	Catalytic mechanisms of enzymes	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
14	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
15	Regulation of enzyme activity	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
16	Effects of physical parameters on enzyme activity	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
17	Enzyme inhibitors – types of inhibition.	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
18	Enzyme inhibitors – types of inhibition.	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
19	TUTORIAL	Lecture	BTB401.1	Mid Term, Quiz & End Sem Exam
20	Nucleic acids - nitrogenous bases	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam

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21	Nucleotides, types, structure and properties of nucleic acids	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam
22	Nucleotides, types, structure and properties of nucleic acids	Lecture	BTB401.2	Mid Term, Quiz & End Sem Exam

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23	Amino acid metabolism - Amino acid deamination	Lecture	BTB401.3	Mid Term, Quiz & End Sem Exam
24	TUTORIAL	Lecture	BTB401.3	Mid Term, Quiz & End Sem Exam
25	Urea cycle	Lecture	BTB401.3	Quiz & End Sem Exam
26	Urea cycle	Lecture	BTB401.3	Quiz & End Sem Exam
27	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
28	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
29	Biosynthesis and breakdown of nutritionally non-essential amino acids (asparagines, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, Tyrosine)	Lecture	BTB401.3	Quiz & End Sem Exam
30	Tutorial	Lecture	BTB401.3	Quiz & End Sem Exam
31	Specialized Products of Amino Acids	Lecture	BTB401.3	Quiz & End Sem Exam
32	Specialized Products of Amino Acids	Lecture	BTB401.3	Quiz & End Sem Exam
33	Nitrogen fixation	Lecture	BTB401.3	Quiz & End Sem Exam
34	Nitrogen fixation	Lecture	BTB401.3	Quiz & End Sem Exam
35	TUTORIAL	Lecture	BTB401.3	Quiz & End Sem Exam
36	Nucleotide Metabolism -structure of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
37	Nucleotide Metabolism -structure of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
38	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
39	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam
40	Metabolism of purines and pyrimidines	Lecture	BTB401.4	Quiz & End Sem Exam

41	Biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN)	Lecture	BTB401.4	Quiz & End Sem Exam

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42	Biosynthesis of nucleotide coenzymes (NAD, NADP, FAD, FMN)	Lecture	BTB401.4	Quiz & End Sem Exam
43	Biosynthesis of nucleotide	Lecture	BTB401.4	Quiz & End Sem

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	coenzymes (NAD, NADP, FAD, FMN)			Exam
44	TUTORIAL	Lecture	BTB401.4	Quiz & End Sem Exam
45	Catabolism of heam	Lecture	BTB401.4	Quiz & End Sem Exam
46	Catabolism of heam	Lecture	BTB401.4	Quiz & End Sem Exam
47	Clinical significance of bilirubin	Lecture	BTB401.4	Quiz & End Sem Exam
48	Clinical significance of bilirubin	Lecture	BTB401.4	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB401.1.	Understand relationships between structure and functions Amino acids and Proteins and the concept of Enzymes, their mode of action and regulation.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.2.	Understand the structure and properties of Nucleic acids – DNA and RNA.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.3.	Learn and understand the amino acid metabolism.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-
BTB401.4.	Understand the metabolism of purines and pyrimidines in the body.	3	3	2	3	-	-	1	2	3	-	-	2	3	1	1	-

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<u>Sample Question Paper</u>

Amity Institute of Biotechnology I MID-SEMESTER (SEM –IV) 2021-22						
Class: B.Tech. Biotechnology IV Semester						
Subject Name: BTB 401 BIOCHEMISTRY-II		Time: 1.5 Hrs		Max. Marks: 30		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the amino acids with examples.	3
CO1	Q.2	What do you understand by enzyme kinetics?	6
CO1	Q.3	Give an account of biochemistry of glycoproteins.	6
CO2	Q.4	Explain the significance of peptide bond.	3
CO2	Q.5a	How does inhibitors work against enzymes?	3
	Q.5b	Discuss the importance of SGOT and SGPT in liver and kidney function tests.	3
CO2	Q 6	Discuss the importance of mis regulation in nucleic acid metabolism.	6

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry-II**/Course code **BTB-401** is level **3** for the academic year 2021-22.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR

AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Bachelor of Technology (B. Tech.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

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Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
III SEM	BTB302	3	3	3	3	-	1	2	2	2	3	1	2

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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY LAB-II
Course Code : BTB-420, Credits: 01, Session :2021-22 (Even Sem.), Class : B.Tech. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend understanding of the qualitative and quantitative estimation of proteins and nucleic acids.

B. Course Outcomes: At the end of the course, students will be able to:

BTB420.1. Practical based understanding of qualitative and quantitative tests of protein and amino acids.

BTB420.2. Practical based understanding of qualitative and quantitative tests of DNA and RNA.

C. Programme Outcomes:

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

E. Assessment Plan:

F. Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

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F. Syllabus

Module I
Colour reactions of proteins (Ninhydrin test, Biuret test, Xanthoprotein test).
Estimation of proteins.
Module II
Biochemical estimation of DNA
Biochemical estimation of RNA
Quantitative determination of DNA and RNA by spectrophotometric method using UV range.
Determination of melting temperature of DNA from thermal denaturation characteristics.

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text & References:
Text:

- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Ninhydrin test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Xanthoprotein test	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
4	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
5	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
6	Estimation of Proteins	Practical	BTB420.1	Class Test (Practical Based) & End Sem Exam
7	Biochemical estimation of DNA	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
8	Biochemical estimation of RNA	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
9	Quantitative determination of DNA and RNA by spectrophotometric method using UV range	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
10	Quantitative determination of DNA and RNA by spectrophotometric method using UV range	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
11	Determination of melting temperature of DNA from thermal denaturation characteristics	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam
12	Determination of melting temperature of DNA from thermal denaturation characteristics	Practical	BTB420.2	Class Test (Practical Based) & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BTB420.1.	Practical based understanding of qualitative and quantitative tests of protein and amino acids.	3	3	3	3	-	1	2	-	2	2	**-**	**2**	3	3	1	-
BTB420.2.	Practical based understanding of qualitative and quantitative tests of DNA and RNA.	3	3	3	3	-	1	2	-	2	2	**-**	**2**	3	3	1	-

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry lab-II**/Course code **BTB-420** is level **3** for the academic year 2021-22.

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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Life Sciences – I
Course Code : BTB 105, Crédits : 03, Session :2021-22 (Odd Sem.), Class : B.tech. (Biotechnology) 1st Year
Faculty Name : Dr. Asha Singh

A. **Introduction:** The objective of this course is to enable students to understand the characteristics and variation among different phylum of Invertebrates from Protozoa to Echinodermata and classification, morphology, reproduction and economic importance of various groups of lower plants which will provide the basic knowledge for the employment of these plants to study plant biotechnology

B. **Course Outcomes:** At the end of the course, students will be able to:
BTB105.1 Develop knowledge about of animal (Invertebrates & vertebrates) and plant (Lower & Higher) kingdom.
BTB105.2. Learn about taxonomy and variability among different groups of animal and plant kingdom.
BTB105.3. Identify basic concepts of classification, morphology, anatomical features & mode of reproduction of lower and higher plants.
BTB105.4. Learn the industrial applications, ecological significance & their importance in agriculture. And develops awareness for career options in biological sciences

C. **Programme Outcomes:**

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance isrequiredtobemaintainedbyastudentto be qualified for taking up the EndSemester examination. The allowanceof 25%includesalltypesofleaves includingmedicalleaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Invertebrates

Salient features and outline classification of various phyla of invertebrates upto class with suitable examples (According to Parker and Haswell latest edition).

Module II: V*ertebrates*

Salient features and outline classification of Phylum Chordataupto order with suitable examples (According to Parker and Haswell latest edition)

Module III: Lower Plants

Systematic: Recent trends in classification of Algae, Fungi, Bryophyte and Pteridophytes. General account: Characteristic features; mode of reproduction and life cycles in Algae; Fungi including Lichens and Mycorrhiza; Bryophyte and Pteridophytes. Economic Importance: Industrial applications; Ecological significance; Importance in agriculture.

Module IV: **Higher Plants**

Systematics: Elementary knowledge of ICBN: Principles; Rank of taxa, Retention and rejection of names; Type method; Principle of priority; Effective and valid publication; Author Citation. Broad outline of Bentham & Hooker, D.D Pant's classification General account: General characteristic features, Distribution, mode of reproduction and generalised life cycles of Gymnosperms and Angiosperms. Economic Importance: Industrial and ecological importance of Gymnosperms and Angiosperms

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Fundamentals of Environmental Chemistry, G.S.Sodhi, Narosa Publishers.
- Introduction to Environmental Pollution, B.K Sharma, H.Kaur, Goel Publishers.
- Biochemistry Styrier.
- *Cell Biology, C B Pawar.*
- Biochemistry, Lalinger.
- Modern Plant Taxonomy, N.S. Subrahmanyam, Vikas Publishing House.
- A Text Book of Botany, V. Singh, P.C. Pande& D.K. Jain, Rastogi Publication.
- Plant Systematics Theory & Practice, Gurcharan Singh, Oxford & IBH Publishing Co.
- Taxonomy, V. Singh & D. K. Jain, Rastogi Publications.

H. Lecture Plan

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Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Diversity among Invertebrates:	Lecture	**BTB105.1**	Mid Term-1, Quiz & End Sem Exam

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2	Concept of species,Binomial nomenclature,	Lecture	**BTB105.1**	Mid Term-1, Quiz & End Sem Exam
3	classification-Hierarchy.	Lecture	**BTB105.1**	Mid Term-1, Quiz & End Sem Exam
4	Salient features of lower invertebrates	Lecture	**BTB105.1**	Mid Term-1, Quiz & End Sem Exam
5	Salient features of higher invertebrates	Lecture	**BTB105.1**	Mid Term-1, Quiz & End Sem Exam
6	Out line classification of lower invertebrates upto class	Lecture	**BTB105.1**	Mid Term-1, Quiz & End Sem Exam
7	Out line classification of higher invertebrates upto class	Lecture	**BTB105.1**	Mid Term-1, Quiz & End Sem Exam
8	suitable examples of lower invertebrates	Lecture	**BTB105.1**	Mid Term-1, Quiz & End Sem Exam
9	suitable examples of higher invertebrates	Lecture	**BTB105.1**	Mid Term-1, Quiz & End Sem Exam
10	Salient features of Phylum Chordata upto order with suitable examples	Lecture	BTB105.2.	Mid Term-1, Quiz & End Sem Exam
11	outline classification of Phylum Chordata upto order with suitable examples	Lecture	BTB105.2.	Mid Term-1, Quiz & End Sem Exam
12	Salient features and outline classification of Fishes, Amphibian	Lecture	BTB105.2.	Mid Term-1, Quiz & End Sem Exam
13	Salient features and outline classification of reptilian	Lecture	BTB105.2.	Mid Term-1, Quiz & End Sem Exam
14	Salient features and outline classification of Aves	Lecture	BTB105.2.	Mid Term-1, Quiz & End Sem Exam

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15	Salient features and outline classification of Mammals	Lecture	BTB105.2.	Mid Term-1, Quiz & End Sem Exam

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16	Systematic: Recent trends in classification of Algae	Lecture	BTB105.2.	Mid Term-1, Quiz & End Sem Exam
17	Systematic: Recent trends in classification of Fungi	Lecture	BTB105.3.	Mid Term-1, Quiz & End Sem Exam
18	Systematic: Recent trends in classification of Bryophyta	Lecture	BTB105.3.	Mid Term-1, Quiz & End Sem Exam
19	Systematic: Recent trends in classification of Pteridophytes.	Lecture	BTB105.3.	Mid Term-1, Quiz & End Sem Exam
20	General account: Characteristic features; mode of reproduction and life cycles in Algae; Fungi including Lichens	Lecture	BTB105.3.	Mid Term-1, Quiz & End Sem Exam
21	General account: Characteristic features; mode of reproduction and life cycles in Algae; Fungi including Lichens and Mycorrhiza	Lecture	BTB105.3.	Quiz & End Sem Exam
22	General account: Characteristic features; mode of reproduction and life cycles in Bryophyte and Pteridophytes	Lecture	BTB105.3.	Quiz & End Sem Exam
23	Economic Importance: Industrial applications; Ecological significance;	Lecture	BTB105.3.	Quiz & End Sem Exam
24	Importance in agriculture.	Lecture	BTB105.3.	Quiz & End Sem Exam
25	Systematics:	Lecture	BTB105.4.	Quiz & End Sem Exam
26	Elementary knowledge of ICBN	Lecture	BTB105.4.	Quiz & End Sem Exam
27	Principles; Rank of taxa,	Lecture	BTB105.4.	Quiz & End Sem Exam

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28	*Retention and rejection of names;*	Lecture	BTB105.4.	Quiz & End Sem Exam
29	Type method; Principle of priority;	Lecture	BTB105.4.	Quiz & End Sem Exam
30	Effective and valid	Lecture	BTB105.4.	Quiz & End Sem

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	publication;			Exam
31	Author Citation	Lecture	BTB105.4.	Quiz & End Sem Exam
32	Broad outline of Bentham & Hooker, D.D Pant's classification	Lecture	BTB105.4.	Quiz & End Sem Exam
33	General account: General characteristic features, Distribution, mode of reproduction	Lecture	BTB105.4.	Quiz & End Sem Exam
34	generalised life cycles of Gymnosperms and Angiosperms.	Lecture	BTB105.4.	Quiz & End Sem Exam
35	Economic Importance:,	Lecture	BTB105.4.	Quiz & End Sem Exam
36	Industrial and ecological importance of Gymnosperms and Angiosperms	Lecture	BTB105.4.	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BTB105.1	Develop knowledge about of animal (Invertebrates & vertebrates) and plant (Lower & Higher) kingdom.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	

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BTB105.2.	Learn about taxonomy and variability among different groups of animal and plant kingdom.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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BTB105.3.	Identify basic concepts of classification, morphology, anatomical features & mode of reproduction of lower and higher plants.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BTB105.4.	Learn the industrial applications, ecological significance & their importance in agriculture. And develops awareness for career options in biological sciences	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

SampleQuestionPaper

Amity Institute of Biotechnology Amity University Madhya Pradesh		
Class: B.Tech.(Biotech) Ist Semester		
Subject Name: BTB 104 Life Sciences-I	Time:3 Hrs	Max.Marks:70

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	

Student will be able to

CO Map	Question No.	Question	Marks
CO1	Q.1	Describe characteristic features of phylum Echinodermata.	6
CO1	Q.2	Q2. Discuss about Dipnoi with examples.	6
	Q.3	Give an account on class Rotifera of Aschelminthes.	6
CO1	Q.4	Give the names of an edible fungus. Comment on its systematic position, habit & habitat	6
CO2	Q.5	Describe briefly the economic importance of lichen	6
	Q6	Discuss briefly the affinities & relationships of gymnosperms	6
CO2	Q.7	Explain about classes Scyphozoa and Anthozoa.	10
CO2	Q.8	Give a detailed account of the alternation of generation in bryophytes with example	10
CO3	Q.9	Brief account of the economic importance of algae.	10
CO3	Q.10	(a) What do you understand by class Mammalia? Write its classification with examples. (b) What is phylogenetic system of classification? Give the outline of the classification proposed by Hutchinson with merits & demerits.	20

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Attainments		**Rubric**
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Life Sciencs-I** /Course code ***BTB 105*** is level ***3*** for the academic year ***2021-22***.

Asha Singh

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AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTIUTE OF BIOTECHNOLOGY
Course Handout
Course : Life Sciences – II
Course Code : BTB 206, Crédits : 03, Session :2021-22 (Even Sem.), Class : B.Tech (Biotechnology) 1st Year
Faculty Name : Dr. Asha Singh

A. **Introduction:** The objective of this course is to enable students to understand the conceptual knowledge about Vertebrates, which includes from Pisces to Mammals. This paper will be helpful to understand the variations from one class to another. Moreover paper will provide knowledge of various physiological activities of higher plants which will help them to understand the various profiles of modern biotechnology.

B. **Course Outcomes:** At the end of the course, students will be able to:

BTB206.1 Develops knowledge with functioning of animal and plant physiological system.

BTB206.2. Learn the importance of hormones and enzymes of an animal and plant body.

BTB206.3. Identify basic concepts of classification, morphology, anatomical features & mode of reproduction of plants.

BTB206.4. Learn the industrial applications, ecological significance & their importance in agriculture. And develops awareness for career options in plant Physiological system.

C. **Programme Outcomes:**

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES OF B.Tech. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology,

instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance isrequiredtobemaintainedbyastudentto be qualified for taking up the EndSemester examination. The allowanceof 25%includesalltypesofleaves includingmedicalleaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Anatomy & Physiology of Rabbit.

- Integumentary system
- Skeletal System: Girdles only
- Digestive system
- Respiratory System

Module II: Anatomy & Physiology of Rabbit.

- Circulatory System: Heart and Aortic Arches only
- Nervous System; Brain only
- Endocrine System
- Urinogenital System

Module-III Plant Physiology-I

Plant-water Relations: Importance of water to plant life; physical properties of water; Imbibition, Diffusion, Osmosis and Plasmolysis; absorption and transport of water; transpiration-types, physiology of stomata, factors affecting transpiration, importance of transpiration.
Transport of Organic Substances: Mechanism of phloem transport; source-sink relationship; factors affecting translocation; Plant Hormones.

Module-IV Plant Physiology-II

Photosynthesis: Significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photo-phosphorylation; Calvin cycle; C4 pathway; CAM plants; photorespiration. Respiration: Seed dormancy; plant movements; the concept of photoperiodism; physiology of flowering; florigen concept; physiology of senescence; fruit ripening.

F. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Guyton, A.C. and Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. / W.B.
Saunders Company.
- Tortora, G.J. and Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons, Inc.
- Ganong, H, Review of Medial Physiology 14th edition, Appleton &Lange Publisher, New York
Shier, D., Butler, J. and Lewis, R., Hole"s Human Anatomy and Physiology, (10th Edition) 2003. WCB/McGraw Hill, Boston.
- Text Book of Plant Physiology, C. P. Malik & A. K. Srivastava, Kalyani Publishers.
- Anatomy of Seed Plants, V. Singh, P. C. Pande, D. K. Jain, Rastogi Publications.
- Ecology & Environment, P.D. Sharma, Rastogi Publications.
- Anatomy of Seed Plants, K. Esau, John Wiley & Sons.
- An introduction to Plant Anatomy, A. J. Eames and A. H. Mac Daniels, Tata McGraw - Hill.
Plant Physiology, S. N. Pandey, B. K. Sinha, Vikas Publishing Hours.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Anatomy of Rabbit: Integumentary system	Lecture	**BTB206.1**	Mid Term-1, Quiz & End Sem Exam
2	Physiology of Rabbit: Integumentary system	Lecture	**BTB206.1**	Mid Term-1, Quiz & End Sem Exam
3	Anatomy of Rabbit: Skeletal System: Girdles only	Lecture	**BTB206.1**	Mid Term-1, Quiz & End Sem Exam
4	Physiology of Rabbit: Skeletal System: Girdles only	Lecture	**BTB206.1**	Mid Term-1, Quiz & End Sem Exam
5	Anatomy of Rabbit: Digestive system	Lecture	**BTB206.1**	Mid Term-1, Quiz & End Sem Exam
6	Physiology of Rabbit: Digestive system	Lecture	**BTB206.1**	Mid Term-1, Quiz & End Sem Exam
7	Anatomy of Rabbit: Respiratory System	Lecture	**BTB206.1**	Mid Term-1, Quiz & End Sem Exam
8	Physiology of Rabbit: Respiratory System	Lecture	**BTB206.1**	Mid Term-1, Quiz & End Sem Exam
9	Anatomy of Rabbit: Circulatory System: Heart and Aortic Arches only	Lecture	**BTB206.2**	Mid Term-1, Quiz & End Sem Exam
10	Physiology of Rabbit: Circulatory System: Heart and Aortic Arches only	Lecture	**BTB206.2**	Mid Term-1, Quiz & End Sem Exam
11	Anatomy of Rabbit: Nervous System; Brain only	Lecture	**BTB206.2**	Mid Term-1, Quiz & End Sem Exam
12	Physiology of Rabbit: Nervous System; Brain only	Lecture	**BTB206.2**	Mid Term-1, Quiz & End Sem Exam
13	Anatomy of Rabbit: Endocrine System	Lecture	**BTB206.2**	Mid Term-1, Quiz & End Sem Exam

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14	Physiology of Rabbit: Endocrine System	Lecture	**BTB206.2**	Mid Term-1, Quiz & End Sem Exam
15	**A**natomy of Rabbit: Urinogenital System	Lecture	**BTB206.2**	Mid Term-1, Quiz & End Sem Exam

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16	Physiology of Rabbit: Urinogenital System	Lecture	**BTB206.2**	Mid Term-1, Quiz & End Sem Exam
17	Plant-water Relations	Lecture	**BTB206.3**	Mid Term-1, Quiz & End Sem Exam
18	Importance of water to plant life;	Lecture	**BTB206.3**	Mid Term-1, Quiz & End Sem Exam
19	physical properties of water	Lecture	**BTB206.3**	Mid Term-1, Quiz & End Sem Exam
20	Imbibition, Diffusion, Osmosis and Plasmolysis; absorption and transport of water;	Lecture	**BTB206.3**	Mid Term-1, Quiz & End Sem Exam
21	Transpiration-types, physiology of stomata, factors affecting transpiration, importance of transpiration.	Lecture	**BTB206.3**	Quiz & End Sem Exam
22	Transport of Organic Substances	Lecture	**BTB206.3**	Quiz & End Sem Exam
23	Mechanism of phloem transport	Lecture	**BTB206.3**	Quiz & End Sem Exam
24	Source-sink relationship;	Lecture	**BTB206.3**	Quiz & End Sem Exam
25	factors affecting translocati on;	Lecture	BTB206.3	Quiz & End Sem Exam
26	Plant Hormones	Lecture	BTB206.3	Quiz & End Sem Exam
27	Photosynthesis:	Lecture	BTB206.4.	Quiz & End Sem Exam
28	Significance	Lecture	BTB206.4.	Quiz & End Sem Exam
29	historical aspects; photosynthetic pigments; action spectra and enhancement effects	Lecture	BTB206.4.	Quiz & End Sem Exam
30	concept of two photosystems;	Lecture	BTB206.4.	Quiz & End Sem Exam
31	Z-scheme; photo-phosphorylation;	Lecture	BTB206.4.	Quiz & End Sem Exam

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32	Calvin cycle;	Lecture	BTB206.4.	Quiz & End Sem Exam
33	C4 pathway; CAM plants; photorespiration.	Lecture	BTB206.4.	Quiz & End Sem Exam
34	Respiration: Seed	Lecture	BTB206.4.	Quiz & End Sem

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	dormancy; plant movements; the			Exam
35	the concept of photoperiodism, physiology of flowering	Lecture	BTB206.4.	Quiz & End Sem Exam
36	florigen concept; physiology of senescence; fruit ripening.	Lecture	BTB206.4.	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BTB206.1	Develops knowledge with functioning of animal and plant physiological system. .	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	
BTB206.2.	Learn the importance of hormones and enzymes of an animal and plant body.	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**
BTB206.3.	Identify basic concepts of classification, morphology, anatomical features & mode of reproduction of plants	3	2	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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BTB206.4.	Learn the industrial applications, ecological significance & their importance in agriculture. And develops awareness for career options in	3	3	2	**2**	**1**				**2**	**1**			**3**	**2**	**1**

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	plant Physiological system.															

SampleQuestionPaper

Amity Institute of Biotechnology Amity University Madhya Pradesh						
Class: B.Tech.(Biotech) II Semester						
Subject Name: BTB 206 Life Sciences-I		Time:3 Hrs		Max.Marks:70		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6	Q. 7, 8, 9, 10	
Student will be able to						

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss briefly about structure and function of integument	6
CO1	Q.2	Discuss about the composition and functions of bile.	6
	Q.3	Write a short note on plasmolysis.	6
CO1	Q.4	What are plant growth inhibitors? Give a brief description.	6
CO2	Q.5	Describe in detail about the transportation of gases in the process of respiration.	6
	Q6	Discuss Brief description on the formation & function of florigen in flowering.	6
CO2	Q.7	Differentiate between C_3 & C_4 plants. Describe the C_4 cycle in plants.	10
CO2	Q.8	What do you mean by seed dormancy? Discuss the reasons and methods to break seed dormancy.	10
CO3	Q.9	What do you mean by seed dormancy? Discuss the reasons and methods to break seed dormancy.	10

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CO3	Q.10	Describe about: (a) Hormones secreted by Pituitary gland and their functions. (b) Thyroid gland structure and its hormones.	20

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Attainments		Rubric
Level	1	IF60%ofstudentssecuremorethan60%marksthenlevel1
Level	2	IF70%ofstudentssecuremorethan60%marksthenlevel2
Level	3	IF80%ofstudentssecuremorethan60%marksthenlevel3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Life Sciences-I** /Course code ***BTB 206*** is level ***3*** for the academic year ***2021-22***.

Asha Singh

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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **ADVANCED GENOMICS & PROTEOMICS**
Course Code : MSB 204, Crédits : 04, Session :2022-23(Even Sem.), Class : M.Sc. Ist Year
Faculty Name : Dr. MANISH KUMAR

A. Introduction: The course helps in developing a detailed understanding of eukaryotic genome complexity and organization. Current research on the molecular basis of the control of gene expression in eukaryotic has developed a detailed understanding of techniques of gene diagnostics and DNA profile to acquire the fundamental of genomics and bioinformatics, it is desirable to have in depth study on these lines.

B. Course Outcomes: At the end of the course, students will be able to:
MSB204.1 Understand the basic of genomics, Anatomy of genomics and human genome project
MSB204.2 Able to understand gene expression, and mapping
MSB204.3 Learn different DNA markers
MSB204.4 Understand Microarray and their applications in analysis of gene expression
MSB204.5 Develop knowledge of fundamental techniques in proteomics.
MSB204.6 Understand Post translational modification.
MSB204.7 Get detail knowledge and understanding of Protein – protein interaction.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technologicalchange.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Introduction to Genomics: The human genome project “Anatomy of prokaryotic and eucaryoticgenome: repetitive DNA and RNA Contents of genomes.

Module II

Transcriptomics and meta-transcriptomics: Introduction, method and uses. Genetic mapping

Module III
Microsatellite DNA markers, RFLP, DNA sequencing, Phylogeny

Module IV
Micro array: DNA micro array marker, computational methods.

PART-II: PROTEOMICS

Module V
Introduction to proteomics
Fundamental methods used in proteomics. 2-D gel electrophoresis + mass spectroscopy.

Module VI
Post translationalprotein modification

Module VII
Protein – protein interaction some examples

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Genes & Genomes, Maxine Singer and Paul Berg
- Genomes II, T.A. Brown

***References*:**

- A Primer of Genome Science, Greg Gibson and Spencer V. Muse
- Database Annotation in Molecular Biology: Principles and Practice, Arthur M. Lesk
- DNA: Structure and Function, Richard R. Sinden
- Recombinant DNA (Second Edition), James D. Watson and Mark Zoller
- Gene Cloning and DNA Analysis – An introduction (Fourth Edition), T.A. Brown
- www.panimatext.com

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
2	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem

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				Exam
3	Human Genome project	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem Exam

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4	Human Genome project	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem Exam
5	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem Exam
6	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem Exam
7	repetitive DNA and RNA Contents of genoms	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem Exam
8	repetitive DNA and RNA Contents of genoms	Lecture	MSB204. 1	Mid Term-1, Quiz & End Sem Exam
9	Transcriptomics and metatranscriptomics	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
10	Transcriptomics and metatranscriptomics	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
11	Transcriptomics and metatranscriptomics	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
12	Introduction , method and uses.genetic mapping	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
13	Introduction , method and uses.genetic mapping	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
14	Introduction , method and uses.genetic mapping	Lecture	MSB204. 2	Mid Term-1, Quiz & End Sem Exam
15	Microsatellite DNA markers	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
16	Microsatellite DNA markers	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
17	Microsatellite DNA markers	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
18	RFLP	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
19	RFLP	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam

20	DNA sequencing, polyogemy	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem

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				Exam
21	DNA sequencing, polyogemy	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem

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				Exam
22	DNA sequencing, polyogemyprocedure	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
23	DNA sequencing, polyogemy	Lecture	MSB204. 3	Mid Term-1, Quiz & End Sem Exam
24	Micro array	Lecture	MSB204. 4	Quiz & End Sem Exam
25	Micro array	Lecture	MSB204. 4	Quiz & End Sem Exam
26	Micro array	Lecture	MSB204. 4	Quiz & End Sem Exam
27	DNA micro array marker, computational methods	Lecture	MSB204. 4	Quiz & End Sem Exam
28	DNA micro array marker, computational methods	Lecture	MSB204. 4	Quiz & End Sem Exam
29	DNA micro array marker, computational methods	Lecture	MSB204. 4	Quiz & End Sem Exam
30	Introduction to proteomics	Lecture	MSB204. 5	Quiz & End Sem Exam
31	Introduction to proteomics	Lecture	MSB204. 5	Quiz & End Sem Exam
32	Fundamental methods used in proteomics	Lecture	MSB204. 5	Quiz & End Sem Exam
33	Fundamental methods used in proteomics	Lecture	MSB204. 5	Quiz & End Sem Exam
34	Fundamental methods used in proteomics	Lecture	MSB204. 5	Quiz & End Sem Exam
35	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204. 5	Quiz & End Sem Exam
36	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204. 5	Quiz & End Sem Exam
37	2-D gel electrophoresis + mass spectroscopy 2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204. 5	Quiz & End Sem Exam
38	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204. 5	Quiz & End Sem Exam
39	Post translationalprotein modification	Lecture	MSB204. 6	Quiz & End Sem Exam
40	Post translationalprotein modification	Lecture	MSB204. 6	Quiz & End Sem Exam
41	Post translationalprotein modification	Lecture	MSB204. 6	Quiz & End Sem Exam
42	Post translationalprotein modification	Lecture	MSB204. 6	Quiz & End Sem Exam

43	Protein – protein interaction some examples	Lecture	MSB204. 7	Quiz & End Sem Exam

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44	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
45	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam

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46	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
47	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
48	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB204.1	Understand the basic of genomics, Anatomy of genomics and human genome project	3	3	1	3	1	1	1	-	2	1	3	1	-	1
MSB204.2	Able to understand gene expression, and mapping	3	3	**2**	3	1	-	-	-	2	1	3	1	-	1
MSB204.3	Learn different DNA markers	3	3	2	3	1	-	-	1	2	1	3	1	1	1
MSB204.4	Understand Microarray and their applications in analysis of gene expression	3	3	1	3	1	-	-	-	2	1	3	1	-	1
MSB204.5	Develop knowledge of fundamental techniques in proteomics.	3	3	1	3	1	-	-	-	2	1	3	1	-	1

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MSB204.6	Understand Post translational modification.	3	3	1	3	1	-	-	-	2	1	3	1	1	1
MSB204.7	Get detail knowledge and understanding of Protein – protein interaction.	3	3	1	3	1	-	-	-	2	1	3	1	1	1

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Amity Institute of Biotechnology I MID-SEMESTER (SEM –II) 2022-23		
Class: M.Sc Biotechnology II Semester		
Subject Name: MSB 204 Advanced Genomics & Proteomics	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

Student will be able to
CO1: Understand the basics of genomics, Anatomy of genomics and human genome project.
CO2: understand gene expression, and mapping.

CO Map	Question No.	Question	Marks
CO1	Q.1	Differentiate between genomics and proteomics.	3
CO1	Q.2a	Discuss the separation processes in genomics.	3
	Q.2b	Discuss the separation processes in proteomics.	3
CO1	Q.3	Discuss physical mapping and use of restriction enzymes.	6
CO2	Q.4	Discuss linkage mapping with suitable example.	3
CO2	Q.5a	Write a short note on phylogeny.	3
	Q.5b	How genomic study is useful in the identification of genomes?	3
CO2	Q 6	Discuss the role of recombination and recombinants in the linkage mapping.	6

Attainments		**Rubric**
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcomeattainment of the course **Advanced Genomics & Proteomics/MSB 204** is **level 3** for the

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academic year 2022-23.

Manish Kr

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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **COMPUTATIONAL BIOLOGY**
Course Code : MSB 205, Crédits : 03, Session :2022-23(Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** The objective is to describe how molecular data can be used to construct a phylogenetic tree and characterize the rates and causes of nucleotide substitutions. The aim is also to explain how a gene/protein family arises and the mechanisms, which underlie evolution at the molecular level.

B. **Course Outcomes:** After successful completion of the course student will be able to:
MSB 205.1 Understand and explain the development of computational biology.
MSB 205.2 Describe the fundamentals of bioinformatics databases and their application
MSB 205.3 Understand and explain the use of various computational methods for phylogenetic studies
MSB 205.4 Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling. Explain the applications of computational biology in different fields of sciences.

C. **Program Outcomes:**

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive

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clear instructions.

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PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context of technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term 1	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%

Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

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F. Syllabus

Module I: Introduction to Computational Biology. History of Bioinformatics
Module II: Bioinformatics Fundamentals

1. Major information Resources & Databases in Bioinformatics
 a. Information Resources: NCBI, EBI, ExPasy Entrez & SRS System
 b. Primary Sequence & Structure Databases: Genbank, SwissProt/Uniprot, EMBL, PIR, PDB, MMDB, NDB, CSD, KEGG etc.
 c. Derived (Secondry) Databases of Sequences and structure:
  i. Prosite, PRODOM, PRINTS, Pfam, BLOCK, INTERPRO etc.
  ii. SCOP, CATH, DSSP, FSSP, RNAbase,
 d. Genome Databases (at NCBI, EBI, TIGR, SANGER), High-throughput genomics sequence (EST, STS, GSS), ENSEMBL.
2. Sequence File formats: fasta, genbank, embl, Swiss-prot, pdb, nbrf, pir and multiple sequences formats (Aln, Mega, Pileup, phylip etc.)
3. Sequence Similarty Basics: Similarty, Indentity, Homology, Scoring, selectivity/Sensitivity, Gap cost, Linear and Affine Gap Penalty, Basic of scoring system and matrices (PAM, BIOSUM, GONNET etc.)
4. Pairwise Sequences Aligment: Brute Force method, Dot matrix method, Global (Needleman-Wunsch) and Local Alignment (Smith-Waterman) using Dynamic programming.
5. Scoring Matrices: Substitution Matrices, Concept log-odds, PAM & BLOSUM Series, Derivation of PAM & BLOSUM matrices, Distance and Similarity matrices.
6. Similarity Searching Tools: BLAST and FASTA, Theory and Algorithms, variants of BLAST and FASTA, PSI-BLAST and PHI BLAST, Statistical Significance.
7. Sequence Pattern and Profiles: Concepts of motif, pattern and profile, Profile construction and its application in Bioinformatics,

Module III: Computational Methods

Scoring methods of MSA (sum of pair, Multidimensional DP, Progressive, Iterative, Probabilistic)
Phylogenetics prediction mrthods: Basics, molecular clock, Substitution Models of evolution, Tree reconstruction methods (Distance based, character based method, statistical), Bootsstrapping.
Suffix tree and its applications in Bioinformatics
Gene Indentification Methods
Predictive Methods using DNA and Protein sequences.
Statistical Modeling: Log-likelihood, Bayesian network, Markov and hidden markov models.
Clustering Algorithms: K-means, Hierarchical and Mixture of Gaussion.

Module IV: Application and software tools

Software and Programmes for sequence comparison and analysis.
Phylogenetics analysis software.
Molecular Structure drawing tool.
Molecular modeling/Docking.
Application of computational biology/Bioinformatics in Agriculture, Human health, Enviroment, Biotechnology, Molecular Biology, Neurobiology, Drug Designing, Veterinary Science.

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;A: Attendance

H. Suggested Text/Reference Books:

Text:

- Bioinformatics: Sequence and Genome Analysis, D.W. Mount, Cold Spring Harbor Laboratory Press.

References:

- Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology, D. Gusfield, Cambridge University Press.
- Biocomputing hypertext coursebook at http://www.techfak.unibielefeld.de/bcd/Curric/welcome.html/
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, A.D. Baxevanis and B.F.F. Ouellette, Wiley-interscience.
- Computational Modeling of Genetic and Biochemical Networks, J.M. Bower and H. Bolouri, MIT Press
- Computational Molecular Biology: An Algorithmic Approach, P.A. Pevzner, MIT Press
- Computer Methods for Macromolecular Sequence Analysis, R.F. Doolittle, J.N, Abelson, M.I. Simon, Academic press
- Essentials of Genomics and Bioinformatics, C.W. Sensen, John Wiley and Sons Inc.
- Introduction to Bioinformatics, T. Attwood and D. Parry-Smith, Prentice Hall
- Introduction to Computational Biology: Maps, Sequences and Genomes, M. Waterman, Chapman and Hall
- Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit, G. V. Heijne and G.V. Heijne, Academic Press

I. Lecture Plan

Lecture	**Topics**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing CO**
1	Introduction to computational Biology & History of Bioinformatics	Lecture	**MSB 205.1**	Mid Term-1, Quiz & End Sem Exam
2	Major information Resources & Databases in Bioinformatics (a & b)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
3	Major information Resources & Databases in Bioinformatics (c & d)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
4	Sequence File formats & Multiple sequence formats	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
5	Sequence Similarity Basics	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
6	Basic of scoring system and matrices	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
7	Pairwise Sequences Aligment	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
8	Local Alignment	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
9	Scoring Matrices	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam

10	Similarity Searching Tools (BLAST)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
11	Similarity Searching Tools (FASTA)	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam

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12	Sequence Pattern and Profiles	Lecture	**MSB 205.2**	Mid Term-1, Quiz & End Sem Exam
13	Scoring methods of MSA	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
14	Phylogenetics prediction methods	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
15	Gene Identification Methods Predictive Methods using DNA and Protein sequences.	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
16	Statistical Modeling: Log-likelihood, Bayesian network, Markov	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
17	Hidden markov models	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
18	Clustering Algorithms: K-means, Hierarchical and Mixture of Gaussion	Lecture	**MSB 205.3**	Mid Term-1, Quiz & End Sem Exam
19	Software and Programmes for sequence comparison and analysis	Lecture	**MSB 205.4**	Mid Term-1, Quiz & End Sem Exam
20	Phylogenetics analysis software (I)	Lecture	**MSB 205.4**	Mid Term-1, Quiz & End Sem Exam
21	Molecular Structure drawing tool (I)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
22	Molecular Structure drawing tool (II)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
23	Molecular modeling/Docking (I)	Lecture	**MSB 205.4**	Mid Term-2, Quiz & End Sem Exam
24	Molecular modeling/Docking (II)	Lecture	**MSB 205.4**	Quiz & End Sem Exam
25	Application of computational biology/Bioinformatics in Agriculture	Lecture	**MSB 205.4**	Quiz & End Sem Exam
26	Application of computational biology/Bioinformatics in Human health	Lecture	**MSB 205.4**	Quiz & End Sem Exam
27	Application of computational biology/Bioinformatics in Human health	Lecture	**MSB 205.4**	Quiz & End Sem Exam

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28	Application of computational biology/Bioinformatics in Environment	Lecture	**MSB 205.4**	Quiz & End Sem Exam
29	Application of computational biology/Bioinformatics in Environment	Lecture	**MSB 205.4**	Quiz & End Sem Exam
30	Application of computational	Lecture	**MSB 205.4**	Quiz & End Sem

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	biology/Bioinformatics in Neurobiology			Exam
31	Application of computational biology/Bioinformatics in Neurobiology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
32	Application of computational biology/Bioinformatics in molecular Biology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
33	Application of computational biology/Bioinformatics in molecular Biology	Lecture	**MSB 205.4**	Quiz & End Sem Exam
34	Application of computational biology/Bioinformatics in Drug Designing	Lecture	**MSB 205.4**	Quiz & End Sem Exam
35	Application of computational biology/Bioinformatics in Drug Designing	Lecture	**MSB 205.4**	Quiz & End Sem Exam
36	Application of computational biology/Bioinformatics in Veterinary Science	Lecture	**MSB 205.4**	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB 205.1	Understand and explain the development of computational biology	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.2	Describe the fundamentals of bioinformatics databases and their application	3	3	3	1	1	-	-	1	2	1	3	1	3	1
MSB 205.3	Understand and explain the use of various computational methods for phylogentic studies	3	3	3	1	1	-	-	1	2	1	3	1	3	1

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MSB 205.3	Know the Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modelling. Explain the applications of computational biology in different fields of sciences	3	3	3	1	1	-	-	1	2	1	3	1	3	1

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<u>Sample Question Paper</u>

<table>
<tr><td colspan="7" align="center">Amity Institute of Biotechnology
MID-SEMESTER 2022-23</td></tr>
<tr><td colspan="7" align="center">Class: M.Sc. (Biotech) II Semester</td></tr>
<tr><td colspan="2">Subject Name:
MSB 205
Computational Biology</td><td colspan="3">Time: 2 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q. 1,4</td><td>Q. 2,3</td><td>Q. 4</td><td>Q. 2,5,6</td><td></td><td></td></tr>
<tr><td colspan="7">Student will be able to
CO1: Understand the broad perspective of computational biology in sequence analysis.
CO2: Utilize the types of molecular and literature databases
(HGT, ESTs, SNPs, Pubmed, Pubmed Central).</td></tr>
</table>

<table>
<tr><td>CO Map</td><td>Question No.</td><td>Question</td><td>Marks</td></tr>
<tr><td>CO1</td><td>Q.1</td><td>Explain in brief the fundamentals of computational biology.</td><td>3</td></tr>
<tr><td rowspan="2">CO1</td><td>Q.2a</td><td>What are different literature databases?</td><td>3</td></tr>
<tr><td>Q.2b</td><td>How literature databases are different from molecular databases.</td><td>3</td></tr>
<tr><td>CO1</td><td>Q.3</td><td>How nucleotide and protein data can be analyzed using database model?</td><td>6</td></tr>
<tr><td>CO2</td><td>Q.4</td><td>Explain the application of computational biology in disease diagnosis and treatment.</td><td>3</td></tr>
</table>

Attainments		**Rubric**
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Computational Biology/MSB 205** is **level 3** for the academic year 2022-23.

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Manish Km

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

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PROGRAM SPECIFIC OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3: Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MSB101	3	3	2	3	1	3	2	2	2	1

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED BIOCHEMISTRY
Course Code : MSB 101, Credits: 04, Session :2021-22 (Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** Objective of this course is to help students navigate the discipline of biochemistry that explains how the collection of inanimate molecules that constitute the living systems interact, to maintain and perpetuate life. This knowledge has its roots in medicine, nutrition, agriculture, fermentation and natural products chemistry. It also aims to provide an understanding of the principles and application of primary and secondary metabolites.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB101.1. Understand the basics of structures of biopolymers.

MSB101.2. Learn carbohydrate metabolism in detail by analyzing all the pathways.

MSB101.3. Learn the various aspects of lipid metabolism and their regulation.

MSB101.4. Understand the metabolism of Nitrogen and excretion of urea from body.

MSB101.5. Learn Nucleotide metabolism and clinical disorders of purine metabolism.

MSB101.6. Develop advanced knowledge of action of major hormones.

MSB101.7. Understand the principles and application of primary and secondary metabolites.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at theirworkplace.

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PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Basics of structures of biopolymers; Carbohydrates, Lipids, Proteins and Nucleic Acids.

Module II

Carbohydrates Metabolsm – I

Anaerobic processes in generating metabolic energy

Glycolysis, fates of pyruvate: Lactate and ethanol metabolism, regulation of glycolysis, glycogen mobilization, regulation of glycogen breakdown.

Oxidative processes: Pyruvate oxidation, coenzymes involved in pyruvate oxidation and citric acid cycle, action of PDH, Complex, Krebs Cycle, Regulation of PDH and Krebs Cycle, anaplerotic sequences, glyoxylate cycle, PPP, Human genetic disorder involving PPP enzymes.

ETC and OP: Electron carriers in respiratory chain, OP, enzyme system for ATP synthesis, chemiosmotic coupling.

Carbohydrate Metabolism – II

Gluconeogenesis. Ethanol consumption and gluconeogenesis, reciprocal regulation of glycolysis and gluconeogenesis, glycogen metabolism in humans, photosynthesis.

Module III: Lipid Metabolism

Utilization and transport of fat and cholesterol, lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain, control of fatty acid oxidation, biosynthesis of fatty acids, fatty acid desaturation, control of fatty acid synthesis, variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.

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Module IV: Nitrogen Metabolism
Utilization of ammonia – GDH, GS, transamination, Biosynthetic of amino acids, amino acids degradation, detoxification and excretion of ammonia, urea cycle, transport of ammonia to liver, porphyrin and hememetabolism – The succinate-glycine pathway, Biological Nitrogen fixation.

Module V: Nucleotide Metabolism
De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides, purine degradation and clinical disorders of purine metabolism (Gout, lesch – nyhan syndrome, immuno deficiency), pyrimidine breakdown, reduction of ribonucleotides to deoxyibonucleotides, thymidylate synthetase – a target enzyme for chemotheraphy.

Module VI: Integration of cellular metabolism and hormonal regulation
Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation.

Module VII: Secondary Plant Metabolism
Importance of secondary metabolites, terpenes, classification, mevalonic acid pathway, phenolic compounds, shikimic acid pathway, alkaloids.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox. , Worth Publishing

References:

- Harper's Biochemistry K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw Hill/ Appleton and Lange.
- Biochemistry (Fifth Edition), Lubert Stryer

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Basics of structures of Carbohydrates	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
2	Basics of structures of Carbohydrates	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
3	Basics of structures of Lipids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
4	Basics of structures of Lipids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
5	Basics of structures of Proteins	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
6	Basics of structures of Proteins	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
7	Basics of structures of Nucleic Acids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
8	Basics of structures of Nucleic Acids	Lecture	MSB101.1	Mid Term, Quiz & End Sem Exam
9	Anaerobic processes in generating metabolic energy	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
10	Glycolysis, fates of pyruvate: Lactate and ethanol metabolism	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
11	Glycolysis, fates of pyruvate: Lactate and ethanol metabolism	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
12	regulation of glycolysis, glycogen mobilization	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
13	glycogen breakdown	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
14	Oxidative processes: Pyruvate oxidation, coenzymes involved in pyruvate oxidation	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
15	citric acid cycle, action of PDH, Complex	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
16	Krebs Cycle, Regulation of PDH and Krebs Cycle, anaplerotic sequences	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
17	glyoxylate cycle, PPP, Human genetic disorder involving PPP enzymes.	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
18	ETC and OP: Electron carriers in respiratory chain, OP.	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
19	enzyme system for ATP synthesis, chemiosmotic coupling	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
20	Gluconeogenesis. Ethanol consumption and gluconeogenesis	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam

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21	reciprocal regulation of glycolysis and gluconeogenesis, glycogen metabolism in humans	Lecture	MSB101.2	Mid Term, Quiz & End Sem Exam
22	Photosynthesis	Lecture	MSB101.2	Mid Term, Quiz

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				& End Sem Exam
23	Utilization and transport of fat and cholesterol	Lecture	MSB101.3	Mid Term, Quiz & End Sem Exam
24	lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain	Lecture	MSB101.3	Mid Term, Quiz & End Sem Exam
25	lipoproteins, fatty acid oxidation, oxidation of unsaturated and odd numbered C chain	Lecture	MSB101.3	Quiz & End Sem Exam
26	control of fatty acid oxidation	Lecture	MSB101.3	Quiz & End Sem Exam
27	biosynthesis of fatty acids, fatty acid desaturation	Lecture	MSB101.3	Quiz & End Sem Exam
28	control of fatty acid synthesis	Lecture	MSB1013	Quiz & End Sem Exam
29	variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.	Lecture	MSB101.3	Quiz & End Sem Exam
30	variants of fatty acids synthesis that lead to antibiotics (polyketides), biosynthesis of TAG, biosynthesis of cholesterol.	Lecture	MSB101.3	Quiz & End Sem Exam
31	Utilization of ammonia, transamination	Lecture	MSB101.4	Quiz & End Sem Exam
32	Biosynthetic of amino acids, amino acids degradation	Lecture	MSB101.4	Quiz & End Sem Exam
33	detoxification and excretion of ammonia	Lecture	MSB101.4	Quiz & End Sem Exam
34	urea cycle, transport of ammonia to liver	Lecture	MSB101.4	Quiz & End Sem Exam
35	porphyrin and hememetabolism	Lecture	MSB101.4	Quiz & End Sem Exam
36	The succinate-glycine pathway, Biological Nitrogen fixation	Lecture	MSB101.4	Quiz & End Sem Exam
37	De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
38	De novo and salvage pathway for synthesis of pyrimidine and purine nucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
39	purine degradation and clinical disorders of purine metabolism (Gout, lesch – nyhan syndrome, immuno deficiency)	Lecture	MSB101.5	Quiz & End Sem Exam

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40	pyrimidine breakdown, reduction of ribonucleotides to deoxyribonucleotides	Lecture	MSB101.5	Quiz & End Sem Exam
41	pyrimidine breakdown, reduction of ribonucleotides to	Lecture	MSB101.5	Quiz & End Sem Exam

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	deoxyribonucleotides			
42	thymidylate synthetase – a target enzyme for chemotheraphy	Lecture	MSB101.5	Quiz & End Sem Exam
43	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
44	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
45	Action of major hormones (insulin, glucagon, epinephrine) responses to metabolic stresses: starvation	Lecture	MSB101.6	Quiz & End Sem Exam
46	Importance of secondary metabolites-terpenes, classification	Lecture	MSB101.7	Quiz & End Sem Exam
47	mevalonic acid pathway, phenolic compounds	Lecture	MSB101.7	Quiz & End Sem Exam
48	shikimic acid pathway, alkaloids	Lecture	MSB101.7	Quiz & End Sem Exam

J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB101.1.	Understand the basics of structures of biopolymers.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.2 .	Learn carbohydrate metabolism in detail by analyzing all the pathways.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1

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MSB101.3.	Learn the various aspects of lipid metabolism and their regulation.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.4.	Understand the metabolism of Nitrogen and excretion of urea from body.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.5 .	Learn Nucleotide metabolism and clinical disorders of purine metabolism.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.6 .	Develop advanced knowledge of action of major hormones.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1
MSB101.7 .	Understand the principles and application of primary and secondary metabolites.	3	3	2	3	-	-	1	2	3	**-**			3	2	-	1

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Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –I) 2021-22						
Class: M.Sc. Biotechnology I Semester						
Subject Name: MSB 101 ADVANCED BIOCHEMISTRY		Time: 1.5 Hrs		Max. Marks: 30		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biomolecules with examples.	3
CO1	Q.2a	What do you understand by phosphorylation?	3
	Q.2b	Discuss secondary metabolites in brief.	3
CO1	Q.3	Give an account of lipid transport in body.	6
CO2	Q.4	Explain the significance of urea cycle in clinics.	3
CO2	Q.5a	What are the factors favoring nucleic acid synthesis?	3
	Q.5b	Discuss the different factors affecting cholesterol synthesis.	3
CO2	Q 6	Phosphofructokinase I is the pace maker of glycolysis. Why?	6

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Biochemistry**/Course code **MSB-101** is level **3** for the academic year 2021-22.

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Amity Institute of Biotechnology
Course Handout
Course : Advanced Microbial Technology
Course Code : MSB102, Credits : 03, Session : 2022-23(Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Manish Kumar

A. **Introduction:** To acquaint the students to understand the basic concept of microbiology and role of various microorganisms in different biotechnological applications, various techniques for their cultivation and control.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB102.1. Study morphology, classification, forms, of bacteria, archaebacteria, mycoplasma and PPLO. Different types of media & their preparations. Isolation of pure cultures, maintenance and preservation. Culture characteristics and Bacterial growth, growth curve, batch and continuous cultures di auxic and synchronous growth enumeration of cells by direct and indirect methods.

MSB102.2. Able to understand the Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals, antiviral etc.

MSB102.3. Know about the Molecular classification of microbes, microbial genetics, prokaryotic gene organization, DNA, replication, transcription and translation. Microbial regulation of gene expression: trp and lac operon. Gene Transfer and Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics and Reproductive cycles of bacteriophage, T4 phage and lambda.

MSB102.4. Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms. Applications of microbiology in effective diagnosis, treatment and prevention of infectious disease.

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C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate the most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need for professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize students to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology,

advances in genetic engineering, bioprocess technology,

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advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

D. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves Including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

E. Syllabus

Module I: Introduction to Microbiology: Bacteria Morphology and classification. Abnormal forms of bacteria, archaebacteria, mycoplasma and PPLO, cultivation of bacteria nutritional requirements of microorganism, physical requirements, different types of media & their preparations. Isolation of pure cultures, maintenance and preservation of the pure cultures. Culture characteristics Bacterial growth Growth curve, batch and continuous cultures di-auxic and synchronous growth enumeration of cells by direct and indirect methods.

Module II: Control of Microorganisms: Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals, antiviral etc.

Module III: Microbial Genetics: Molecular classification of microbes, The Basics of microbial genetics, prokaryotic gene organization. The basic principles of microbial DNA, replication, transcription and translation. Microbial regulation of gene expression: the trp and lac operon. Gene Transfer Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics Reproductive cycles of bacteriophage, T4 and lambda.

Module IV: Medical Microbiology: Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms (bacteria, fungi, parasites, and viruses), applications of the basic principles of microbiology in effective diagnosis, treatment and prevention of infectious disease.

F. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

G. Suggested Text/Reference Books:

- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill
- General Microbiology, R.Y. Stanier, J.L. Ingraham, M. L. Wheelis and P.R. Painter, Macmillian

- Principles of Microbiology, R.M. Atlas, Wm C. Brown Publisher.
- The microbes An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing Benjamin Cummings.
- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin& Cummings.

H. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction to Microbiology	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
2	Discovery of Microbial World	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
3	Spontaneous Generation	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
4	Role of microbes in disease causation	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
5	Development of Pure Culture	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
6	Methods in Microbiology	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
7	Principle of Microbial Nutrition	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
8	Culture Media Types	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
9	Theory of Sterilization	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
10	Practice of Sterilization	Lecture	MSB 102.1	Mid Term, Quiz & End Sem Exam
11	Concept of Sterilization	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam

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12	Disinfection	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam

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13	Methods of Control	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
14	Chemotherapeutics	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
15	Mode of Action of Antibiotics	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
16	Penicillin and Ampicillin	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
17	Sulfonamide and Vanomycin	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
18	Streptomycin and Tatracycline	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
19	Chloramphenicol	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
20	Antifungals and Antivirals	Lecture	MSB 102.2	Mid Term, Quiz & End Sem Exam
21	Basics of Microbial Genetics and Prokaryotic gene organization	Lecture	MSB 102.3	Quiz & End Sem Exam
22	Principles of Microbial DNA	Lecture	MSB 102.3	Quiz & End Sem Exam
23	Replication, Transcription, Translation	Lecture	MSB 102.3	Quiz & End Sem Exam
24	Regulation of Gene Expression: Trp and Lac Operon	Lecture	MSB 102.3	Quiz & End Sem Exam
25	Transformation, Transduction, Conjugation	Lecture	MSB 102.3	Quiz & End Sem Exam
26	Plasmids and Transposons	Lecture	MSB 102.3	Quiz & End Sem Exam
27	Viral Genetics	Lecture	MSB 102.3	Quiz & End Sem Exam
28	Reproductive Cycles of Bacteriophage, T4 and Lambda	Lecture	MSB 102.3	Quiz & End Sem Exam

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29	Normal Microflora of Host	Lecture	MSB 102.4	Quiz & End Sem Exam

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30	Host Parasite Interactions	Lecture	MSB 102.4	Quiz & End Sem Exam
31	Mechanisms of Pathogenesis	Lecture	MSB 102.4	Quiz & End Sem Exam
32	Clinical manifestations associated to medically important pathogens	Lecture	MSB 102.4	Quiz & End Sem Exam
33	Applications of Microbiology	Lecture	MSB 102.4	Quiz & End Sem Exam
34	Diagnosis of Diseases	Lecture	MSB 102.4	Quiz & End Sem Exam
35	Treatment of different microbial diseases	Lecture	MSB 102.4	Quiz & End Sem Exam
36	Prevention of different microbial diseases	Lecture	MSB 102.4	Quiz & End Sem Exam

I. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4

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MSB 102.1	Study morphology, classification, forms of bacteria, archaebacteria, mycoplasma and PPLO. Different types of media & their preparations. Isolation of pure cultures, maintenance and preservation. Culture characteristics and Bacterial growth, growth curve, batch and continuous cultures di auxic and synchronous growth Eneumeration of	3	2	2	2	2	2	2	2	2	1	3	2	2	2

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	cells by direct and indirect methods.														
MSB 102.2	Able to understand the Concept of sterilization and disinfection. Physical and chemical methods of control. Chemotherapeutics mode of action of antibiotics, Penicillin, ampicillin, sulfonamide, vancomycin, streptomycine, tetracycline, chloramphenicol, antifungals antiviral	3	2	2	2	2	2	2	2	2	1	3	2	2	2
MSB 102.3	Know about the Molecular classification of microbes, microbial genetics, prokaryotic gene organization, DNA, replication, transcription and translation. Microbial regulation of gene expression: trp and lac operon. Gene Transfer and Genetic change: transformation, transduction, conjugation, plasmids, transposons. Viral Genetics and Reproductive cycles of bacteriophage, T4 phage and lambda.	3	2	2	2	2	2	2	2	2	1	3	2	2	2

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MSB 102.4	Normal microflora of host, host parasite interactions, mechanisms of pathogenesis, and clinical manifestations associated with medically-important pathogenic microorganisms (bacteria, fungi, parasites, and viruses),	3	2	2	2	2	2	2	2	2	1	3	2	2	2

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	applications of the basic principles of microbiology in effective diagnosis, treatment and prevention of infectious disease.														

Sample Question Paper

Amity Institute of Biotechnology MID-SEMESTER 2022-23						
Class: M.Sc. (Biotech) I Semester						
Subject Name: MSB 102 Advanced Microbial Technology		Time: 2 Hrs			Max. Marks: 30	
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q. 1,4	Q. 2,3	Q. 4	Q. 2,5,6		
Student will be able to CO1: List the broad perspective of microbiology and microbial technology. CO2: Apply the knowledge to different types of microbes (Bacteria, Virus, Algae, Fungus and Protozoa).						

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the microbial nutritional requirement.	3
CO1	Q.2a	What are different sterilization techniques?	3
	Q.2b	How the mode of action of Penicillin and chloramphenicol are different from each other?	3
CO1	Q.3	How Lactose Operon works in presence and absence of Lactose as a positive or negative regulation?	6
CO2	Q.4	Explain the application of microbiology in effective diagnosis, treatment and prevention of infectious diseases.	3

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Attainments		Rubric
Level	1	IF 60 % of students secure more than 60 % marks then level 1
Level	2	IF 70 % of students secure more than 60 % marks then level 2
Level	3	IF 80 % of students secure more than 60 % marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Microbial Technology/MSB 102** is **level 3** for the academic year 2022-23.

Manish Km

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

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advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MSB120	3	3	3	3	-	1	2	-	2	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY LAB
Course Code : MSB 120, Credits: 02, Session :2021-22 (Odd Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The aim is to extend advanced understanding of the qualitative and quantitative estimation of proteins and nucleic acids.

B. Course Outcomes: At the end of the course, students will be able to:

MSB120.1. Understand the practical based learning of estimation of proteins.

MSB120.2. Understand the practical based learning of enzyme activity.

MSB120.3. Understand the practical based learning of estimation of DNA & RNA.

MSB120.4. Understand the practical based learning of estimation of carbohydrate.

MSB120.5. Understand the practical based learning of estimation of lipid.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

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D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Proteins
Identification of protein by Biuret test.
Quantization of protein by Bradford method
Separation of proteins by SDS-PAGE
Module II: Enzyme
Enzyme activity study of serum alkaline phosphates.
Module III: Nucleic Acid
Biochemical estimation of DNA
Biochemical estimation of RNA
Separation of DNA on Agarose gel.
Module IV: Carbohydrate
Biochemical estimation of blood sugar
Module V: Lipids
Blood Cholesterol estimation.

G. Examination Scheme:

IA	**EE**

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Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Biuret test	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
4	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
5	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
6	quantitation of protein by Bradford method	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
7	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
8	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
9	Separation of proteins by SDS-PAGE	Practical	MSB120.1	Class Test (Practical Based) & End Sem Exam
10	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
11	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
12	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MSB120.2	Class Test (Practical Based) & End Sem Exam
13	Biochemical estimation of DNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam

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14	Biochemical estimation of DNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
15	Biochemical estimation of RNA	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
16	Biochemical estimation of RNA	Practical	MSB120.3	Class Test

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				(Practical Based) & End Sem Exam
17	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
18	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
19	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
20	Separation of DNA samples on Agarose gel	Practical	MSB120.3	Class Test (Practical Based) & End Sem Exam
21	Biochemical estimation of blood sugar	Practical	MSB120.4	Class Test (Practical Based) & End Sem Exam
22	Biochemical estimation of blood sugar	Practical	MSB120.4	Class Test (Practical Based) & End Sem Exam
23	Blood Cholesterol estimation	Practical	MSB120.5	Class Test (Practical Based) & End Sem Exam
24	Blood Cholesterol estimation	Practical	MSB120.5	Class Test (Practical Based) & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB120.1.	Understand the practical based learning of estimation of proteins.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.2.	Understand the practical based learning of enzyme activity.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.3.	Understand the practical based learning of estimation of DNA & RNA.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.4.	Understand the practical based learning of estimation of carbohydrate.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB120.5.	Understand the practical based learning of estimation of lipid.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Biochemistry Lab**/Course code **MSB-120** is level **3** for the academic year 2021-22.

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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

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PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology,

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advanced genomics and proteomics, computational biology, environmental biotechnology,

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advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:
1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MSB201	3	3	2	3	1	3	2	2	2	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED MOLECULAR BIOLOGY
Course Code : MSB 201, Credits: 04, Session :2021-22 (Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The objective of the course is to provide a clear understanding of DNA (genetic material) so that they can manipulate it and understand basic tools and techniques involved in its manipulation. Strong foundation in molecular biology enables the students to familiarize themselves with Genetic engineering technology.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB201.1. Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes.

MSB201.2. Learn the advanced mechanism of transcription in prokaryotes and eukaryotes.

MSB201.3. Develop understanding of various post-transcriptional processes in cell.

MSB201.4. Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes.

MSB201.5. Understand about the advances of gene expression regulation.

MSB201.6. Develop advanced knowledge of various mechanisms of gene silencing.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at theirworkplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: DNA replication and repair

DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork; termination of replication DNA repair, photo reaction, base excision repair, nucleotide excision repair, transcription coupled repair, mismatch repair , error pone repair recombinational repair.

Module II: Transcription of DNA

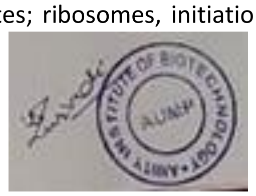
Transcription in prokaryotes and eukaryotes, RNA polymerase – Composition and function; transcription mechanism; transcription factor and their role, inhibition of RNA synthesis.

Module III: Processing of RNA

Procession of ribosomal and transfer RNA"s processing of mRNA-5'cap formation; 3' polyadenylation ; RNA splicing , RNA editing , RNA degradation.

Module IV: Translation

Translation mechanism in prokaryotes and eukaryotes; ribosomes, initiation of translation, elongation, termination, amino acid activation; translational recoding inhibitors, post translation modification of protein.



Module V: Regulation of gene expression

Regulation in prokaryotes – repressors and negative control, positive control, role of c AMP, Ampreceptor protein, lac, tryp, His and ara operons, Regulation in Eukaryotes=promoters and enhancers, transcriptional regulatory protein, transcriptional activators, eukaryotic repressor.

Module VI: Gene Silencing

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RNAi (SiRNA and MiRNA) molecular mechanism and current application in gene silencing, Antisense RNA technology, Biochemistry of ribozyme, Hammer head, hairpin ribozymes. Application of antisense and ribozymes in genetic engineering.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education

References:

- Genome, T.A. Brown, John Willey & Sons Inc.
- Molecular Biology of the Cell by Alberts Bruce, Bray Demos, and Watson James D.
- Gene VIII, Benjamin Lewin 2005, Oxford University Press
- Molecular Cell Biology, H. Lodish, A. Berk, S. Zipursky, P Matsundaira, D. Baltimore and J.E. Barnell, W.H. Freeman and Company.
- Molecular Cloning: A Laboratory Manual (3-Vilcume set), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold spring Harbor Laboratory Press.
- Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing.

Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley and Sons Inc.

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I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
2	DNA polymerases in prokaryotes and eukaryotes; replication protein, replication fork	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
3	termination of replication DNA repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
4	photo reaction	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
5	base excision repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
6	nucleotide excision repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
7	transcription coupled repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
8	mismatch repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
9	error pone repair, recombinational repair	Lecture	MSB201.1	Mid Term, Quiz & End Sem Exam
10	Transcription in prokaryotes and eukaryotes	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
11	Transcription in prokaryotes and eukaryotes	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
12	RNA polymerase – Composition and function	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
13	transcription mechanism	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
14	transcription mechanism	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
15	transcription factor and their role	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
16	inhibition of RNA synthesis	Lecture	MSB201.2	Mid Term, Quiz & End Sem Exam
17	Procession of ribosomal and transfer RNA	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
18	Procession of ribosomal and transfer RNA	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam

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19	processing of mRNA-5’cap formation	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
20	3’ polyadenylation	Lecture	MSB201.3	Mid Term, Quiz

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				& End Sem Exam
21	RNA splicing	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
22	RNA editing	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
23	RNA degradation	Lecture	MSB201.3	Mid Term, Quiz & End Sem Exam
24	Translation mechanism in prokaryotes and eukaryotes	Lecture	MSB201.4	Mid Term, Quiz & End Sem Exam
25	Translation mechanism in prokaryotes and eukaryotes	Lecture	MSB201.4	Quiz & End Sem Exam
26	ribosomes, initiation of translation	Lecture	MSB201.4	Quiz & End Sem Exam
27	Elongation	Lecture	MSB201.4	Quiz & End Sem Exam
28	termination	Lecture	MSB2014	Quiz & End Sem Exam
29	amino acid activation	Lecture	MSB201.4	Quiz & End Sem Exam
30	inhibitors, post translation modification of protein	Lecture	MSB201.4	Quiz & End Sem Exam
31	Regulation in prokaryotes	Lecture	MSB201.5	Quiz & End Sem Exam
32	repressors and negative control	Lecture	MSB201.5	Quiz & End Sem Exam
33	positive control, role of cAMP	Lecture	MSB201.5	Quiz & End Sem Exam
34	Ampreceptor protein	Lecture	MSB201.5	Quiz & End Sem Exam
35	Lac operon	Lecture	MSB201.5	Quiz & End Sem Exam
36	Tryp operon	Lecture	MSB201.5	Quiz & End Sem Exam
37	His operon	Lecture	MSB201.5	Quiz & End Sem Exam
38	His operon	Lecture	MSB201.5	Quiz & End Sem Exam
39	Regulation in Eukaryotes=promoters and enhancers	Lecture	MSB201.5	Quiz & End Sem Exam

40	transcriptional regulatory protein	Lecture	MSB201.5	Quiz & End Sem Exam

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41	transcriptional activators, eukaryotic repressor	Lecture	MSB201.5	Quiz & End Sem Exam
42	RNAi (SiRNA and MiRNA)	Lecture	MSB201.6	Quiz & End Sem

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				Exam
43	RNAi (SiRNA and MiRNA)	Lecture	MSB201.6	Quiz & End Sem Exam
44	molecular mechanism and current application in gene silencing	Lecture	MSB201.6	Quiz & End Sem Exam
45	Antisense RNA technology, Biochemistry of ribozyme	Lecture	MSB201.6	Quiz & End Sem Exam
46	Hammer head and hairpin ribozymes	Lecture	MSB201.6	Quiz & End Sem Exam
47	Application of antisense and ribozymes in genetic engineering	Lecture	MSB201.6	Quiz & End Sem Exam
48	Application of antisense and ribozymes in genetic engineering	Lecture	MSB201.6	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB201.1.	Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.2.	Learn the advanced mechanism of transcription in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.3.	Develop understanding of various post-transcriptional processes in cell.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.4.	Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB201.5.	Understand about the advances of gene expression regulation.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

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MSB201.6 .	Develop advanced knowledge of various mechanisms of gene silencing.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

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Sample Question Paper

Amity Institute of Biotechnology
I MID-SEMESTER (SEM –II) 2021-22

Class: M.Sc. Biotechnology II Semester

Subject Name: MSB 101 ADVANCED MOLECULAR BIOLOGY	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the types of nucleic acids with examples.	3
CO1	Q.2	What do you understand by semi conservative mode of DNA replication?	6
CO1	Q.3	Give an account of transcription termination in *E. coli*.	6
CO2	Q.4	Explain the significance of poly A tail in RNA.	3
CO2	Q.5a	tRNA acts as an adapter molecule in translation. Discuss.	3
	Q.5b	Discuss the different mechanisms of antisense technology.	3
CO2	Q 6	How does post-translation modification ensure the functionality of a protein? Discuss.	6

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Molecular Biology** /Course code **MSB-201** is level **3** for the academic year 2021-22.

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : **ADVANCED GENOMICS & PROTEOMICS**
Course Code : MSB 204, Crédits : 04, Session :2021-22(Even Sem.), Class : M.Sc. Ist Year
Faculty Name : Prof. (Dr.) Raghvendra Kumar Mishra

A. Introduction: The course helps in developing a detailed understanding of eukaryotic genome complexity and organization. Current research on the molecular basis of the control of gene expression in eukaryotic has developed a detailed understanding of techniques of gene diagnostics and DNA profile to acquire the fundamental of genomics and bioinformatics, it is desirable to have in depth study on these lines.

B. Course Outcomes: At the end of the course, students will be able to:

MSB204.1 Understand the basic of genomics, Anatomy of genomics and human genome project
MSB204.2 Able to understand gene expression, and mapping
MSB204.3 Learn different DNA markers
MSB204.4 Understand Microarray and their applications in analysis of gene expression
MSB204.5 Develop knowledge of fundamental techniques in proteomics.
MSB204.6 Understand Post translational modification.
MSB204.7 Get detail knowledge and understanding of Protein – protein interaction.

C. Programme Outcomes:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.
PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.
PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.
PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.
PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.
PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.
PO7. Independent thinking: Inculcation of ability to think independently for problem solving.
PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.
PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct attheir workplace.
PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Introduction to Genomics: The human genome project "Anatomy of prokaryotic and eucaryotic genome: repetitive DNA and RNA Contents of genoms.

Module II
Transcriptomics and metatranscriptomics: Introduction , method and uses.genetic mapping

Module III
Microsatellite DNA markers, RFLP, DNA sequencing, polyogemy,

Module IV
Micro array: DNA micro array  marker, computational methods.

PART-II: PROTEOMICS

Module V
Introduction to proteomics
Fundamental methods used in proteomics. 2-D gel electrophoresis + mass spectroscopy.

Module VI
Post translationalprotein modification

Module VII
Protein – protein interaction some examples

G. Examination Scheme:

Components	**A**	**CT**	**S/V/Q/HA**	**EE**
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Genes & Genomes, Maxine Singer and Paul Berg
- Genomes II, T.A. Brown

References:

- A Primer of Genome Science, Greg Gibson and Spencer V. Muse
- Database Annotation in Molecular Biology: Principles and Practice, Arthur M. Lesk
- DNA: Structure and Function, Richard R. Sinden
- Recombinant DNA (Second Edition), James D. Watson and Mark Zoller
- Gene Cloning and DNA Analysis – An introduction (Fourth Edition), T.A. Brown
- www.panimatext.com

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Correspon ding CO	Mode of Assessing CO
1	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
2	Introduction to Genomics:	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
3	Human Genome project	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
4	Human Genome project	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam

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5	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
6	Anatomy of prokaryotic and eucaryotic genome	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
7	repetitive DNA and RNA	Lecture	MSB204.1	Mid Term-1, Quiz

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	Contents of genoms			& End Sem Exam
8	repetitive DNA and RNA Contents of genoms	Lecture	MSB204.1	Mid Term-1, Quiz & End Sem Exam
9	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
10	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
11	Transcriptomics and metatranscriptomics	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
12	Introduction , method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
13	Introduction , method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
14	Introduction , method and uses.genetic mapping	Lecture	MSB204.2	Mid Term-1, Quiz & End Sem Exam
15	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
16	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
17	Microsatellite DNA markers	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
18	RFLP	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
19	RFLP	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
20	DNA sequencing, polyogemy	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
21	DNA sequencing, polyogemy	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
22	DNA sequencing, polyogemyprocedure	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
23	DNA sequencing, polyogemy	Lecture	MSB204.3	Mid Term-1, Quiz & End Sem Exam
24	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam
25	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam
26	Micro array	Lecture	MSB204.4	Quiz & End Sem Exam
27	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam
28	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam

29	DNA micro array marker, computational methods	Lecture	MSB204.4	Quiz & End Sem Exam

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30	Introduction to proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
31	Introduction to proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
32	Fundamental methods	Lecture	MSB204.5	Quiz & End Sem

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	used in proteomics			Exam
33	Fundamental methods used in proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
34	Fundamental methods used in proteomics	Lecture	MSB204.5	Quiz & End Sem Exam
35	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
36	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
37	2-D gel electrophoresis + mass spectroscopy 2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
38	2-D gel electrophoresis + mass spectroscopy	Lecture	MSB204.5	Quiz & End Sem Exam
39	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
40	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
41	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
42	Post translationalprotein modification	Lecture	MSB204.6	Quiz & End Sem Exam
43	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
44	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
45	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
46	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
47	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam
48	Protein – protein interaction some examples	Lecture	MSB204.7	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES										CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
MSB204.1	Understand the basic of genomics, Anatomy of genomics and human genome project	3	3	1	3	1	1	1	-	2	1	3	1	-	1
MSB204.2	Able to understand gene expression, and mapping	3	3	**2**	3	1	-	-	-	2	1	3	1	-	1
MSB204.3	Learn different DNA markers	3	3	2	3	1	-	-	1	2	1	3	1	1	1
MSB204.4	Understand Microarray and their applications in analysis of gene expression	3	3	1	3	1	-	-	-	2	1	3	1	-	1
MSB204.5	Develop knowledge of fundamental techniques in proteomics.	3	3	1	3	1	-	-	-	2	1	3	1	-	1
MSB204.6	Understand Post translational modification.	3	3	1	3	1	-	-	-	2	1	3	1	1	1
MSB204.7	Get detail knowledge and understanding of Protein – protein interaction.	3	3	1	3	1	-	-	-	2	1	3	1	1	1

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Sample Question Paper

<table>
<tr><td colspan="7" align="center">Amity Institute of Biotechnology
I MID-SEMESTER (SEM –II) 2021-22</td></tr>
<tr><td colspan="7" align="center">Class: M.Sc. Biotechnology II Semester</td></tr>
<tr><td colspan="2">Subject Name:
MSB 204 ADVANCED GENOMICS AND PROTEOMICS</td><td colspan="3">Time: 1.5 Hrs</td><td colspan="2">Max. Marks: 30</td></tr>
<tr><td>Levels of the questions as per Blooms Taxonomy</td><td>Remembering</td><td>Understanding</td><td>Applying</td><td>Analyzing</td><td>Evaluating</td><td>Creating</td></tr>
<tr><td>Question Mapping</td><td>Q.1,4</td><td>Q.2,3</td><td>Q.4</td><td>Q.2,5,6</td><td></td><td></td></tr>
</table>

<table>
<tr><th>CO Map</th><th>Question No.</th><th>Question</th><th>Marks</th></tr>
<tr><td>CO1</td><td>Q.1</td><td>Describe the characteristics of prokaryote genomes.</td><td>3</td></tr>
<tr><td rowspan="2">CO1</td><td>Q.2a</td><td>What do you understand by microarray?</td><td>3</td></tr>
<tr><td>Q.2b</td><td>Explain the basic principle and technique of iso-electric focusing.</td><td>3</td></tr>
<tr><td>CO1</td><td>Q.3</td><td>Describe Mass Spectroscopy: its principle and application.</td><td>6</td></tr>
<tr><td>CO2</td><td>Q.4</td><td>What are different post-translational modifications?</td><td>3</td></tr>
<tr><td rowspan="2">CO2</td><td>Q.5a</td><td>What is the importance of sequencing project?</td><td>3</td></tr>
<tr><td>Q.5b</td><td>Discuss the interactions stabilize the 3-dimensional folding of a protein structure.</td><td>3</td></tr>
<tr><td>CO2</td><td>Q 6</td><td>Discuss the significances of a SSR Marker.</td><td>6</td></tr>
</table>

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Advanced Genomics and Proteomics**/Course code **MSB-204** is level **3** for the academic year 2021-22.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR

AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology,

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advanced genomics and proteomics, computational biology, environmental biotechnology,

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advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MSB220	3	3	2	3	1	3	2	2	2	3

AMITY UNIVERSITY
MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ADVANCED MOLECULAR BIOLOGY LAB
Course Code : MSB 220, Credits: 02, Session :2021-22 (Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend the advanced understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB220.1. Understand the practical based learning of isolation of nucleic acids and DNA protein interaction.

MSB220.2. Understand the practical based learning in-vitro transcription, translation and repair mechanism.

MSB220.3. Understand the practical based learning of PCR and Gradient PCR.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

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D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

1. Isolation of genomic DNA from prokaryotic and Eukaryotes.
2. Isolation of plasmid.
3. Study of DNA protein interaction.
4. Study of in vitro transcription.
5. Study of DNA methylation.
6. Study of DNA repair mechanism.
7. Invitro study of translation
8. Isolation of RNA
9. PCR and Gradient PCR

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:

Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

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I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of genomic DNA from prokaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
2	Isolation of genomic DNA from prokaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of genomic DNA from eukaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
4	Isolation of genomic DNA from eukaryotes	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
5	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
6	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
7	Isolation of plasmid	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
8	Study of DNA protein interaction	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
9	Study of DNA protein interaction	Practical	MSB220.1	Class Test (Practical Based) & End Sem Exam
10	Study of in vitro transcription	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
11	Study of in vitro transcription	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
12	Study of DNA methylation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
13	Study of DNA methylation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam

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14	Study of DNA repair mechanism	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
15	Study of DNA repair mechanism	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
16	Invitro study of translation	Practical	MSB220.2	Class Test

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				(Practical Based) & End Sem Exam
17	Invitro study of translation	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
18	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
19	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
20	Isolation of RNA	Practical	MSB220.2	Class Test (Practical Based) & End Sem Exam
21	PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
22	PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
23	Gradient PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam
24	Gradient PCR	Practical	MSB220.3	Class Test (Practical Based) & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB220.1.	Understand the practical based learning of isolation of nucleic acids and DNA protein interaction.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB220.2.	Understand the practical based learning in-vitro transcription, translation and repair mechanism.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB220.3.	Understand the practical based learning of PCR and Gradient PCR.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Molecular Biology Lab**/Course code **MSB-220** is level **3** for the academic year 2021-22.

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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
III SEM	MSB302	3	3	2	3	1	3	2	2	2	1

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENZYME TECHNOLOGY
Course Code : MSB 302, Credits: 03, Session :2021-22 (Odd Sem.), Class : M.Sc. 2nd Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The course aims to provide an understanding of the principles and application of proteins, secondary metabolites and enzyme biochemistry in therapeutic applications and clinical diagnosis. The theoretical understanding of biochemical systems would certainly help to interpret the results of laboratory experiments.

B. **Course Outcomes:** At the end of the course, students will be able to:
MSB302.1. Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action.
MSB302.2. Understand about various modes of inhibition of enzyme actions with examples.
MSB302.3. Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc.
MSB302.4. Learn enzyme reactors and various parameters for bio-process design.
MSB302.5. Learn about the concepts of bio-process design.
MSB302.6. Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at theirworkplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Enzymes

Introduction and scope, Nomenclature, Mechanism of Catalysis, enzyme catalysis in organic media, Industrial applications.

Module II: Enzyme Kinetics

Single substrate steady state kinetics; King-Altman's method; Inhibitors and activators; Multi-substrate systems; Effect of pH and temperature; Allosteric enzymes. Thermodynamic explanation for transition complex formation, limitations of Michaelis – Menten equation, LB plot method to study enzyme kinetics, effect of pH

And temperature on kinetics,allosteric enzyme kinetics,models as WMC, KNF with examples of ACTase and Hb.

Module III: Immobilization of Enzymes

Advantages, Carriers, adsorption, covalent coupling, cross-linking and entrapment methods, Micro-environmental effects

Module IV: Enzyme Reactors

Reactors for batch/continuous enzymatic processing, Choice ot reactor type: idealized enzyme reactor systems; Mass Transfer in Enzyme Reactors: Steady state analysis of mass transfer and biochemical reaction in enzyme reactors.

Module V: Bio-process Design

Physical parameters, reactor operational stability; Immobilized cells.

Module VI: Challenges and future trends

Catalytic antibodies and Non-protein biomolecules as catalysts, Biocatalysts from Extreme Thermoph!lic and HyperthermophilicArchaea and Bacteria.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Enzyme Technology, M.F. Chaplin and C. Bucke, Cambridge University Press.

References:

- Biotechnological Innovations in Chemical Synthesis, R.C.B. Currell, V.D. Mieras, Biotol Partners Staff, Butterworth Heinemann.
- Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis, R.A. Copeland, John Wiley and Sons Inc.
- Enzymes Biochemistry, Biotechnology, Clinical Chemistry, Trevor Palner
- Enzyme Kinetics: Behaviour and Analysis of Rapid Equilibrium and Steady State Enzyme Systems, I.H. Segel, Wiley-Interscience
- Industrial Enzymes & their applications, H. Uhlig, John Wiley and Sons Inc

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction and scope	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
2	Nomenclature	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
3	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
4	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
5	Mechanism of Catalysis	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
6	enzyme catalysis in organic media	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
7	Industrial applications	Lecture	MSB302.1	Mid Term, Quiz & End Sem Exam
8	Single substrate steady state kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
9	Single substrate steady state kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
10	King-Altman's method	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
11	Inhibitors and activators	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
12	Multi-substrate systems	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam

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13	Effect of pH and temperature	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
14	Allosteric enzymes	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam

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15	Thermodynamic explanation for transition complex formation	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
16	limitations of Michaelis – Menten equation	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
17	LB plot method to study enzyme kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
18	effect of pH and temperature on kinetics	Lecture	MSB302.2	Mid Term, Quiz & End Sem Exam
19	allosteric enzyme kinetics	Lecture	MSB302.2	Quiz & End Sem Exam
20	models as WMC, KNF with examples of ACTase and Hb	Lecture	MSB302.2	Quiz & End Sem Exam
21	models as WMC, KNF with examples of ACTase and Hb	Lecture	MSB302.2	Quiz & End Sem Exam
22	Advantages, Carriers, adsorption	Lecture	MSB302.3	Quiz & End Sem Exam
23	covalent coupling, cross-linking and entrapment methods	Lecture	MSB302.3	Quiz & End Sem Exam
24	covalent coupling, cross-linking and entrapment methods	Lecture	MSB302.3	Quiz & End Sem Exam
25	Micro-environmental effects	Lecture	MSB302.3	Quiz & End Sem Exam
26	Reactors for batch/continuous enzymatic processing	Lecture	MSB302.4	Quiz & End Sem Exam
27	Choice of reactor type: idealized enzyme reactor systems	Lecture	MSB302.4	Quiz & End Sem Exam
28	Mass Transfer in Enzyme Reactors	Lecture	MSB302.4	Quiz & End Sem Exam
29	Steady state analysis of mass transfer	Lecture	MSB302.4	Quiz & End Sem Exam
30	biochemical reaction in enzyme reactors	Lecture	MSB302.4	Quiz & End Sem Exam
31	Physical parameters	Lecture	MSB302.5	Quiz & End Sem Exam
32	reactor operational stability	Lecture	MSB302.5	Quiz & End Sem Exam
33	Immobilized cells	Lecture	MSB302.5	Quiz & End Sem Exam
34	Catalytic antibodies and Non-protein biomolecules as catalysts	Lecture	MSB302.6	Quiz & End Sem Exam
35	Biocatalysts from Extreme Thermophilic bacteria	Lecture	MSB302.6	Quiz & End Sem Exam
36	Hyperthermophilic Archaea and Bacteria	Lecture	MSB302.6	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB302.1.	Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.2.	Understand about various modes of inhibition of enzyme actions with examples.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.3.	Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.4.	Learn enzyme reactors and various parameters for bio-process design.	3	3	2	3	-	-	1	2	3	-			3	2	-	1
MSB302.5.	Learn about the concepts of bio-process design.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

MSB30 2.6.	Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.	3	3	2	3	-	-	1	2	3	-			3	2	-	1

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Sample Question Paper

Amity Institute of Biotechnology I MID-SEMESTER (SEM –III) 2021-22		
Class: M.Sc. Biotechnology III Semester		
Subject Name: MSB 302 ENZYME TECHNOLOGY	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Discuss in brief about the nomenclature of Enzymes.	3
CO1	Q.2	Explain the Lineweaver Burk plot & its significance.	6
CO1	Q.3	Give a brief account on enzyme kinetics.	6
CO2	Q.4	Briefly discuss the properties of an inhibitor.	3
CO2	Q.5a	Discuss the acid-base catalysis in brief.	3
	Q.5b	What is reversible inhibition? Discuss in brief.	3
CO2	Q 6	Discuss the Michaelis-Menten equation. Derive the double reciprocal plot with this equation.	6

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Enzyme Technology**/Course code **MSB-302** is level **3** for the academic year 2021-22.

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Science (M. Sc.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology,

advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
III SEM	MSB321	3	3	2	3	1	3	2	2	2	1

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : ENZYME TECHNOLOGY LAB
Course Code : MSB 321, Credits: 01, Session :2021-22 (Odd Sem.), Class : M.Sc. 2^{nd} Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend advanced understanding of isolation, recovery, and immobilization of enzymes.

B. **Course Outcomes:** At the end of the course, students will be able to:

MSB321.1. Understand the practical based learning of Isolation of industrially important microorganisms and growth curve.

MSB321.2. Understand the practical based learning ethanol production, production of antibiotics and fermentation.

MSB321.3. Understand the practical based learning of downstream processing.

MSB321.4. Understand the practical based learning of enzyme assay, enzyme purification and kinetics.

MSB321.5. Understand the practical based learning of enzyme production and immobilization.

C. **Programme Outcomes:**

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at theirworkplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

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D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Isolation of industrially important microorganisms for microbial processes.
Determination of Thermal Death Point and Thermal death time of microorganisms for design of a sterilizer
Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.

Module II
Comparative studied of ethanol production using different substrates.
Microbial production of antibiotics (Penicillin)
Production and estimation of alkaline protease
Sauer Krant fermentation

Module III: Downstream processing
Conventional filtration
Protein precipitation and recovery
Aqueous two-phase separation
Ion exchange chromatography
Gel filtration
Membrane based filtration i.e. Micro filtration and cross filtration in cross flow Modules.

Module IV
Isolation of Enzymes from plant and microbial sources.
Enzyme assay; activity and specific activity – determination of amylase, nitrate reductase, cellulose, protease.

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Purification of Enzyme by ammonium sulphate fractionation.
Enzyme Kinetics: Effect of varying substrate concentration on enzyme activity
Effect of Temperature and pH on enzyme activity.
Module V
Production of enzyme on industrial scale using solid and state fermentation
Enzyme immobilization

G. Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:
Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

References:

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of industrially important microorganisms for microbial processes.	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
2	Determination of Thermal Death Point and Thermal death time of microorganisms for design of a sterilizer	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
3	Determination of growth curve of a supplied microorganism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained	Practical	MSB321.1	Class Test (Practical Based) & End Sem Exam
4	Comparative studied of ethanol production using different substrates. Microbial production of antibiotics (Penicillin)	Practical	MSB321.2	Class Test (Practical Based) & End Sem Exam

5	Production and estimation of alkaline protease Sauer Krant fermentation	Practical	MSB321.2	Class Test (Practical Based) & End Sem Exam
6	Conventional filtration Protein precipitation and recovery	Practical	MSB321.3	Class Test (Practical Based) & End Sem Exam
7	Aqueous two-phase separation	Practical	MSB321.3	Class Test

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	Ion exchange chromatography Gel filtration			(Practical Based) & End Sem Exam
8	Membrane based filtration i.e. Micro filtration and cross filtration in cross flow Modules.	Practical	MSB321.3	Class Test (Practical Based) & End Sem Exam
9	Isolation of Enzymes from plant and microbial sources. Enzyme assay; activity and specific activity – determination of amylase, nitrate reductase, cellulose, protease.	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
10	Purification of Enzyme by ammonium sulphate fractionation. Enzyme Kinetics: Effect of varying substrate concentration on enzyme activity	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
11	Effect of Temperature and pH on enzyme activity	Practical	MSB321.4	Class Test (Practical Based) & End Sem Exam
12	Production of enzyme on industrial scale using solid and state fermentation Enzyme immobilization	Practical	MSB321.5	Class Test (Practical Based) & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MSB321.1.	Understand the practical based learning of Isolation of industrially important microorganisms and growth curve.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.2.	Understand the practical based learning ethanol production, production of antibiotics and fermentation.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.3.	Understand the practical based learning of downstream processing.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.4.	Understand the practical based learning of enzyme assay, enzyme purification and kinetics.	3	3	3	3	-	1	2	-	2	2			3	3	-	1
MSB321.5.	Understand the practical based learning of enzyme production and immobilization.	3	3	3	3	-	1	2	-	2	2			3	3	-	1

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Enzyme Technology Lab**/Course code **MSB-321** is level **3** for the academic year 2021-22.

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AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Technology (M. Tech.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M. Tech. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and

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immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MTB101	3	3	3	3	3	1	2	2	2	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY AND METABOLIC REGULATION
Course Code : MTB 101, Credits: 04, Session :2021-22 (Odd Sem.), Class : M.Tech. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The objectives of the Metabolic Biochemistry course are to provide a comprehensive understanding of human metabolism in areas of enzymology and protein structure and function; energy releasing and energy consuming metabolic processes; the regulation of synthesis and breakdown of sugars, lipids, nucleic acids, and amino acids which is necessary for further work in the biochemical/biomedical and biotechnology areas.

B. Course Outcomes: At the end of the course, students will be able to:

MTB101.1. Learn and understand the structure of biomolecules from their monomers to polymers.

MTB101.2. Learn the metabolism of biomolecules at advanced level and they will be able to interconnect these pathways.

MTB101.3. Learn about different levels of regulation of enzymes in metabolic pathways.

MTB101.4. Learn regulation of various metabolic pathways and diseases due to mis regulation of metabolic pathways.

C. Programme Outcomes:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

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D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I

Structure of Biomolecules, Metabolism of Carbohydrates, Lipids, Proteins, Amino acids and Nucleic acids.

Module II

Photosynthesis in Microorganisms; Role of chlorophylls, carotenoids and phycobilins; Calvin cycle; Chemolithotrophy; hydrogen-iron-nitrite-oxidizing bacteria; nitrate and sulfate reduction; methanogenesis and acetogenesis; Bacterial fermentations.

Module III:Modes of Regulation

Different levels of regulation - protein synthesis/degradation, allosteric regulation, reversible covalent modification, proteolytic processing, Requirements for ATP in synthesis and degradation cycle, Reversibility of the different methods of regulation, Consequences of misregulation

Module IV: Regulation of metabolic pathways

Glycolysis/glycogenolysis, Phosphogluconate/Citric Acid Cycle, Oxidative Phosphorylation, Fatty acid oxidation, Fatty Acid Biosynthesis, Amino Acid Oxidation, Regulation of Metabolism for the production of Primary and Secondary Metabolites with case studies

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Principles of Biochemistry by A. Lehninger revised by Nelson and Cox.
- Biochemistry by Mathews, Van Holde and Ahern. IIIrd Edition.

References:

- "Biochemistry" by White, Handler and R.B. Smith 7th Ed. 1983
- Biochemistry" by L.Stryer Third Edition.
- Biochemistry by Voet and Voet.
- Fundamentals of Biochemistry by Conn and Stumph.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Structure of Biomolecules	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
2	Structure of Biomolecules	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
3	Structure of Biomolecules	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
4	Metabolism of Carbohydrates	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
5	Metabolism of Carbohydrates	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
6	Metabolism of Carbohydrates	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
7	Metabolism of Lipids	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
8	Metabolism of Lipids	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
9	Metabolism of Proteins	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
10	Metabolism of Proteins	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam

11	Metabolism of Amino acids	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam

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12	Metabolism of Nucleic acids	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
13	Metabolism of Nucleic acids	Lecture	MTB101.1	Mid Term, Quiz & End Sem Exam
14	Photosynthesis in Microorganisms	Lecture	MTB101.2	Mid Term, Quiz

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				& End Sem Exam
15	Photosynthesis in Microorganisms	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
16	Role of chlorophylls	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
17	carotenoids and phycobilins	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
18	Calvin cycle	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
19	Chemolithotrophy; hydrogen- iron- nitrite-oxidizing bacteria	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
20	Chemolithotrophy; hydrogen- iron- nitrite-oxidizing bacteria	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
21	nitrate and sulfate reduction	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
22	methanogenesis and acetogenesis	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
23	Bacterial fermentations	Lecture	MTB101.2	Mid Term, Quiz & End Sem Exam
24	Different levels of regulation	Lecture	MTB101.3	Mid Term, Quiz & End Sem Exam
25	protein synthesis/degradation	Lecture	MTB101.3	Quiz & End Sem Exam
26	protein synthesis/degradation	Lecture	MTB101.3	Quiz & End Sem Exam
27	allosteric regulation	Lecture	MTB101.3	Quiz & End Sem Exam
28	reversible covalent modification	Lecture	MTB101.3	Quiz & End Sem Exam
29	proteolytic processing	Lecture	MTB101.3	Quiz & End Sem Exam
30	Requirements for ATP in synthesis and degradation cycle	Lecture	MTB101.3	Quiz & End Sem Exam
31	Requirements for ATP in synthesis and degradation cycle	Lecture	MTB101.3	Quiz & End Sem Exam
32	Requirements for ATP in synthesis and degradation cycle	Lecture	MTB101.3	Quiz & End Sem Exam
33	Requirements for ATP in synthesis and degradation cycle	Lecture	MTB101.3	Quiz & End Sem Exam
34	Consequences of misregulation	Lecture	MTB101.3	Quiz & End Sem Exam
35	Glycolysis	Lecture	MTB101.4	Quiz & End Sem Exam
36	Glycogenolysis	Lecture	MTB101.4	Quiz & End Sem Exam

37	Phosphogluconate	Lecture	MTB101.4	Quiz & End Sem Exam

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38	Citric Acid Cycle	Lecture	MTB101.4	Quiz & End Sem Exam
39	Oxidative Phosphorylation	Lecture	MTB101.4	Quiz & End Sem

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				Exam
40	Oxidative Phosphorylation	Lecture	MTB101.4	Quiz & End Sem Exam
41	Fatty acid oxidation	Lecture	MTB101.4	Quiz & End Sem Exam
42	Fatty Acid Biosynthesis	Lecture	MTB101.4	Quiz & End Sem Exam
43	Amino Acid Oxidation	Lecture	MTB101.4	Quiz & End Sem Exam
44	Amino Acid Oxidation	Lecture	MTB101.4	Quiz & End Sem Exam
45	regulation of Metabolism for the production of Primary and Secondary Metabolites	Lecture	MTB101.4	Quiz & End Sem Exam
46	regulation of Metabolism for the production of Primary and Secondary Metabolites	Lecture	MTB101.4	Quiz & End Sem Exam
47	regulation of Metabolism for the production of Primary and Secondary Metabolites	Lecture	MTB101.4	Quiz & End Sem Exam
48	Discussion/Revision	Lecture	MTB101.4	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MTB101.1.	Learn and understand the structure of biomolecules from their monomers to polymers.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB101.2.	Learn the metabolism of biomolecules at advanced level and they will be able to interconnect these pathways.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB101.3.	Learn about different levels of regulation of enzymes in metabolic pathways.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB101.4.	Learn regulation of various metabolic pathways and diseases due to mis regulation of metabolic pathways.	3	3	2	3	-	-	1	2	3	-			3	2	1	1

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Amity Institute of Biotechnology
I MID-SEMESTER (SEM –I) 2021-22

Class: M.Tech. Biotechnology I Semester

Subject Name: MTB 101 BIOCHEMISTRY AND METABOLIC REGULATION	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the biomolecules with examples.	3
CO1	Q.2a	What do you understand by phosphorylation?	3
	Q.2b	Discuss secondary metabolites in brief.	3
CO1	Q.3	Give an account of lipid transport in body.	6
CO2	Q.4	Explain the significance of urea cycle in clinics.	3
CO2	Q.5a	What are the factors favoring nucleic acid synthesis?	3
	Q.5b	Discuss the different factors affecting cholesterol synthesis.	3
CO2	Q 6	Phosphofructokinase I is the pacemaker of glycolysis. Why?	6

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry and Metabolic Regulation**/Course code **MTB-101** is level **3** for the academic year 2021-22.

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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Technology (M. Tech.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M. Tech. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and

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immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I SEM	MTB120	3	3	3	3	3	1	2	2	2	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : BIOCHEMISTRY AND METABOLIC REGULATION
Course Code : MTB 120, Credits: 02, Session :2021-22 (Odd Sem.), Class : M.Tech. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend advanced understanding of the qualitative and quantitative estimation of carbohydrates, proteins, lipids and nucleic acids.

B. **Course Outcomes:** At the end of the course, students will be able to:
MTB120.1. Understand the practical based learning of estimation of proteins.
MTB120.2. Understand the practical based learning of enzyme activity.
MTB120.3. Understand the practical based learning of estimation of DNA & RNA.
MTB120.4. Understand the practical based learning of estimation of carbohydrate.
MTB120.5. Understand the practical based learning of estimation of lipid.

C. **Programme Outcomes:**

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

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D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I: Proteins

Identification of protein by Biuret test, quantitation of protein by Bradford method, Separation of proteins by SDS-PAGE, Enzyme: Determination of serum alkaline phosphatase activity

Module II: Nucleic Acid

Biochemical estimation of DNA, RNA. Separation of DNA samples on Agarose gel.

Carbohydrate: Colour reactions of different type of carbohydrates, Biochemical estimation of blood sugar

Lipids: Blood Cholesterol estimation.

G. Examination Scheme:

IA	**EE**

Class Test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment/Spotting	Practical Record	Viva
15	10	05	35	15	10	10

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CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Vikas Shrivastava. Laboratory Procedures in Biotechnology, Vol.II; Biochemistry, Methods and Instrumentation in Biotechnology, Enzymology & Enzyme Technology. Vayu Education of India, New Delhi 2016 (ISBN 978-93-85077-44-9).

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Identification of protein by Biuret test	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
2	Identification of protein by Biuret test	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
3	Identification of protein by Biuret test	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
4	quantitation of protein by Bradford method	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
5	quantitation of protein by Bradford method	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
6	quantitation of protein by Bradford method	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
7	Separation of proteins by SDS-PAGE	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
8	Separation of proteins by SDS-PAGE	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
9	Separation of proteins by SDS-PAGE	Practical	MTB120.1	Class Test (Practical Based) & End Sem Exam
10	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MTB120.2	Class Test (Practical Based) & End Sem Exam

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11	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MTB120.2	Class Test (Practical Based) & End Sem Exam
12	Enzyme: Determination of serum alkaline phosphatase activity	Practical	MTB120.2	Class Test (Practical Based) & End Sem Exam
13	Biochemical estimation of DNA	Practical	MTB120.3	Class Test (Practical Based)

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				& End Sem Exam
14	Biochemical estimation of DNA	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
15	Biochemical estimation of RNA	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
16	Biochemical estimation of RNA	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
17	Separation of DNA samples on Agarose gel	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
18	Separation of DNA samples on Agarose gel	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
19	Separation of DNA samples on Agarose gel	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
20	Separation of DNA samples on Agarose gel	Practical	MTB120.3	Class Test (Practical Based) & End Sem Exam
21	Colour reactions of different type of carbohydrates	Practical	MTB120.4	Class Test (Practical Based) & End Sem Exam
22	Colour reactions of different type of carbohydrates	Practical	MTB120.4	Class Test (Practical Based) & End Sem Exam
23	Biochemical estimation of blood sugar	Practical	MTB120.5	Class Test (Practical Based) & End Sem Exam
24	Blood Cholesterol estimation	Practical	MTB120.5	Class Test (Practical Based) & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MTB120.1.	Understand the practical based learning of estimation of proteins.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB120.2.	Understand the practical based learning of enzyme activity.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB120.3.	Understand the practical based learning of estimation of DNA & RNA.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB120.4.	Understand the practical based learning of estimation of carbohydrate.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB120.5.	Understand the practical based learning of estimation of lipid.	3	3	3	3	-	1	2	-	2	2			3	3	2	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Biochemistry and Metabolic Regulation Lab**/Course code **MTB-120** is level **3** for the academic year 2021-22.

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PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Technology (M. Tech.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M. Tech. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and

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immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MTB201	3	3	3	3	3	1	2	2	2	2

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : CELL AND MOLECULAR BIOLOGY
Course Code : MTB 201, Credits: 04, Session :2021-22 (Even Sem.), Class : M.Tech. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. Introduction: The object of the present course is to develop basic knowledge and skills in cell and molecular biology and to understand the structure and function of the cellular and sub cellular components of cells and tissues with the help of recent techniques. This course will help students to get an understanding of cell function at the molecular level including the fundamentals of DNA They will become aware of the complexity and harmony of the cell. Applications of cellular and molecular biology in Biotechnology will also be presented.

B. Course Outcomes: At the end of the course, students will be able to:

MTB201.1. Learn various aspects of protein targeting and transportation of small molecules across the membrane by different means.

MTB201.2. Learn and understand the cell cycle with check points.

MTB201.3. Learn and understand intracellular signaling mechanisms.

MTB201.4. Learn the mechanism of replication of DNA both in prokaryotes and eukaryotes and repair mechanisms processed by the cell.

MTB201.5. Learn in detail about the mechanism of transcription and post-transcriptional processes in prokaryotes and eukaryotes.

MTB201.6. Learn and understand the mechanism translation, gene expression regulation in prokaryotes and eukaryotes as well as gene silencing.

C. Programme Outcomes:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

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PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

D. **Programme Specific Outcomes:**

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. **Assessment Plan:**

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal	Mid Term	CT	15%

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Evaluation	Seminar/Viva-	S/V/Q/HA	10%

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	Voce/Quiz/Home Assignment		
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

Module I
Protein targeting - Chemical and physical properties of cell membranes and their major components, significance of these properties to membrane structure, integral and peripheral membrane proteins, biosynthesis of membrane and secreted proteins; targeting of proteins to membranes.
Module II
Membrane transport/Cell Cycle - Mechanisms for transport of small molecules across the membrane, including simple diffusion, facilitative diffusion, primary and secondary active transport, action of ionophores. Cell cycle and the events associated with each stage, control of the cell cycle and the proteins involved; know the role of the cyclins and cyclin-dependent kinases, cell cycle checkpoints, methods for synchronizing the cell cycle in cell populations.
Module III
Intracellular Signaling I - define growth, growth factor, growth factor receptor, mitogen, receptor, effector, second messenger, action of hormones and other biologically active agents that act via receptors in the nucleus and/or cytoplasm. Intracellular Signaling II - the intracellular signaling cascades triggered by hormone binding to these receptor, G proteins signalling, the action of Ca 2+ and diacylglycerol as second messengers.
Module IV: Replication
Replication of DNA, Role of DNA polymerases & proteins involved in DNA replication, Compare and contrast eukaryote and prokaryote DNA replication, telomeres, telomerase and altered telomerase function in aging and disease.
Recombination & Repair: Mutations and types of site mutations: substitution, transition, transversion, insertion, deletion, tautomer, frameshift and nonsense mutation. Repair mechanisms: dimer repair, excision repair, mismatch repair, trans-lesion repair, and recombinational repair.
Module V
Transcription **-** RNA transcription and the proteins required for each step, maturation of the RNA transcript derived from a eukaryotic gene, structure of prokaryote and eukaryote promoter and the function of promoter sequences, inhibitors of prokaryote and eukaryote transcription and their mechanisms of action. Concept of operon, inducer, operator and polycistronic transcript, expression of the lac operon and trp operon in *E. coli,* catabolite repression, leader peptide and attenuator site, enhancer and transcription factors, four common DNA-binding motifs found in transcription factors, mRNA stability and alternative splicing in gene expression
Module VI: Translation
Genetic code and the concept of colinearity of the gene and protein, components required for translation, basic steps involved in initiation, elongation, and termination of protein translation, translational recoding, inhibitors of protein translation. Compare and contrast the spatial and temporal differences in prokaryotic and eukaryotic transcription and translation

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G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Molecular Cell Biology by Bruce Albert
- Molecular Biology by Lodish Darnell and Baltimore
- Molecular Biology of the gene by Watson et al 4th ed.

References:

- Genes VIII by Benjamin Lewis
- Genetics by Ursula Goodenough
- Cytogenetics by l Garl P. Swanson, Mertz & Young
- Biochemistry by Stryer
- Genome by T.A. Brown, John Willey and Sons Inc.

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Protein targeting	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
2	Chemical and physical properties of cell membranes and their major components	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
3	Chemical and physical properties of cell membranes and their major components	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
4	significance of these properties to membrane structure	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
5	integral and peripheral membrane proteins	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
6	biosynthesis of membrane and secreted proteins	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
7	biosynthesis of membrane and secreted proteins	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
8	targeting of proteins to membranes	Lecture	MTB201.1	Mid Term, Quiz & End Sem Exam
9	Membrane transport	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
10	Mechanisms for transport of small molecules across the membrane	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam

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11	including simple diffusion, facilitative diffusion, primary and secondary active transport,	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam

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	action of ionophores			
12	including simple diffusion, facilitative diffusion, primary and secondary active transport, action of ionophores	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
13	Cell cycle and the events associated with each stage	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
14	control of the cell cycle and the proteins involved	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
15	know the role of the cyclins and cyclin-dependent kinases	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
16	cell cycle checkpoints	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
17	methods for synchronizing the cell cycle in cell populations	Lecture	MTB201.2	Mid Term, Quiz & End Sem Exam
18	Intracellular Signaling I	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
19	define growth, growth factor, growth factor receptor, mitogen, receptor, effector, second messenger	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
20	define growth, growth factor, growth factor receptor, mitogen, receptor, effector, second messenger	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
21	action of hormones and other biologically active agents that act via receptors in the nucleus and/or cytoplasm	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
22	action of hormones and other biologically active agents that act via receptors in the nucleus and/or cytoplasm	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
23	Intracellular Signaling II - the intracellular signaling cascades triggered by hormone binding to these receptor	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
24	Intracellular Signaling II - the intracellular signaling cascades triggered by hormone binding to these receptor	Lecture	MTB201.3	Mid Term, Quiz & End Sem Exam
25	G proteins signalling	Lecture	MTB201.3	Quiz & End Sem Exam
26	the action of Ca^{2+} and diacylglycerol as second messengers	Lecture	MTB201.3	Quiz & End Sem Exam

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27	Replication of DNA	Lecture	MTB201.4	Quiz & End Sem Exam

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28	Role of DNA polymerases & proteins involved in DNA replication	Lecture	MTB201.4	Quiz & End Sem Exam
29	Compare and contrast eukaryote and prokaryote DNA replication	Lecture	MTB201.4	Quiz & End Sem Exam
30	telomeres, telomerase and altered telomerase function in aging and disease	Lecture	MTB201.4	Quiz & End Sem Exam
31	Recombination & Repair: Mutations and types of site mutations: substitution, transition, transversion, insertion, deletion, tautomer, frameshift and nonsense mutation.	Lecture	MTB201.4	Quiz & End Sem Exam
32	Recombination & Repair: Mutations and types of site mutations: substitution, transition, transversion, insertion, deletion, tautomer, frameshift and nonsense mutation.	Lecture	MTB201.4	Quiz & End Sem Exam
33	Repair mechanisms: dimer repair, excision repair, mismatch repair, trans-lesion repair, and recombinational repair.	Lecture	MTB201.4	Quiz & End Sem Exam
34	Repair mechanisms: dimer repair, excision repair, mismatch repair, trans-lesion repair, and recombinational repair.	Lecture	MTB201.4	Quiz & End Sem Exam
35	Transcription - RNA transcription and the proteins required for each step, maturation of the RNA transcript	Lecture	MTB201.5	Quiz & End Sem Exam
36	Transcription - RNA transcription and the proteins required for each step, maturation of the RNA transcript	Lecture	MTB201.5	Quiz & End Sem Exam
37	structure of prokaryote and eukaryote promoter and the function of promoter sequences, inhibitors of prokaryote and eukaryote transcription and their mechanisms of action	Lecture	MTB201.5	Quiz & End Sem Exam

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38	Concept of operon, inducer, operator and polycistronic transcript, expression of the lac operon and trp operon in *E. coli*	Lecture	MTB201.5	Quiz & End Sem Exam

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39	Concept of operon, inducer, operator and polycistronic transcript, expression of the lac operon and trp operon in *E. coli*	Lecture	MTB201.5	Quiz & End Sem Exam
40	catabolite repression, leader peptide and attenuator site, enhancer and transcription factors	Lecture	MTB201.5	Quiz & End Sem Exam
41	four common DNA-binding motifs found in transcription factors, mRNA stability and alternative splicing in gene expression	Lecture	MTB201.5	Quiz & End Sem Exam
42	four common DNA-binding motifs found in transcription factors, mRNA stability and alternative splicing in gene expression	Lecture	MTB201.5	Quiz & End Sem Exam
43	Genetic code and the concept of colinearity of the gene and protein	Lecture	MTB201.6	Quiz & End Sem Exam
44	components required for translation, basic steps involved in initiation	Lecture	MTB201.6	Quiz & End Sem Exam
45	elongation, and termination of protein translation	Lecture	MTB201.6	Quiz & End Sem Exam
46	translational recoding, inhibitors of protein translation	Lecture	MTB201.6	Quiz & End Sem Exam
47	Compare and contrast the spatial and temporal differences in prokaryotic and eukaryotic transcription and translation	Lecture	MTB201.6	Quiz & End Sem Exam
48	Compare and contrast the spatial and temporal differences in prokaryotic and eukaryotic transcription and translation	Lecture	MTB201.6	Quiz & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MTB201.1.	Learn various aspects of protein targeting and transportation of small molecules across the membrane by different means.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB201.2.	Learn and understand the cell cycle with check points.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB201.3.	Learn and understand intracellular signaling mechanisms.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB201.4.	Learn the mechanism of replication of DNA both in prokaryotes and eukaryotes and repair mechanisms processed by the cell.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB201.5.	Learn in detail about the mechanism of transcription and post-transcriptional processes in prokaryotes and eukaryotes.	3	3	2	3	-	-	1	2	3	-			3	2	1	1

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MTB201.6.	Learn and understand the mechanism translation, gene expression regulation in prokaryotes and eukaryotes as well as gene silencing.	3	3	2	3	-	-	1	2	3	-			3	2	1	1

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<u>Sample Question Paper</u>

Amity Institute of Biotechnology I MID-SEMESTER (SEM –II) 2021-22						
Class: M.Tech. Biotechnology II Semester						
Subject Name: MTB 101 CELL AND MOLECULAR BIOLOGY		Time: 1.5 Hrs		Max. Marks: 30		
Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Explain in brief the types of nucleic acids with examples.	3
CO1	Q.2	What do you understand by semi conservative mode of DNA replication?	6
CO1	Q.3	Give an account of transcription termination in *E. coli*.	6
CO2	Q.4	Explain the significance of poly A tail in RNA.	3
CO2	Q.5a	tRNA acts as an adapter molecule in translation. Discuss.	3
	Q.5b	Discuss the different mechanisms of antisense technology.	3
CO2	Q 6	How does post-translation modification ensure the functionality of a protein? Discuss.	6

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Cell and Molecular Biology**/Course code **MTB-201** is level **3** for the academic year 2021-22.

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AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Technology (M. Tech.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M. Tech. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and

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immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put "- "

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MTB204	3	3	3	3	3	1	2	2	2	2

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AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : GENOMICS AND PROTEOMICS
Course Code : MTB 204, Credits: 04, Session :2021-22 (Even Sem.), Class : M.Tech. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The course helps in developing a detailed understanding of eukaryotic genome complexity and organization. Current research on the molecular basis of the control of gene expression in eukaryotic has developed a detailed understanding of techniques of gene diagnostics and DNA profile to acquire the fundamental of genomics and bioinformatics, it is desirable to have in depth study on these lines.

B. **Course Outcomes:** At the end of the course, students will be able to:

MTB204.1. Learn various aspects of prokaryotic and eukaryotic genomes.

MTB204.2. Learn and understand the advanced concepts of transcriptomes.

MTB204.3. Learn and understand the sequencing projects.

MTB204.4. Learn the basics of proteomics, protein folding and engineering.

MTB204.5. Learn in detail about the methods in proteomics, Post translational protein modifications and Protein – protein interaction.

MTB204.6. Learn and understand the computer simulations and Denovo design.

C. **Programme Outcomes:**

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-longlearning.

PO8: Ability to communicate effectively and develop scientific writing.

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PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

GENOMICS

Module I: Introduction to Genomics

Anatomy of prokaryotic and eukaryotic genome. Contents of genomes, Repetitive DNA. Bioinformatics for the analysis of sequence data.

Module II: Transcriptomes

Genome expression; RNA Contents, genetic mapping, Microsatellite DNA markers, RFLP, DNA sequencing, PCR, Micro array: DNA micro array marker, random primers, computational methods.

Module III

Strategies for large-scale sequencing projects. The structure, function and evolution of the human genome. The human genome project. Human disease genes.

PROTEOMICS

Module IV

Introduction to proteomics. Protein structure: secondary structural elements, super-secondary structure, domains, mechanisms of protein folding, tertiary folds. Formation of oligomers. Protein solubility and interaction with solvents and solutes. The activity of proteins. Protein engineering principles.

Module V

Fundamental methods used in proteomics, Relationship between protein structure and function. Post translational protein modifications. Protein – protein interaction.

Module VI

Use of computer simulations and knowledge-based methods in the design process. De-novo design; making use of databases of sequence and structure.

G. Examination Scheme:

Components	A	CT	S/V/Q/HA	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

H. Suggested Text/Reference Books:

Text:

- Genomes II, T.A. Brown
- Recombinant DNA (Second Edition), James D. Watson and Mark Zoller

References:

- A Primer of Genome Science, Greg Gibson and Spencer V. Muse
- Database Annotation in Molecular Biology: Principles and Practice, Arthur M. Lesk
- Gene Cloning and DNA Analysis – An introduction (Fourth Edition), T.A. Brown
- Genes & Genomes, Maxine Singer and Paul Berg
- DNA: Structure and Function, Richard R. Sinden

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Anatomy of prokaryotic and eukaryotic genome	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
2	Anatomy of prokaryotic and eukaryotic genome	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
3	Anatomy of prokaryotic and eukaryotic genome	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
4	Contents of genomes	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
5	Contents of genomes	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
6	Repetitive DNA	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
7	Bioinformatics for the analysis of sequence data	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
8	Bioinformatics for the analysis of sequence data	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
9	Genome expression	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
10	RNA Contents, genetic mapping	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
11	Microsatellite DNA markers, RFLP	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
12	DNA sequencing	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
13	PCR	Lecture	MTB202.1	Mid Term, Quiz & End Sem Exam
14	Micro array: DNA	Lecture	MTB202.2	Mid Term, Quiz & End Sem Exam
15	micro array marker	Lecture	MTB202.2	Mid Term, Quiz & End Sem Exam
16	random primers	Lecture	MTB202.2	Mid Term, Quiz & End Sem Exam
17	computational methods	Lecture	MTB202.2	Mid Term, Quiz & End Sem Exam
18	Strategies for large-scale sequencing projects	Lecture	MTB202.2	Mid Term, Quiz & End Sem Exam
19	Strategies for large-scale sequencing projects	Lecture	MTB202.2	Mid Term, Quiz & End Sem Exam
20	The structure, function and evolution of the human genome	Lecture	MTB202.2	Mid Term, Quiz & End Sem Exam
21	The structure, function and evolution of the human genome	Lecture	MTB202.2	Mid Term, Quiz & End Sem Exam

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22	The human genome project	Lecture	MTB202.2	Mid Term, Quiz & End Sem Exam
23	The human genome project	Lecture	MTB202.2	Mid Term, Quiz & End Sem Exam
24	Human disease genes	Lecture	MTB202.3	Mid Term, Quiz

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				& End Sem Exam
25	Introduction to proteomics	Lecture	MTB202.3	Quiz & End Sem Exam
26	Protein structure	Lecture	MTB202.3	Quiz & End Sem Exam
27	secondary structural elements	Lecture	MTB202.3	Quiz & End Sem Exam
28	super-secondary structure	Lecture	MTB202.3	Quiz & End Sem Exam
29	domains, mechanisms of protein folding	Lecture	MTB202.3	Quiz & End Sem Exam
30	tertiary folds. Formation of oligomers	Lecture	MTB202.3	Quiz & End Sem Exam
31	Protein solubility and interaction with solvents and solutes	Lecture	MTB202.3	Quiz & End Sem Exam
32	The activity of proteins	Lecture	MTB202.3	Quiz & End Sem Exam
33	Protein engineering principles.	Lecture	MTB202.3	Quiz & End Sem Exam
34	Fundamental methods used in proteomics	Lecture	MTB202.3	Quiz & End Sem Exam
35	Fundamental methods used in proteomics	Lecture	MTB202.4	Quiz & End Sem Exam
36	Relationship between protein structure and function	Lecture	MTB202.4	Quiz & End Sem Exam
37	Relationship between protein structure and function	Lecture	MTB202.4	Quiz & End Sem Exam
38	Post translational protein modifications	Lecture	MTB202.4	Quiz & End Sem Exam
39	Post translational protein modifications	Lecture	MTB202.4	Quiz & End Sem Exam
40	Protein – protein interaction	Lecture	MTB202.4	Quiz & End Sem Exam
41	Protein – protein interaction	Lecture	MTB202.4	Quiz & End Sem Exam
42	Use of computer simulations and knowledge-based methods in the design process	Lecture	MTB202.4	Quiz & End Sem Exam
43	Use of computer simulations and knowledge-based methods in the design process	Lecture	MTB202.4	Quiz & End Sem Exam
44	Use of computer simulations and knowledge-based methods in the design process	Lecture	MTB202.4	Quiz & End Sem Exam

45	De-novo design	Lecture	MTB202.4	Quiz & End Sem Exam

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46	De-novo design	Lecture	MTB202.4	Quiz & End Sem Exam
47	making use of databases of sequence and structure	Lecture	MTB202.4	Quiz & End Sem Exam
48	making use of databases of sequence	Lecture	MTB202.4	Quiz & ESE

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MTB204.1.	Learn various aspects of prokaryotic and eukaryotic genomes.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB204.2.	Learn and understand the advanced concepts of transcriptomes.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB204.3.	Learn and understand the sequencing projects.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB204.4.	Learn the basics of proteomics, protein folding and engineering.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB204.5.	Learn in detail about the methods in proteomics, Post translational protein modifications and Protein – protein interaction.	3	3	2	3	-	-	1	2	3	-			3	2	1	1
MTB204.6.	Learn and understand the computer simulations and Denovo design.	3	3	2	3	-	-	1	2	3	-			3	2	1	1

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Sample Question Paper

Amity Institute of Biotechnology
I MID-SEMESTER (SEM –II) 2021-22

Class: M.Tech. Biotechnology II Semester

Subject Name: MTB 204 GENOMICS AND PROTEOMICS	Time: 1.5 Hrs	Max. Marks: 30

Levels of the questions as per Blooms Taxonomy	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Question Mapping	Q.1,4	Q.2,3	Q.4	Q.2,5,6		

CO Map	Question No.	Question	Marks
CO1	Q.1	Describe the characteristics of prokaryote genomes.	3
CO1	Q.2a	What do you understand by microarray?	3
	Q.2b	Explain the basic principle and technique of iso-electric focusing.	3
CO1	Q.3	Describe Mass Spectroscopy: its principle and application.	6
CO2	Q.4	What are different post-translational modifications?	3
CO2	Q.5a	What is the importance of sequencing project?	3
	Q.5b	Discuss the interactions stabilize the 3-dimensional folding of a protein structure.	3
CO2	Q 6	Discuss the significances of a SSR Marker.	6

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Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Genomics and Proteomics**/Course code **MTB-204** is level **3** for the academic year 2021-22.

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AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Master of Technology (M. Tech.) Biotechnology, Academic Year – 2021-22

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M. Tech. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and

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immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

Note: - Correlation levels 1, 2 and 3 as defined below:

1: Slight (Low), 2: Moderate (Medium) and 3 : Substantial (High)

If there is no correlation, put “- “

PROGRAMME ARTICULATION MATRIX											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
II SEM	MTB220	3	3	3	3	3	1	2	2	2	2

AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY INSTITUTE OF BIOTECHNOLOGY
Course Handout
Course : CELL AND MOLECULAR BIOLOGY LAB
Course Code : MTB 220, Credits: 02, Session :2021-22 (Even Sem.), Class : M.Sc. 1st Year
Faculty Name : Dr. Anurag Jyoti

A. **Introduction:** The aim is to extend advanced understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

B. **Course Outcomes:** At the end of the course, students will be able to:

MTB220.1. Understand the practical based learning of isolation of nucleic acids and study of apoptosis.

MTB220.2. Understand the practical based learning of cell organelle isolation, in-vitro transcription, translation and repair mechanism.

MTB220.3. Understand the practical based learning of site-directed mutagenesis and RNA isolation.

C. **Programme Outcomes:**

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

D. Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

E. Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by a studentto be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	A	5%
End Semester Examination	End Semester Examination	EE	70%
Total			**100%**

F. Syllabus

1. Isolation of genomic DNA from prokaryotic and Eukaryotes
2. Isolation of plasmid.
3. Study of apoptosis by TUNEL method
4. Isolation of cell organelles by ultracentrifugation.
5. Study of in vitro transcription.
6. Study of DNA repair mechanism
7. Site-directed mutagenesis
8. Isolation of RNA

G. Examination Scheme:

IA			**EE**			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

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H. Suggested Text/Reference Books:

Text:

- Rajesh Singh Tomar, Anurag Jyoti and Raghvendra Kumar Mishra. Laboratory Procedures in Biotechnology, Vol.III; Molecular Biology, Genetics, RDT & Structural Biology. Vayu Education of India, New Delhi 2016 (ISBN 93-86000-10-5).

References:

Molecular Cloning: A Laboratory Manual (3 Vol Set): 4Th Edition. ISBN-10: 9781621821045

I. Lecture Plan

Lecture	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Isolation of genomic DNA from prokaryotic and Eukaryotes	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
2	Isolation of genomic DNA from prokaryotic and Eukaryotes	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
3	Isolation of genomic DNA from prokaryotic and Eukaryotes	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
4	Isolation of plasmid	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
5	Isolation of plasmid	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
6	Isolation of plasmid	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
7	Study of apoptosis by TUNEL method	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
8	Study of apoptosis by TUNEL method	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
9	Study of apoptosis by TUNEL method	Practical	MTB220.1	Class Test (Practical Based) & End Sem Exam
10	Isolation of cell organelles by ultracentrifugation	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
11	Isolation of cell organelles by ultracentrifugation	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam

12	Isolation of cell organelles by ultracentrifugation	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
13	Study of in vitro transcription	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam

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14	Study of in vitro transcription	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
15	Study of in vitro transcription	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
16	Study of DNA repair mechanism	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
17	Study of DNA repair mechanism	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
18	Study of DNA repair mechanism	Practical	MTB220.2	Class Test (Practical Based) & End Sem Exam
19	Site-directed mutagenesis	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam
20	Site-directed mutagenesis	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam
21	Site-directed mutagenesis	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam
22	Isolation of RNA	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam
23	Isolation of RNA	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam
24	Isolation of RNA	Practical	MTB220.3	Class Test (Practical Based) & End Sem Exam

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J. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAMME OUTCOMES												CORRELATION WITH PROGRAMME SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10			PSO1	PSO2	PSO3	PSO4
MTB220.1.	Understand the practical based learning of isolation of nucleic acids and study of apoptosis.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB220.2.	Understand the practical based learning of cell organelle isolation, in-vitro transcription, translation and repair mechanism.	3	3	3	3	-	1	2	-	2	2			3	3	2	1
MTB220.3.	Understand the practical based learning of site-directed mutagenesis and RNA isolation.	3	3	3	3	-	1	2	-	2	2			3	3	2	1

Attainments		Rubric
Level	1	IF 60% of students secure more than 60% marks then level 1
Level	2	IF 70% of students secure more than 60% marks then level 2
Level	3	IF 80% of students secure more than 60% marks then level 3

Course outcome: Based on internal and external assessment the level of Course outcome attainment of the course **Cell and Molecular Biology Lab**/Course code **MTB-220** is level **3** for the academic year 2021-22.

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