



**AMITY UNIVERSITY**  
— R A J A S T H A N —

**Master of Technology (Biotechnology)**

**Programme Code: MTB**

**Duration – 2 Years Full Time**

**Programme Structure  
And  
Curriculum & Scheme of Examination  
With  
Choice Based Credit System (CBCS)  
2021-23 Batch**

**AMITY UNIVERSITY**  
**RAJASTHAN**

## PREAMBLE

Amity University aims to achieve academic excellence by providing multi-faceted education to students and encourage them to reach the pinnacle of success. The University has designed a system that would provide rigorous academic programme with necessary skills to enable them to excel in their careers.

This booklet contains the Programme Structure, the Detailed Curriculum and the Scheme of Examination. The Programme Structure includes the courses (Core and Elective), arranged semester wise. The importance of each course is defined in terms of credits attached to it. The credit units attached to each course has been further defined in terms of contact hours i.e. Lecture Hours (L), Tutorial Hours (T), Practical Hours (P). Towards earning credits in terms of contact hours, 1 Lecture and 1 Tutorial per week are rated as 1 credit each and 2 Practical hours per week are rated as 1 credit. Thus, for example, an L-T-P structure of 3-0-0 will have 3 credits, 3-1-0 will have 4 credits, and 3-1-2 will have 5 credits.

The Curriculum and Scheme of Examination of each course includes the course objectives, course contents, scheme of examination and the list of text and references. The scheme of examination defines the various components of evaluation and the weightage attached to each component. The different codes used for the components of evaluation and the weightage attached to them are:

<u>Components</u>	<u>Codes</u>	<u>Weightage (%)</u>
Case Discussion/ Presentation/ Analysis	C	05 - 10
Home Assignment	H	05 - 10
Project	P	05 - 10
Seminar	S	05 - 10
Viva	V	05 - 10
Quiz	Q	05 - 10
Class Test	CT	10 - 15
Attendance	A	05
End Semester Examination	EE	70

It is hoped that it will help the students study in a planned and a structured manner and promote effective learning. Wishing you an intellectually stimulating stay at Amity University.

July, 2021

## PROGRAMME OVERVIEW

Biotechnology in the present scenario is helping by showing advancement in diagnosis of a disease by helping us to move forward from primitive Symptomatic Treatment to modern Molecular Treatment along with rapid organization and analysis of biological data possible (Bioinformatics), Marine and aquatic applications of Biotechnology used to improve cleanup of toxic spills, improve yields of fisheries (Blue Biotechnology), Agricultural use of Biotechnology, heading towards the production of crops in not only good quantity but also with good quality (Green Biotechnology), Medicine including designing of organisms to produce antibiotics and the engineering of genetic cures through genomic manipulation (Red Biotechnology), Exemplified by the designing of an organism to produce useful chemicals, use of enzymes as industrial catalysts (White Biotechnology).

In view of above Amity University Rajasthan running Bachelors, Master and Ph.D biotechnology programs to fulfill the demand of various biopharmaceutical and biotechnological industries. All these programs course curriculum and structure have been designed in consultation with various pharmaceutical, biotechnological and dairy industry experts to meet the demand and supply of technical qualified personals. The course curriculum covering the major part of advanced biotechnological process, bioprocess and downstream technology, enzyme technology, separation technology, immunology, virology, genetics, molecular modeling drug design, biopharmaceuticals, pharmaceutical biotechnology, and bioinformatics in relation to the industry requirements.

The MSc. programme in Biotechnology seeks to provide education and training, empower students with technical skill-set, create capacities and build career opportunities in four key domains of biotechnology namely:

- Research and Development (Academic & Research Institutions and Industrial Sectors)
- Biotechnology Industries, Breweries, Pharmaceutical & Food Industries
- Forensic, Diagnostics Centers and Regulatory agencies
- Data handlings, Coding and Clinical research

This is achieved through a combination of interdisciplinary curricula as well as intensive laboratory work. Through its unique pedagogical methods, the academic programme allows transferability of acquired skills in domains unrelated to biotech sectors. Students are expected to have both specialized knowledge and practical experience for addressing contemporary problems in both academic and industrial setting.

### **Program Learning Outcomes (PLO):**

The objective of the programme is to highlight the role played by biotechnology in modern society and its relevance to sustainable development. It seeks to provide the following:

<b>PLO-I</b>	:	Graduates will be able to identify, analyze and understand problems related to biotechnology engineering and finding valid conclusions with basic knowledge in biotechnology engineering with special emphasis on optimization and scale up.
<b>PLO-II</b>	:	Graduates will be able to design and develop solution to biotechnology engineering problems by applying appropriate tools while keeping in mind safety factor for healthy environmental & society.
<b>PLO-III</b>	:	Solve organizational problems arising from a legal and technology framework and products, exhibit professionalism, ethical attitude to become an entrepreneur.
<b>PLO-IV</b>	:	Identify, evaluate and assess risks and payoffs in monetary and non-monetary terms and Ability to work with multidisciplinary subjects in industries and research.

**Credit Summary Sheet**

<b>M. Tech. Biotechnology</b>					
<b>Semester</b>	<b>CC</b>	<b>DE</b>	<b>VA</b>	<b>OE</b>	<b>Total</b>
<b>1</b>	19	3	4	-	26
<b>2</b>	20	3	4	3	30
<b>3</b>	20	3	4	3	30
<b>4</b>	30	-	-	-	30
<b>Total</b>	<b>89</b>	<b>09</b>	<b>12</b>	<b>06</b>	<b>116</b>

**Note:- CC - Core Course, VA - Value Added Course, OE - Open Elective, DE - Domain Elective**

## Program Structure

M. Tech. Biotechnology: I Semester						
Course Code	Course Title	Category	Lectures (L) Hours Per Week	Tutorial (T) Hours Per Week	Practical (P) Hours Per Week	Credits
MTB101	Advanced Biochemistry & Metabolic Regulation	CC	3	-	-	3
MTB102	Advanced Microbial Biotechnology	CC	3	1	-	4
MTB103	Advanced Bioinformatics	CC	3	-	-	3
MTB104	Cellular and Molecular Biotechnology	CC	3	-	-	3
MTB121	Advanced Biochemistry & Metabolic Regulation Lab	CC	-	-	2	1
MTB122	Advanced Microbial Biotechnology Lab	CC	-	-	2	1
MTB123	Advanced Bioinformatics Lab	CC	-	-	2	1
MTB124	Cellular and Molecular Biotechnology Lab	CC	-	-	2	1
AND001	ANANDAM-I	CC	-	-	-	2
DE Electives: Student has to select 1 course from the list of following DE electives						
MTB130	Instrumentation in Biotechnology	DE	3	-	-	3
MTB131	Biosafety, Bioethics & IPR	DE				
MTB132	Industrial Safety & Hazards	DE				
BCS 111	Communicational Skills - I	VA	1	-	-	1
BSS111	Behavioural Science I (Self Development and Interpersonal Skills)	VA	1	-	-	1
FLT 111 FLG 111 FLS 111 FLC 111	Foreign Language - I French German Spanish Chinese	VA	2	-	-	2
NCVA	-	NCVA	-	-	-	-
	<b>TOTAL</b>					<b>26</b>

**Note:** Common details for ANANDAM course given at the end of syllabus.

M. Tech. Biotechnology: II Semester						
Course Code	Course Title	Category	Lectures (L) Hours Per Week	Tutorial (T) Hours Per Week	Practical (P) Hours Per Week	Credits
MTB201	Enzymology & Protein Engineering	CC	3	-	-	3
MTB202	Bioprocess & Fermentation Technology	CC	3	-	-	3
MTB203	Advanced Immunotechnology	CC	3	-	-	3
MTB204	Advance Biostatistics and Scientific Writing	CC	3	-	-	3
MTB205	Advanced Medical Biotechnology	CC	3	-	-	3
MTB221	Enzymology & Protein Engineering Lab	CC	-	-	2	1
MTB222	Bioprocess & Fermentation Technology Lab	CC	-	-	2	1
MTB223	Advanced Immunotechnology Lab	CC	-	-	2	1
AND002	ANANDAM-II	CC	-	-	-	2
DE Electives: Student has to select 1 course from the list of following DE electives						
MTB230	Environmental Biotechnology	DE	3	-	-	3
MTB231	Entrepreneurship development in Biotechnology	DE				
MTB232	Pharmaceutical Technology & Biotechnology	DE				
OE	Open Elective -I	OE	3	-	-	3
BCS 211	Communicational Skills - II	VA	1	-	-	1
BSS211	Behavioural Science – II (Behavioral Communication and Relationship Management)	VA	1	-	-	1
FLT 211 FLG 211 FLS 211 FLC 211	Foreign Language - II French German Spanish Chinese	VA	2	-	-	2
	<b>TOTAL</b>					<b>30</b>

M. Tech. Biotechnology: III Semester						
Course Code	Course Title	Category	Lectures (L) Hours Per Week	Tutorial (T) Hours Per Week	Practical (P) Hours Per Week	Credits
MTB301	Bioprocess Plant Design	CC	3	-	-	3
MTB302	Downstream Processing	CC	3	-	-	3
MTB303	Nanobiotechnology	CC	3	-	-	3
MTB304	Recombinant DNA Technology	CC	3	-	-	3
MTB305	Genomics & Proteomics	CC	2	-	-	2
MTB322	Downstream Processing Lab	CC	-	-	2	1
MTB323	Nanobiotechnology Lab	CC	-	-	2	1
MTB324	Recombinant DNA Technology Lab	CC	-	-	2	1
MTB325	Genomics & Proteomics Lab	CC	-	-	2	1
AND003	ANANDAM-III	CC	-	-	-	2
DE Electives: Student has to select 1 course from the list of following DE electives						
MTB330	Advanced Food Technology	DE	3	-	-	3
MTB331	Tissue Engineering	DE				
MTB332	Drug Discovery & Development	DE				
OE	Open Elective-II	OE	3	-	-	3
BCS 311	Communicational Skills - III	VA	1	-	-	1
BSS311	Behavioral Science III (Leading Through Teams)	VA	1	-	-	1
FLT 311	Foreign Language - III	VA	2	-	-	2
FLG 311	French					
FLS 311	German					
FLC 311	Spanish					
	Chinese					
	<b>TOTAL</b>					<b>30</b>

M. Tech. Biotechnology: IV Semester						
Course Code	Course Title	Category	Lectures (L) Hours Per Week	Tutorial (T) Hours Per Week	Practical (P) Hours Per Week	Credits
MTB460	Major Project /Dissertation	CC	-	-	-	30
	<b>TOTAL</b>					<b>30</b>

**ADVANCED BIOCHEMISTRY AND METABOLIC REGULATION**

Course Code: MTB101

Credit Unit:03

**Theory****Course Objective:**

The objectives of this course are to build up on undergraduate level knowledge of biochemical principles with specific emphasis on different metabolic pathways. The course shall make the students aware of various disease pathologies within the context of each topic.

**Course Contents:****Module I: Protein Structure**

Chemical basis of life: Miller-Urey experiment, abiotic formation of amino acid oligomers, composition of living matter; Water – properties of water, essential role of water for life on earth pH, buffer, maintenance of blood pH and pH of gastric juice, pH optima of different enzymes (pepsin, trypsin and alkaline phosphatase), ionization and hydrophobicity, emergent properties of biomolecules in water, biomolecular hierarchy, macromolecules, molecular assemblies; Structure-function relationships: amino acids – structure and functional group properties, peptides and covalent structure of proteins, elucidation of primary and higher order structures, Ramachandran plot, evolution of protein structure, protein degradation and introduction to molecular pathways controlling protein degradation, structure-function relationships in model proteins like ribonuclease A, myoglobin, hemoglobin, chymotrypsin *etc.*; basic principles of protein purification; tools to characterize expressed proteins; Protein folding: Anfinsen's Dogma, Levinthal paradox, cooperativity in protein folding, free energy landscape of protein folding and pathways of protein folding, molten globule state, chaperons, diseases associated with protein folding, introduction to molecular dynamic simulation.

**Module II: Glycobiology**

Sugars-mono, di, and polysaccharides with specific reference to glycogen, amylose and cellulose, glycosylation of other biomolecules- glycoproteins and glycolipids; lipids- structure and properties of important members of storage and membrane lipids; lipoproteins.

**Module III: Structure and functions of DNA, RNA and Lipids**

Self-assembly of lipids, micelle, biomembrane organization - sidedness and function; membrane bound proteins - structure, properties and function; transport phenomena; nucleosides, nucleotides, nucleic acids - structure, a historical perspective leading up to the proposition of DNA double helical structure; difference in RNA and DNA structure and their importance in evolution of DNA as the genetic material.

**Module IV: Bio-energetics**

Bioenergetics-basic principles; equilibria and concept of free energy; coupled interconnecting reactions in metabolism; oxidation of carbon fuels; recurring motifs in metabolism; Introduction to GPCR, Inositol/DAG//PKC and Ca<sup>++</sup> signaling pathways; glycolysis and gluconeogenesis; reciprocal regulations and non-carbohydrate sources of glucose; Citric acid cycle, entry to citric acid cycle, citric acid cycle as a source of biosynthetic precursors; Oxidative phosphorylation; importance of electron transfer in oxidative phosphorylation; F<sub>1</sub>-F<sub>0</sub> ATP Synthase; shuttles across mitochondria; regulation of oxidative phosphorylation; Photosynthesis – chloroplasts and two photosystems; proton gradient across thylakoid membrane.

**Module V: Role of vitamins & cofactors in metabolism**

Calvin cycle and pentose phosphate pathway; glycogen metabolism, reciprocal control of glycogen synthesis and breakdown, roles of epinephrine and glucagon and insulin in glycogen metabolism; Fatty acid metabolism; protein turnover and amino acid catabolism.

**Examination Scheme:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

**Text & References:***Text:*

- Lehninger, A. (2013). Principles of Biochemistry, 6<sup>th</sup> Ed., Nelson and Cox.
- Mathews, Van Holde & (2012). Ahern Biochemistry. 4<sup>th</sup> Edition.

*References:*

- Smith, E. L., Hill, R. L. Lehman, I. R. Lefkowitz, R. J. Handler, P. & White, A. (1983). Biochemistry 7<sup>th</sup> Ed. McGraw-Hill Book Company.
- Berg, J. M., Tymoczko, J. L. & Stryer, L. (1990). Biochemistry, 3<sup>rd</sup> Ed., W.H. Freeman and Company.
- Voet, D. V. & Voet, J. G. (2010). Biochemistry, 4<sup>th</sup> Ed. Wiley
- Conn, E. E. & Stumph, P. K. (1987). Outlines of Biochemistry, John Wiley & Sons.

**ADVANCED MICROBIAL BIOTECHNOLOGY****Course Code: MTB102****Credit Unit:3L+1T****Theory****Course Objective:**

The objective of this course is to introduce students to the exciting area of microbial Biotechnology, To understand the habitual and application of microbes in different products and process.

**Course Contents:****UNIT I: HISTORY AND SCOPE**

History and scope of microbial biotechnology, Microbial biodiversity and its use, Bergey's manual of systemic bacteriology, Microbial Genetics, Isolation, Strain improvement, Identification, Preservation and Maintenance of Industrial Microorganisms. Fermenter parts and components; Media for industrial fermentation; Sterilization.

**UNIT II: MICROBIAL METABOLITES & FERMENTED FOOD PRODUCTION**

Production of microbial enzymes and its applications, Industrial Bioproducts– microbial synthesis of organic acids (Citric acid, acetic acid,), alcohol (ethanol), antibiotics production (penicillin), Bacteriocins, vitamin(B12) and amino acid(glutamic acid, Tryptophan), Fermented beverages (wine, Beer, Cider) , Fermented food (soy sauce/cheese/Kefir/Sauerkraut), LABs & Fermented Dairy products, Probiotics , single cell proteins.

**UNIT III: Agricultural Microbial Technology**

Microbial Bio-fertilizers and Biopesticides,Biocontrol, Bioherbicides. Large-scale production of microbial inoculants and Biofertilizer Technology for agriculture.

**Unit 4: Environmental Biotechnology**

Microbes in bioremediation and biodegradation, Lignocellulosic waste degradation, Microbes in waste water treatment and SWM, microbial ore leaching and mineral recovery, oil recovery, Microbes as alternative energy sources by microbial fuel cells and biofuels. Marine microbial metabolites and biopolymer production

**Unit 5: Medical Microbiology**

Microbial Pathogenesis, Methods of isolation and detection of pathogenic microorganisms; Biosensors, Production of vaccine, Hormones, antibiotics& AMR.

**Examination Scheme:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

**Text & References:****Text:**

- Pelczar, M.J., Chan, E.C.S. & Kreig, N.R. (2001). Microbiology 6<sup>th</sup> Ed. Tata McGraw Hill.
- Prescott, L.M. (2014). Microbiology, 9<sup>th</sup> Ed. McGraw by Hill Higher Education.

**References:**

- Stanier, R.Y., Ingraham, J.L., Wheelis M.L. & Painter, P.R. (2005). General Microbiology, 5<sup>th</sup> Ed. McMillan,
- Atlas, R.M. (1997). Principles of Microbiology 2<sup>nd</sup> Ed. WMT Brown Publishers.

- VanDemark, P.J. & Batzing, B.L. Menlo Park (1987). *The microbes: an introduction to their nature and importance*, Benjamin/Cummings Publishing Co.
- Tortora, G. J., Funke, B. R. and Case, C.L. (1994). *Microbiology* 5<sup>th</sup> Ed. Benjamin Cummings Inc. California.

**ADVANCED BIOINFORMATICS****Course Code: MTB103****Credit Unit:03****Theory****Course Objective:**

The course depicts the fundamental concepts and methods in Bioinformatics, a field at the junction of Biology and Computing. The course covers the principles and methods used to search and compare DNA, RNA and proteins, cast as biological "sequences". It also includes three dimensional data of protein structure and the associated problems are structure prediction (secondary and tertiary), analysis of protein structures for clues regarding function, and structural alignment. It serves a gateway course for all science students.

**Course Contents:****Module I: Biological databases**

Database concepts; Introduction to Data types and source; Protein Sequence and Structural Databases; Nucleic acid databases; Genome databases; Specialized Databases; Protein databases- UniProt, Structure databases- PDB and MMDB. Clinically relevant drug-drug interactions databases; Information retrieval from Biological databases: Entrez system, TCGA data bases, Bioportal.

**Module II Sequence Analysis**

Biological background for sequence analysis; Sequence alignment: Global, Local, Pairwise and Multiple sequence analysis; Algorithm for alignments; Scoring Matrices-Pam And Blosum

Gap Penalties, Filtering, Position Specific Scoring Matrices, Internet Resources Tools for Sequence alignment .

**Module III Phylogenetic Analysis**

Phylogenetic trees: Phylogenetic representations, Definition and description, various types of trees, Methods of phylogenetic analysis: Distance method (UPGMA, The Neighbour Joining, The Fitch/Margoliash method) and Character-based methods (Maximum Parsimony, Maximum Likelihood). Tree evaluation and Comparison of Phylogenetic Trees obtained using DNA seq. Vs. protein seq. Vs. Full genomes. Softwares for phylogenetic analysis

**Module IV Insilico Structure prediction of protein and docking**

Protein identification, physical properties, motifs and patterns, structure, folding classes, structure classification databases- CATH and SCOP; structure prediction in proteins- Secondary and Tertiary structure prediction. Structure Visualization tools -RASMOL, PyMoL SWISS-PDB Viewer. Docking of Molecules- Types of Docking and softwares.

**Module V EST- Gene Prediction**

ESTs – construction, databases, Basics of clustering, application of ESTs, Gene Prediction and Functional classification. Genome Anatomy, Genome Comparison, Genome Analysis, Gene Expression Analysis and databases for profile data. Basics of NGS and its platforms.

**Examination Scheme:**

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

**Text & References:****Text:**

- Sensen, C.W. (2002). Essentials of Genomics and Bioinformatics, John Wiley and Sons.
- Mount, D.W. (2004). Bioinformatics: Sequence and Genome Analysis. 2<sup>nd</sup> Ed., Cold Spring Harbor Laboratory Press.
- Baxevanis, A.D. and Ouellette, B.F.F (2009). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiley – Interscience
- Harshawardhan P. Bal, Bioinformatics Principles and Applications, Tata McGraw-Hill Publishing Company Ltd.
- Bioinformatics Basics: Applications in Biological Science and Medicine- Hooman Rashidi, Lukas K. Buehler

***References:***

- Gusfield, D. (1997). Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology, Cambridge University Press
- Heijne, G. Von and Heijne, G. Von (1987). Sequence Analysis in Molecular Biology: Treasure Trove or Trivial Pursuit by Academic Press.
- Pevzner, P.A. (2000). Computational Molecular Biology: An Algorithmic Approach by MIT Press
- Doolittle, R.F., Abelson, J.N, & Simon, M.I. (1996). Computer Methods for Macromolecular Sequence Analysis, Academic press
- Waterman, M. (1995). Introduction to Computational Biology: Maps, Sequences and Genomes, 1<sup>st</sup> Ed, Chapman and Hall.

# CELLULAR AND MOLECULAR BIOTECHNOLOGY

Course Code: MTB104

Credit Unit:03

## Theory

### Course Objective:

The object of the present course is to develop basic knowledge and skills in the Cellular and Molecular Biotechnology and to understand the structure and function of the cellular and sub cellular components of cells and tissues with the help of recent state-of-the-art technologies. 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. Various applications of Cellular and Molecular Biotechnology in medicine and for sustainable agriculture will also be presented.

### Course Contents:

#### Module I

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 II

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<sup>2+</sup> and diacylglycerol as second messengers.

#### Module III

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 IV

**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

**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, inhibitors of protein translation. Compare and contrast the spatial and temporal differences in prokaryotic and eukaryotic transcription and translation

#### Module VI

TAIR and EMBL and their role in bioinformatics analysis of the gene function. Changing landscapes of sequencing technologies (Sanger, Next Generation Sequencing [NGS], and Third-Generation Sequencing (also known as long-read sequencing) for whole genome sequencing of microbes, plants, and animals. Different techniques (DNA Microarrays, RNA Seq, Northern analysis, the GUS reporter system ( $\beta$ -glucuronidase), and quantitative real time PCR [qRT-PCR]) used for detecting and quantifying the expression of the genes (transcripts levels) in response to the growth and development and/or biotic and/or abiotic stresses, functional genomics by forward (Ethyl methane sulphate [EMS] mutants) and reverse (T-DNA and RNAi-mediated gene silencing) genetic approaches, micro-RNA (miRNA) mediated post-transcriptional regulation of gene expression, post-translational modifications (SUMOylation, phosphorylation, glycosylation, ubiquitination, nitrosylation, and methylation), epistatic gene interactions, molecular basis of epigenetics, applications of the CRISPR-Cas9 system for DNA-free genome editing in plants and animals, and country-specific ethical and social concerns related to the use of Genetically Modified (GM) agronomically important crop species.

### Examination Scheme:

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

### Text & References:

***Text:***

- Albert, B. (2002). Molecular Biology of the Cell 4<sup>th</sup> Ed., Garland Science New York.
- Darnell, L. and Baltimore (2012). Molecular Biology, Mac Millan
- Watson et al., (2013). Molecular Biology of the gene, 7<sup>th</sup> Ed., Pearson.

***References:***

- Lewis, B. (2003). Genes VIII, Benjamin Cummings.
- Goodenough, U. W. (1984). Genetics 2<sup>nd</sup> Ed. Saunders (W.B.) Co Ltd.
- Swanson, C. P., Merz, T. & Young, W.J. (1981). Cytogenetics, Prentice Hall
- Berg, J. M., Tymoczko, J. L. & Stryer, L. (2002). Biochemistry, 3<sup>rd</sup> Ed. W.H. Freeman and Company, ,
- Brown, T.A. (1990). Genomes 2<sup>nd</sup> Ed. Oxford: Wiley-Liss,

**ADVANCED BIOCHEMISTRY AND METABOLIC REGULATION -Lab****Course Code: MTB121****Credit Unit:01****Course Contents:****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  
 Ammonium Sulfate precipitation, Dialysis of the purified protein solution against 60% glycerol as a demonstration of storage method, Affinity Chromatography

**Module II: Nucleic Acid**

Biochemical estimation of DNA, RNA. Separation of DNA samples on Agarose gel.

**Carbohydrate:** Color reactions of different type of carbohydrates, Biochemical estimation of blood sugar

**Lipids:** Blood Cholesterol estimation.

**Examination Scheme:**

IA				EE		
Practical (Mid Term)	Viva	Regular Performance	Attendance	Practical (End Term)	Practical Record	Viva
20	15	10	05	25	10	15

**Note:** Minor variation could be there depending on the examiner.

**ADVANCED MICROBIAL BIOTECHNOLOGY -Lab****Course Code: MTB122****Credit Unit:01****Course Contents:****Module 1: Basic Microbiological Techniques (Isolation, Identification and Enumeration of Microbes)**

1. Basic and specialized media preparation & Pure culture techniques
2. Isolation, Characterization (Micro, Macro & Biochemical) & Enumeration of microorganisms from soil/air/water: Bacteria, Fungi and Actinomycetes.
3. Anaerobic culture techniques
4. Growth pattern analysis of Bacteria and fungi and Effect of various intrinsic & Extrinsic factors

**Module 2: Advanced Microbial Biotechnological Techniques**

5. **Agricultural Microbiology:** Isolation of nitrogen fixers (Rhizobium/Azotobacter), PGPR/PSB/PSF
6. **Environmental Biotechnology:** Estimation of coliforms by MPN in water, Determination of BOD & COD of effluent
7. **Medical Microbiology:** Antibiotic Sensitivity Testing, Identification of food pathogen
8. **Food Microbiology:** Microbiological QA Parameters, Preparation of Fermented food & Beverage (Sauerkraut/ Yogurt/Wine), Organic acid production (Citric acid) by Solid state/ submerged fermentation.

**Examination Scheme:**

IA				EE		
Practical (Mid Term)	Viva	Regular Performance	Attendance	Practical (End Term)	Practical Record	Viva
20	15	10	05	25	10	15

**Note:** Minor variation could be there depending on the examiner.

## ADVANCED BIOINFORMATICS -Lab

**Course Code: MTB123**

**Credit Unit:01**

**Course Objective:**

To demonstrate the techniques and soft wares used for sequence analysis, alignment, structure prediction of the proteins and other compounds and finding the phylogenetic relationships

**Course Contents:**

**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

**Examination Scheme:**

IA				EE		
Practical (Mid Term)	Viva	Regular Performance	Attendance	Practical (End Term)	Practical Record	Viva
20	15	10	05	25	10	15

**Note:** Minor variation could be there depending on the examiner.

**CELLULAR AND MOLECULAR BIOTECHNOLOGY -Lab****Course Code: MTB124****Credit Unit:01****Course Objective:**

The laboratory experiments in Recombinant DNA Technology would certainly help to comprehend the theoretical aspects of the subject.

**Course Contents:**

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. Sterile and element-contamination-free hydroponic system for the growth of model plant species for studying the stress-mediated spatio-temporal changes in the gene expression.
9. Quantitative real time PCR (qRT-PCR) for the analysis of gene expression.

**Examination Scheme:**

<b>IA</b>				<b>EE</b>		
<b>Practical (Mid Term)</b>	<b>Viva</b>	<b>Regular Performance</b>	<b>Attendance</b>	<b>Practical (End Term)</b>	<b>Practical Record</b>	<b>Viva</b>
20	15	10	05	25	10	15

**Note:** Minor variation could be there depending on the examiner.

## INSTRUMENTATION IN BIOTECHNOLOGY

**Course Code: MTB130**

**Credit Unit:03**

### Theory

#### Course Objective:

To demonstrate a thorough knowledge of the equipment and operating modes of instrumentation systems used in the area of biotechnology and critically discuss the limitations and biohazards of the equipment and techniques employed in biotechnology.

#### Course Contents:

##### Module I: Ultracentrifugation

Sedimentation equilibrium and sedimentation velocity methods, Analytical and Preparative centrifuges, application of density gradient and differential centrifugation.

##### Module II: Gel electrophoresis

Agarose and Polyacrylamide, Two-dimensional electrophoresis, Isoelectric focussing, Capillary electrophoresis, Pulse-field gel electrophoresis, Immunoelectrophoresis.

##### Module III

TLC gas chromatography, gel filtration, ion-exchange chromatography, affinity chromatography and HPLC, FPLC.

##### Module IV

UV and visible Spectroscopy, Spectrofluorimetry, Atomic absorption spectrophotometry, Mass Spectrometry, Infrared Spectroscopy, MALDITOF, Nuclear Magnetic Resonance and Electron Spin Resonance Spectroscopy, Magnetic Resonance Imaging. X-Ray diffraction.

##### Module V

Optical and Electron Microscopy, Transmission and Scanning Electron Microscopy, Tunneling Electron Microscopy, Polarization and Fluorescence microscopy.

Radio tracers, GM Counter, Proportional and Scintillation Counters, Autoradiography, Radio-immunoassay.

#### Examination Scheme:

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

#### Text & References:

##### Text:

- Wilson, K. & Walker, J. (2000). Practical Biochemistry, Principles & Techniques 5<sup>th</sup> Ed. Cambridge University Press.
- Friefelder, D. (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Biology 2<sup>nd</sup> Ed. W. H. Freeman

##### References:

- Hoppert, M. (2005). Microscopic Techniques in Biotechnology, Wiley-Blackwell.
- Venn, R. F. (2002). Principles and Practice of Bioanalysis 1<sup>st</sup> Ed. Taylor and Francis, London.
- Van Impe, J.F.M., Vanrolleghem, P. A. & Iserentant, D. M. (1998). Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, Springer Science + Business media
- Glusker, J.P. & Trueblood, K.N. (1985). Crystal Structure Analysis: a primer by Oxford University Press.
- Rhodes, G. (1993). Crystallography Made Crystal Clear: A Guide for Users of Macromolecular Models, Academic Press Inc.
- Gunter, H. (1992). NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry, Wiley India Pvt. Limited.
- Van Holde, K. E., Johnson, W. C. & Ho, P. S. (2006). Principles of Physical Biochemistry” by Prentice Hall

**BIOSAFETY, BIOETHICS & IPR****Course Code: MTB131****Credit Unit:03****Theory:****Course Objective:**

To create awareness on IPR issues and need for knowledge in patents in biotechnology, understand the biosafety regulations and ethical practices in biotechnology and become familiarize with the ethical practices in biotechnology.

**Module-1:**

**Intellectual Property:** Patents, Trademarks, Copyright, Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs, IPs of relevance to Biotechnology and Case Studies; Agreements and Treaties, Indian Patent Act 1970 & recent amendments.

**Module-2:**

**Patents and Concept of Prior Art:** Types of patent applications, Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees, Invention in context of "prior art".

**Module-3:**

**Patent Filing Procedures:** National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting—disclosure/non-disclosure; Patent licensing and agreement Patent infringement.

**Module-4:**

**Biosafety:** Introduction to Biological Safety Cabinets; Biosafety Levels of Specific Microorganisms; Biosafety guidelines: Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, applications in food and agriculture; Environmental release of GMOs; Risk Analysis, Risk management and communication; National Regulations and relevant International Agreements, Cartagena Protocol.

**Module-5:**

**Bioethics:** Ethical implications of biotechnological products and techniques, Social and ethical implications of biological weapons.

**Evaluation:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
<b>Weightage (%)</b>	15	5	10	10	10	50

**Books Recommended:****Text books:**

1. Deepa Goel & Shomini Parashar IPR, Biosafety and Bioethics, Pearson Education India, (2013)
2. Anupam Singh Intellectual Property Rights and Bio-Technology Biosafety and Bioethics, Narendra Publishing House, (2012)

**Reference books:**

1. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., (2007)
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., (2007)

**INDUSTRIAL SAFETY AND HAZARDS****Course Code: MTB132****Credit Unit:03****Theory****Course Objective:**

Course addresses management and engineering design concepts required for process safety in chemical and biotechnology systems, with pharmaceutical manufacturing applications. Content focuses on sound engineering principles and practices as they apply to industrial situations, project design, risk mitigation, process and equipment integrity, and engineering codes and standards.

**Course Contents:****Module I: Hazards**

Chemical hazards classification. Radiation hazards and control of exposure to radiation. Types of fire and fire prevention methods. Mechanical hazards. Electrical hazards

**Module II: Psychology and Hygiene**

Industrial psychology Industrial hygiene. Safety in plant site selection and plant layout. Industrial lighting and ventilation. Industrial noise.

**Module III: Occupational diseases and control**

Occupational diseases and prevention methods. Safe housekeeping, Instrumentation for safe operation. Personal protective equipments. Safety in chemical operations and processes.

**Module IV: Management**

Safety organization – safety committee – safety education and training. Management process. Philosophy and need for Industrial safety. Role of Government in Industrial safety.

**Module V: Laws**

Factory Act. ESI Act, Environmental Act. Workmen - compensation Act. Advantages of adopting safety laws.

**Examination Scheme:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

**Text & References:****Text:**

- Guide for Safety in the Chemical laboratory second edition, Manufacturing Chemists Association. Van Nostrand Reinhold Company, New York.
- Anonymous (1972). Guide for Safety in the Chemical Laboratory, 2<sup>nd</sup> Ed., Van Nostrand Reinhold Co., Litton Educational Publishing, Inc., New York
- Fawcett, H.H. & Wood, W.S. (1982). Safety and Accident Prevention in Chemical Operation, 2<sup>nd</sup> Ed. John Wiley and sons, New York.

**References:**

- Industrial Safety and Laws by Indian School of Labour Education, Madras.

**COMMUNICATION SKILLS – I****Course Code:** BCS 111**Credit Unit:**01**Course Objective:**

The Course is designed to give an overview of the four broad categories of English Communication thereby enhance the learners' communicative competence.

**Course Contents:****Module I: Listening Skills**

Effective Listening: Principles and Barriers  
Listening Comprehension on International Standards

**Module II: Speaking Skills**

Pronunciation and Accent  
Reading excerpts from news dailies & magazines  
Narrating Incident; Story telling.  
Extempore & Role Plays

**Module III: Reading Skills**

Vocabulary: Synonyms, antonyms, diminutives, homonyms, homophones  
Idioms & phrases  
Foreign words in English

**Module IV: Writing Skills**

Writing Paragraphs  
Précis Writing  
Letter writing  
Coherence and structure  
Essay writing

**Module V: Activities**

News reading  
Picture reading  
Movie magic  
Announcements

**Examination Scheme:**

Components	CT1	CT2	CAF	V	GD	GP	A
Weightage (%)	20	20	25	10	10	10	5

CAF – Communication Assessment File

GD – Group Discussion

GP – Group Presentation

**Text & References:**

- Working in English, Jones, Cambridge
- Business Communication, Raman – Prakash, Oxford
- Speaking Personally, Porter-Ladousse, Cambridge
- Speaking Effectively, Jermy Comfort, et.al, Cambridge

## Behavioural Science-I (Self Development and Interpersonal Skills)

**Course Code:** BSS111

**Credit Unit:**01

### Course Objective:

This course aims at imparting an understanding of:  
 Self and the process of self exploration  
 Learning strategies for development of a healthy self esteem  
 Importance of attitudes and their effect on work behaviour  
 Effective management of emotions and building interpersonal competence.

### Course Contents:

#### Module I: Understanding Self

Formation of self concept  
 Dimension of Self  
 Components of self  
 Self Competency

#### Module II: Self-Esteem: Sense of Worth

Meaning and Nature of Self Esteem  
 Characteristics of High and Low Self Esteem  
 Importance & need of Self Esteem  
 Self Esteem at work  
 Steps to enhance Self Esteem

#### Module III: Emotional Intelligence: Brain Power

Introduction to EI  
 Difference between IQ, EQ and SQ  
 Relevance of EI at workplace  
 Self assessment, analysis and action plan

#### Module IV: Managing Emotions and Building Interpersonal Competence

Need and importance of Emotions  
 Healthy and Unhealthy expression of emotions  
 Anger: Conceptualization and Cycle  
 Developing emotional and interpersonal competence  
 Self assessment, analysis and action plan

#### Module V: Leading Through Positive Attitude

Understanding Attitudes  
 Formation of Attitudes  
 Types of Attitudes  
 Effects of Attitude on  
 Behaviour  
 Perception  
 Motivation  
 Stress  
 Adjustment  
 Time Management  
 Effective Performance  
 Building Positive Attitude

#### Module VI: End-of-Semester Appraisal

Viva based on personal journal  
 Assessment of Behavioural change as a result of training  
 Exit Level Rating by Self and Observer

### Examination Scheme:

Components	SAP	A	Mid Term Test (CT)	VIVA	Journal for Success (JOS)
Weightage (%)	20	05	20	30	25

### **Text & References:**

- Towers, Marc: Self Esteem, 1<sup>st</sup> Edition 1997, American Media
- Pedler Mike, Burgoyne John, Boydell Tom, A Manager's Guide to Self-Development: Second edition, McGraw-Hill Book Company.
- Covey, R. Stephen: Seven habits of Highly Effective People, 1992 Edition, Simon & Schuster Ltd.
- Khera Shiv: You Can Win, 1<sup>st</sup> Edition, 1999, Macmillan
- Gegax Tom, Winning in the Game of Life: 1<sup>st</sup> Edition, Harmony Books
- Chatterjee Debashish, Leading Consciously: 1998 1<sup>st</sup> Edition, Viva Books Pvt. Ltd.
- Dr. Dinkmeyer Don, Dr. Losoncy Lewis, The Skills of Encouragement: St. Lucie Press.
- Singh, Dalip, 2002, Emotional Intelligence at work; First Edition, Sage Publications.
- Goleman, Daniel: Emotional Intelligence, 1995 Edition, Bantam Books
- Goleman, Daniel: Working with E.I., 1998 Edition, Bantam Books.

**FRENCH – I****Course Code:** FLT 111**Credit Unit:**02**Course Objective:**

To familiarize the students with the French language

- with the phonetic system
- with the syntax
- with the manners
- with the cultural aspects

**Course Contents:****Module A: pp. 01 to 37: Unités 1, 2, Unité 3 Objectif 1,2**

Only grammar of Unité 3: objectif 3, 4 and 5

**Contenu lexical: Unité 1 : Découvrir la langue française : (oral et écrit)**

1. se présenter, présenter quelqu'un, faire la connaissance des autres, formules de politesse, rencontres
2. dire/interroger si on comprend
3. Nommer les choses

**Unité 2: Faire connaissance**

1. donner/demander des informations sur une personne, premiers contacts, exprimer ses goûts et ses préférences
2. Parler de soi: parler du travail, de ses activités, de son pays, de sa ville.

**Unité 3: Organiser son temps**

1. dire la date et l'heure

**Contenu grammatical:**

1. organisation générale de la grammaire
2. article indéfini, défini, contracté
3. nom, adjectif, masculin, féminin, singulier et pluriel
4. négation avec « de », "moi aussi", "moi non plus"
5. interrogation : Inversion, est-ce que, qui, que, quoi, qu'est-ce que, où, quand, comment, quel(s), quelle(s)  
Interro-négatif : réponses : oui, si, non
6. pronom tonique/disjoint- pour insister après une préposition
7. futur proche

**Examination Scheme:**

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

**Text & References:**

- le livre à suivre: Campus: Tome 1

**GERMAN – I****Course Code:** FLG 111**Credit Unit:02****Course Objective:**

To enable the students to converse, read and write in the language with the help of the basic rules of grammar, which will later help them to strengthen their language.

To give the students an insight into the culture, geography, political situation and economic opportunities available in Germany

**Course Contents:****Module I: Introduction**

Self introduction: heissen, kommen, wohnwn, lernen, arbeiten, trinken, etc.

All personal pronouns in relation to the verbs taught so far.

Greetings: Guten Morgen!, Guten Tag!, Guten Abend!, Gute Nacht!, Danke sehr!, Danke!, Vielen Dank!, (es tut mir Leid!),

Hallo, wie geht's?: Danke gut!, sehr gut!, prima!, ausgezeichnet!,

Es geht!, nicht so gut!, so la la!, miserabel!

**Module II: Interviewspiel**

To assimilate the vocabulary learnt so far and to apply the words and phrases in short dialogues in an interview – game for self introduction.

**Module III: Phonetics**

Sound system of the language with special stress on Diphthongs

**Module IV: Countries, nationalities and their languages**

To make the students acquainted with the most widely used country names, their nationalitie and the language spoken in that country.

**Module V: Articles**

The definite and indefinite articles in masculine, feminine and neuter gender. All Vegetables, Fruits, Animals, Furniture, Eatables, modes of Transport

**Module VI: Professions**

To acquaint the students with professions in both the genders with the help of the verb “sein”.

**Module VII: Pronouns**

Simple possessive pronouns, the use of my, your, etc.

The family members, family Tree with the help of the verb “to have”

**Module VIII: Colours**

All the color and color related vocabulary – colored, colorful, colorless, pale, light, dark, etc.

**Module IX: Numbers and calculations – verb “kosten”**

The counting, plural structures and simple calculation like addition, subtraction, multiplication and division to test the knowledge of numbers.

“Wie viel kostet das?”

**Module X: Revision list of Question pronouns**

W – Questions like who, what, where, when, which, how, how many, how much, etc.

**Examination Scheme:**

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

**Text & References:**

- Wolfgang Hieber, Lernziel Deutsch
- Hans-Heinrich Wangler, Sprachkurs Deutsch
- Schulz Griesbach, Deutsche Sprachlehre für Ausländer
- P.L Aneja, Deutsch Interessant- 1, 2 & 3
- Rosa-Maria Dallapiazza et al, Tangram Aktuell A1/1,2
- Braun, Nieder, Schmöe, Deutsch als Fremdsprache 1A, Grundkurs

**SPANISH – I****Course Code:** FLS 111**Credit Unit:**02**Course Objective:**

To enable students acquire the relevance of the Spanish language in today's global context, how to greet each other. How to present / introduce each other using basic verbs and vocabulary

**Course Contents:****Module I**

A brief history of Spain, Latin America, the language, the culture...and the relevance of Spanish language in today's global context.

Introduction to alphabets

**Module II**

Introduction to '*Saludos*' (How to greet each other. How to present / introduce each other).

Goodbyes (*despedidas*)

The verb *llamarse* and practice of it.

**Module III**

Concept of Gender and Number

Months of the years, days of the week, seasons. Introduction to numbers 1-100, Colors, Revision of numbers and introduction to ordinal numbers.

**Module IV**

Introduction to *SER* and *ESTAR* (both of which mean To Be).Revision of '*Saludos*' and '*Llamarse*'. Some adjectives, nationalities, professions, physical/geographical location, the fact that spanish adjectives have to agree with gender and number of their nouns. Exercises highlighting usage of *Ser* and *Estar*.

**Module V**

Time, demonstrative pronoun (*Este/esta, Aquel/aquella* etc)

**Module VI**

Introduction to some key AR /ER/IR ending regular verbs.

**Examination Scheme:**

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

**Text & References:**

- Español, En Directo I A
- Español Sin Fronteras

**CHINESE – I****Course Code:** FLC 111**Credit Unit:**02**Course Objective:**

There are many dialects spoken in China, but the language which will help you through wherever you go is Mandarin, or Putonghua, as it is called in Chinese. The most widely spoken forms of Chinese are Mandarin, Cantonese, Gan, Hakka, Min, Wu and Xiang. The course aims at familiarizing the student with the basic aspects of speaking ability of Mandarin, the language of Mainland China. The course aims at training students in practical skills and nurturing them to interact with a Chinese person.

**Course Contents:****Module I**

Show pictures, dialogue and retell.

Getting to know each other.

Practicing chart with Initials and Finals. (CHART – The Chinese Phonetic Alphabet Called “Hanyu Pinyin” in Mandarin Chinese.)

Practicing of Tones as it is a tonal language.

Changes in 3<sup>rd</sup> tone and Neutral Tone.

**Module II**

Greetings

Let me Introduce

The modal particle “ne”.

Use of Please ‘qing’ – sit, have tea ..... etc.

A brief self introduction – Ni hao ma? Zaijian!

Use of “bu” negative.

**Module III**

Attributives showing possession

How is your Health? Thank you

Where are you from?

A few Professions like – Engineer, Businessman, Doctor, Teacher, Worker.

Are you busy with your work?

May I know your name?

**Module IV**

Use of “How many” – People in your family?

Use of “zhe” and “na”.

Use of interrogative particle “shenme”, “shui”, “ma” and “nar”.

How to make interrogative sentences ending with “ma”.

Structural particle “de”.

Use of “Nin” when and where to use and with whom. Use of guixing.

Use of verb “zuo” and how to make sentences with it.

**Module V**

Family structure and Relations.

Use of “you” – “mei you”.

Measure words

Days and Weekdays.

Numbers.

Maps, different languages and Countries.

**Examination Scheme:**

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

**Text & References:**

- “Elementary Chinese Reader Part I” Lesson 1-10

## ENZYMOLGY AND PROTEIN ENGINEERING

**Course Code: MTB201**

**Credit Units:03**

### Course Contents:

#### Module I: Enzymes

Introduction, Nomenclature, Mechanism of Catalysis, Catalysis in organic media, Enzyme regulation, Allosteric enzymes

#### Module II : Enzyme Kinetics

Enzyme kinetics, Thermodynamics of enzyme reactions, Enzyme inhibition. Multisubstrate reaction

#### Module III: Immobilization

Immobilization of Enzymes; Advantages, Carriers, adsorption, covalent coupling, cross-linking and entrapment methods, Micro-environmental effects

#### Module IV: Protein Engineering

Protein engineering of enzyme : Rational and directed evolution , Mutational effect on engineered proteins, Engineered proteins; Structure function design for protein design

#### Module V:

##### Enzyme expression systems

Protein expression in bacterial, mammalian, insect systems. Biotransformations, Concept of bioreactors

##### Biotechnological applications of enzymes

Enzyme utilization in industry, Ribozymes, Abzymes, Inteins, Cold adapted enzymes.

### Examination Scheme:

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

### Text & References:

#### Text:

- Enzymology T. Devasena (2010) Oxford publications
- Protein Engineering: Principles and Practice 1st Edition Jeffrey L. Cleland and Charles S. Craik
- Enzyme Technology, M.F. Chaplin and C. Bucke, Cambridge University Press.
- **Protein Engineering: Technology and Application** (2013) Tomohisa Ogawa InTech Open
- Protein Engineering and Design Sheldon J. Park, Jennifer R. Cochran 2009 CRC Press

#### References:

- Enzymes Biochemistry, Biotechnology, Clinical Chemistry, Trevor Palner
- Enzyme Kinetics: Behavior 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

## BIOPROCESS AND FERMENTATION TECHNOLOGY

**Course Code: MTB202**

**Credit Units:03**

### Course Objective:

The objective of the course is to apply the principles of biochemical engineering in large scale cultivation of microorganism for production of important products.

### Course Contents:

#### Module I

Advantage of bioprocess over chemical process. Basic principle in bioprocess technology. Media formulation sterilization, thermal death kinetics, batch and continuous sterilization system. Sterilization of Industrial Media, Air and Fermenter

#### Module II

Transport phenomena in bioprocess – Mass transfer, mass transfer co-efficient for gases and liquids. Rate of oxygen transfer. Determination of oxygen transfer coefficient. Rheological properties of intermedium. Biological heat transfer, Heat transfer coefficients.

Bioprocess control and monitoring variables such as temperature, agitation, pressure etc.

#### Module III

Kinetics of microbial growth, substrate utilization and product formation Batch, Fed-batch, CSTR types of reactors – CSTR, tower, airlift, bubble column, packed bed, immobilized cells, Control and monitoring, online and off-line control, Computers in bioprocess control systems.

#### Module IV

**Industrial production of enzymes:** cellulase, amylase, protease; organic acids: citric acid, acetic acid, lactic acid; ethanol, biomass, antibiotics: classification, penicillins, tetracyclins, chloramphenicol; vitamins: B<sub>12</sub>, riboflavin, fermented dairy products.

**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.

**Antibiotics:** Classification, penicillin, tetracycline, streptomycin, cephalosporin. Various penicillin as precursor and ‘R’ – side chain, penicillanase, 6-APA, penicillin production, harvest and recovery, uses of various forms etc.

**Streptomycin:** Chemical structure, production, harvest and recovery, uses by-product of streptomycin fermentation etc.

**Module V Biomass:** Bakers and distillers yeast production using various raw materials, “bio” 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.

### Examination Scheme:

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

### Text & References:

#### Text:

- Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Text Pvt. Ltd.
- Industrial Microbiology, Casida, New Age International
- Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers

#### References:

- Biochemical Engineering, Bailey and Ollis.
- Principles of Biochemical Engineering, Humphrey.

## ADVANCED IMMUNOTECHNOLOGY

**Course Code: MTB203**

**Credit Units:03**

### Course Objective:

Role of antibody engineering in biomedical applications and the importance of immunogenetics 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.

### Course Contents:

#### Module I: Introduction

Concept of immunity- Innate and acquired, Active and Passive immunity, Cell mediated and Humoral immunity, Primary and secondary immune response, Clonal nature of Immune Response.

#### Module II:

Immune system: Central and peripheral immune system  
 Primary lymphoid organs: Thymus and Bone marrow, T and B cell development  
 Secondary lymphoid organs: Spleen, lymphnode and MALT  
 Ectopic lymphoid tissues  
 Hematopoiesis, Cells of the immune system- Eosinophils, Neutrophils, Basophils, B and T-lymphocytes, macrophages, Null cells, dendritic cells, Mast cells.  
 Receptors: BCR and TCR, Fc receptor

#### Module III:

Nature and biology of Antigen: Immunogen vs. Antigen, factors affecting immunogenicity, Hapten and carriers, Adjuvants, Super antigens  
 Antibody structure in relation to function and antigen-binding; Types of antibodies and their structures: isotypes, allotypes, idiotypes. Monoclonal antibodies: production and applications, Generation of antibody diversity,

#### Module IV

MHC: Structure of MHC class I, II & III, exogenous and endogenous antigen presentation by MHC, MHC restriction, Self-tolerance in relation to MHC.  
 Autoimmunity and autoimmune diseases, Role of MHC in autoimmune diseases  
 Transplantation immunology, immunosuppressive therapy, tissue typing, immunologically privileged sites.

#### Module V

Complement system  
 Vaccines  
 Tumor immunology  
 Concept of inflammation and hypersensitivity  
 Antigen - antibody interaction based diagnostics: agglutination and precipitation, ELISA, RIA, IFA

### Examination Scheme:

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

### Text & References:

#### Text:

Owen J., Punt J., and Stranford Sharon (2013): Kuby's Immunology, 7<sup>th</sup> Edition, Macmillan higher education, New York. ISBN-13: 978-1-4292-1919-8.  
 Delves P., Martin S., Burton D. and Roitt I.(2006): Roitt's Essential Immunology, 11<sup>th</sup> Edition, Blackwell Publishers, Oxford.

#### References:

• Abbas AK, Lichtman AH, Pillai S (2010) Cellular and Molecular Immunology, 6<sup>th</sup> Edition, Saunders Elsevier, ISBN:978-0-8089-2411-1

**ADVANCE BIOSTATISTICS AND SCIENTIFIC WRITING****Course Code: MTB204****Credit Unit: 03****Theory****Objective:**

To develop the skills and knowledge in research, types of research, interdisciplinary research, scientific methods of research, criteria of effective research, scientific interpretation of data using the biostatistics tools, scientific writing skills, and characteristics of an effective researcher.

**UNIT-I**

**Research Formulation** - Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem - Literature review - Primary and secondary sources - reviews, treatise, monographs-patents - web as a source - searching the web - Critical literature review - Identifying gap areas from literature review - Development of working hypothesis.

**UNIT-II**

**Research design and methods** - Research design - Basic Principles- Need of research design - Features of good design - Important concepts relating to research design - Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models. Developing a research plan - Exploration, Description, Diagnosis, Experimentation. Determining experimental and sample designs.

**UNIT-III**

**Data Collection and analysis:** Execution of the research - Observation and Collection of data - Methods of data collection - Sampling Methods, Sampling Errors - Data Processing and Analysis strategies - Hypothesis-testing - Generalization and Interpretation.

**UNIT-IV**

**Quantitative Methods:** Data presentation, statistical analysis and interpretation of data, types of analysis, simple regression analysis, correlation, coefficient of determination, ( $r^2$ ), z-test, t-test, ANOVA, Chi-square test, multi-variate analysis of data, multiple regression. Computer Application : Role of computer in research, data organization, software selection and its applications, solving problems by using scientific software and tools, sample programmes for analysis of data.

**UNIT-V**

**Reporting and scientific writing:** Structure and components of scientific reports, types of report, research paper report, review paper report, technical reports and thesis. Thesis writing - different steps and software tools (LaTeX.) in the design and preparation of thesis, layout, structure (chapter plan) and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes. Oral presentation - planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication. Selection of scientific journal based on indexing with Web of Science, Scopus etc., communication of manuscript with journals, revision in manuscripts.

**Examination Scheme:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

**Text & References:****Text:**

- C. R. Kothari, Research Methodology: Methods & Techniques, Wishwa Publication
- . D K Bhattacharyya, Research Methodology, Excel Books
- Loraine Blaxter, Christina Hughes, Molcolm Tight, How to Research, Viva Books Pvt. Ltd.
- Research papers / web articles in the field of research methodology.

**References:**

- Introduction to Biostatistics, Ronald N. Forthfer and Eun Sun Lee .Publisher: Elsevier.
- Biostatistics: A foundation for analysis in the Health Sciences, W.W Daniel. Publisher: John Wiley and Sons.
- Statistical Methodology, S.P Gupta. Publisher: S. Chand & Co.

**ADVANCED MEDICAL BIOTECHNOLOGY****Course Code: MTB205****L: 3, T: 0, P: 0 C: 3****Theory****Course Objective:**

To develop an understanding of role of biochemistry and molecular biology in the diagnosis and clinical management of disease.

**Course Contents:****Module I**

**Diagnostic tools and Procedures:** Immunological Approaches to Detect Protein Biomarkers of Disease; DNA-Based Approaches to Disease Diagnosis, Detecting RNA Signatures of Disease; Cell culture diagnostics-based approach; Biochemical investigation in disease conditions. Radio-imaging techniques – EEG, Xray, Ultrasonography, CT scan, Electromyography, Magnetic resonance imaging.

**Module II**

**Biochemical test:** Clinical significance of biochemical tests and their role in the diagnosis and monitoring of disease, Clinical characteristic of disease. Different biochemical test using protein and enzyme markers and their interpretation. Kidney Function test: Glomerular Filtration Tests, Serum Creatinine (S-Crea) and Derived Calculations, Serum Cystatin C, Creatinine Clearance, Tubule Function Test, Biochemical Tests for Liver Diseases: Tests of hepatocyte integrity Tests of bile duct system and the canalicular pole of hepatocytes, Tests measuring protein synthesis by the liver, Analytes measuring the transport and excretory capacity of the liver, Tests measuring to the metabolize endogenous and xenogenous Substances, blood sugar test, hormone assay, Newborn Screening etc. Biochemical tests on different bacteria different biochemical compounds.

**Module -III**

**Source of infection:** Identification of disease agents, Mode of spread of infections- Skin, wound & burn, alimentary tract, blood infection, laboratory infection, nosocomial infections, infections in immune-compromised patients etc., Epidemiology-epidemics, pandemics and endemics disease. Control measure of microbial diseases-public health control methods. Hygiene regulations, population screening for disease.

**Module IV**

**Clinically important Pathogens** -Mode & Mechanism of Infection, diagnosis, treatment & Prevention of Viruses -Influenza virus and Corona viruses; Hepatitis viruses- A, B, C and E, gastroenteritis virus -Rotavirus, Adenovirus, Acute encephalitis viruses- Dengue, Japanese Encephalitis Virus, Herpes Virus and Chikungunya. Clinically important bacteria- Staphylococci, Streptococci, Pneumococcus, and Mycobacteria; Clinically important fungal infection- Aspergillosis, Mucormycosis (Black fungus) and Candidiosis etc. Clinically important Protozoan's and Helminthes infections- Amebiasis, Malaria & cysticercosis.

**Module V****Disease and therapy**

Disease: Types, Causes, Symptoms, diagnosis and treatment of genetic Diseases, Diabetes, Cardiovascular disease, Cancer, Neurogenetic disorders, Liver diseases and Chronic respiratory diseases. Treatment products from recombinant and non-recombinant organisms, Interferons, Antisense therapy, Gene therapy, Types of gene therapy and Immunotherapy; Modes of action of major groups of antimicrobial agents.

**Examination Scheme:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

**Text & References:****Text:**

- Marshall, W J, Clinical Chemistry, 3<sup>rd</sup> edition, Mosby, 1997.
- Harper's Biochemistry K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell, McGraw Hill/ Appleton and Lange

**References:**

- Sudbery, P. Human molecular genetics. Addison Wesley Longman (1998)
- Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, M.M. Cox., Worth Publishing
- Principles of Physical Biochemistry, K.E. Van Holde, W.C. Johnson, Prentice Hall

## ENZYMOLOGY AND PROTEIN ENGINEERING -Lab

**Course Code: MTB221**

**Credit Units:01**

**Course Objective:**

The laboratory will help the students to isolate enzymes from different sources, enzyme assays and studying their kinetic parameters which have immense importance in industrial processes.

1. Purification of Enzyme by ammonium sulphate fractionation.
2. Effect of Temperature and pH on enzyme activity.
3. Plot of enzyme kinetic graphs
4. Enzyme immobilization
5. Cloning and expression of protein
6. Effect of mutation on protein: In silico studies

**Examination Scheme:**

IA				EE		
Practical (Mid Term)	Viva	Regular Performance	Attendance	Practical (End Term)	Practical Record	Viva
20	15	10	05	25	10	15

**BIOPROCESS AND FERMENTATION TECHNOLOGY -Lab****Course Code: MTB222****Credit Units:01****Course Contents:****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 Kraut fermentation

**Module VIII**

Use of alginate for cell immobilization

**Examination Scheme:**

IA				EE		
Practical (Mid Term)	Viva	Regular Performance	Attendance	Practical (End Term)	Practical Record	Viva
20	15	10	05	25	10	15

**ADVANCED IMMUNOTECHNOLOGY -Lab****Course Code: MTB223****Credit Units:01****Course Objective:**

The objectives of the course is to understand the principles of immune function and immunization and to provide advanced training in modern cellular and molecular immunology, with emphasis on the interface between the basic and clinical aspects of the subject.

**Course Contents:****Module I**

Blood film preparation and identification of cells, Differential leucocyte count, Total leucocyte count, preparation of serum and plasma.

**Module II**

Lymphoid organs and their location in mice

**Module III**

Ouchterlony Double diffusion Test, Immunoelectrophoresis, ELISA:- DOT or SANDWICH

**Module IV**

Purification of IgG through affinity chromatography

**Module V**

Agglutination based tests: WIDAL Test, Identification of blood group

**Examination Scheme:**

IA				EE		
Practical (Mid Term)	Viva	Regular Performance	Attendance	Practical (End Term)	Practical Record	Viva
20	15	10	05	25	10	15

**Note:** Minor variation could be there depending on the examiner.

## ENVIRONMENTAL BIOTECHNOLOGY

**Course Code: MTB230**

**Credit Units:03**

### Theory

#### Course Objective:

The objective of this course is to familiarize the students with the processes and micro organism that can be employed for a cleaner environment. The students will be applying basic knowledge of microbiology for developing the practices for a cleaner environment, water, fuel, fertilizer, pesticides etc. The course also aims to make the students aware of legislation and acts prevalent to control the degradation of our eco system.

#### Course Contents:

##### Module I

Treatment of municipal wastes and industrial effluents (Physico-Chemical, biological analysis of waste water), Rr. Sec and test waste water treatment sludge treatment and disposal treatment of wastes from paper, textile, dairy, petrochemical and pharmaceutical industry .

##### Module II

Bioremediation and phytoremediation of toxic compounds like pesticides, hydrocarbons, polymers, surfactants, biotransformation and bioaccumulation

##### Module III

Renewable and non-renewable energy resources, clean fuel technology, biofuels.

##### Module IV

Biofertilizers and biopesticides – a cleaner agricultural practice, concept of N<sub>2</sub> - fixation, azolla, cyanobacteria, Rhizobium and VAM as biofertilizers.

##### Module V

Biomining – microbe assisted microbial leaching, bioaccumulation and bio sorption  
 Biosensors and biomarkers for ecotoxicity measurement, EIA and Environmental audit.  
 Principles in ecotoxicology; animal toxicity tests; statistical concepts of LD<sub>50</sub>; dose-effect and dose response relationship; frequency response and cumulative response; Biological and chemical factors and influence toxicity; global dispersion of toxic substance; dispersion and circulating mechanisms of pollutants; Aquatic toxicity testes; statistical tests; response of planktons to toxicants; EC<sub>50</sub>;

#### Examination Scheme:

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
<b>Weightage (%)</b>	15	5	10	10	10	50

#### Text & References:

##### Text:

- Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
- Introduction to Environmental Biotechnology, Milton Wainwright

##### References:

- Waste Water Engineering, Metcalf and Eddy. Publisher: Tata McGraw hill
- Agricultural Biotechnology, S.S. Purohit
- Environmental Microbiology: Methods and Protocols, Alicia L. Ragout De Spencer, Jonh F.T. Spencer  
 Principles of Environmental Engineering, Gilbert Masters

**ENTREPRENEURSHIP DEVELOPMENT IN BIOTECHNOLOGY****Course Code: MTB231****Credit Unit: 03****Theory****Course Objectives:**

To develop awareness about the biotechnology enterprise and Exposure of management principles and the global scenario of biotechnology industries by discussing the various aspects of bio-entrepreneurships, project management, biotech enterprises, business development in biotechnology and entrepreneurship opportunity in industrial biotechnology

**Module-I**

**BIO ENTERPREUNERSHIP:** Introduction to bio-business, from the Indian context, SWOT analysis of bio-business. Entrepreneur, Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology, pillars of bio-entrepreneurship and major start-ups in Biotechnology, Concept and theories of Entrepreneurship, Entrepreneurial traits and motivation, Nature and importance of Entrepreneurs, Government schemes for commercialization of technology (eg. Biotech Consortium India Limited).

**Module-II**

**PROJECT MANAGEMENT:** Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal.

**Module-III**

**BIOTECH ENTERPRISES:** Desirables in start-up, Setting up Small, Medium & Large scale industry, Quality control in Biotech industries, Location of an enterprise, steps for starting a small industry, incentives and subsidies, exploring export possibilities.

**Module-IV**

**BUSINESS DEVELOPMENT IN BIOTECHNOLOGY:** Factors affecting biotech business: (finance, infrastructure, equipment, manpower, resources, project location, end product, quality issues, etc) Basic principles and practices of management – Definition, concepts and application; Organization types, coordination, control and decision making in management

**Module-V**

**ENTREPRENEURSHIP OPPORTUNITY IN INDUSTRIAL BIOTECHNOLOGY:** Business opportunity, Essential requirement, marketing strategies, schemes, challenges and scope-with case study- Pollution monitoring and Bioremediation for Industrial pollutants, Pesticides, Herbicides etc. Integrated compost production- microbe enriched compost. Bio pesticide/insecticide production. Fermented products-probiotic and prebiotics. Stem cell production, stem cell bank, contract research. Production of monoclonal/polyclonal antibodies, Single cell protein and secondary metabolite production. Contact research in microbial genomics.

**Examination Scheme:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

**Suggested Book:**

1. Dynamics of Entrepreneurial Development and Management by Vasant Desai, Himalaya Publishing House, 2005.
2. Science Business: The Promise, the Reality, and the Future of Biotech by Gary P. Pisano Harvard Business School Press: 2006.
3. Innovation and entrepreneurship in biotechnology: Concepts, theories & cases by D. Hyne & John Kapeleris, 2006
4. Principles of Management P. C.Tripathi, P.N. Reddy Tata McGraw Hill Fifth Edition, 2012
5. Bio Entrepreneurship development-A resource book by BCIL, Govt of India 2018.

## PHARMACEUTICAL TECHNOLOGY and BIOTECHNOLOGY

**Course Code: MTB232**

**Credit Units:03**

### Theory:

#### Course Objective:

The main objectives are to cover representative pharmaceutical dosage forms and general issues of formulation, production, quality requirements, validation and uses and to gain an understanding of the challenges associated with quality pharmaceutical manufacturing

#### Pharmaceutical Technology:

##### Module –I:

**Introduction to Physical Pharmaceutics** – Metrology, Calculations and Posology.

**Pharmacopoeias & Formularies:** IP,BP,USP

**Packaging of Pharmaceuticals:** Polymer Science and Applications, Formulations and Development, Packaging

**Particulate Technology:** Particle Size, Size reduction, Size Separation, Powder Flow and Compaction

**Unit Operations:** Mixing, Evaporation, Filtration, Centrifugation, Extraction, Distillation, Sterilization, and Drying

##### Module-II

#### Pharmaceutical Dosage Forms & New Drug Delivery Systems:

Introduction to different dosage forms, their classification with examples (Official formulation), their relative application. Various route of drug administration.

Drug delivery systems: transdermal, parenteral, oral, mucosal, ocular, buccal, rectal and pulmonary delivery. Novel formulation approaches for better delivery of biotechnology derived drugs, such as reverse micelles, liposomes, microemulsions and microencapsulation.

#### Pharmaceutical Biotechnology:

##### Module III

#### Immunity & Immunological preparations.

Introduction about Immunity, Types of Immunity, Immunological preparations, Classification of Immunological preparations, Bacterial & Viral Vaccines, Method of preparation using animals, Alternative method using eggs, Diagnostic preparations containing bacterial toxins, Preparation containing antibodies used to produce passive immunity.

Blood & blood Products:

##### Module-IV

**Blood Products and Plasma Substitutes:** Collection, processing and storage of whole human blood, concentrated human RBCs, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin, fibrin foam, plasma substitutes: ideal requirements, PVP, dextran.

##### Module-V

#### Pharmaceutical Biotechnology based drug Products:

Introduction, Method of Preparation and Use of :Activase, Humulin,Streptokinase Humatrope, Hepatitis B vaccine.

Introduction, Method of Preparation and Use of : Penicillins, streptomycins, tetracyclines, vitamin B12 & ethanol.

#### Evaluation:

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
<b>Weightage (%)</b>	15	5	10	10	10	50

#### Text & References:

1. Daan J. A. Crommelin and Robert D. Sindelar, (2014). Pharmaceutical Biotechnology, 3<sup>rd</sup> Ed. Informa Healthcare USA, Inc.
2. Chandrakant Kokate, Pramod H.J and S.S. Jalalpure, (2012). Textbook of Pharmaceutical Biotechnology, Elsevier Health Sciences.
3. Vyas S.P and Dixit V.K. (2007) Pharmaceutical Biotechnology 1<sup>st</sup>Ed.CBS Publishers & Distributors.

## COMMUNICATION SKILLS - II

**Course Code:** BCS 211**Credit Units:**01**Course Objective:**

To enrich the understanding of English language and communication, structure, style, usage, and vocabulary for global business purposes.

**Course Contents:****Module I: Fundamentals of Communication**

Role and purpose of communication: *7 C's of communication*

Barriers to effective communication

Enhancing listening

Forms of Communication: one-to-one, informal and formal

**Module II: Verbal Communication (Written)**

Business Letter

Social correspondence

Writing resume and Job applications

**Module III: Speaking skills**

Conversational English

Guidelines to give an effective presentation

Activities to include:

Presentations by students

Just a minute

**Examination Scheme:**

Components	CT1	CT2	CAF	V	GD	GP	A
Weightage (%)	20	20	25	10	10	10	5

CAF – Communication Assessment File

GD – Group Discussion

GP – Group Presentation

**Text & References:**

- Business Communication, Raman – Prakash, Oxford
- Textbook of Business Communication, Ramaswami S, Macmillan
- Speaking Personally, Porter-Ladousse, Cambridge

**Behavioural Science – II**  
**(Behavioral Communication and Relationship Management)**  
 Course Code: **BSS211** Credit Units:01

**Course Objective:**

This course aims at imparting an understanding of:  
 Process of Behavioural communication  
 Aspects of interpersonal communication and relationship  
 Management of individual differences as important dimension of IPR

**Course Contents:****Module I: Behavioural Communication**

Scope of Behavioural Communication  
 Process – Personal, Impersonal and Interpersonal Communication  
 Guidelines for developing Human Communication skills  
 Relevance of Behavioural Communication in relationship management

**Module II: Managing Individual Differences in Relationships**

Principles  
 Types of issues  
 Approaches  
 Understanding and importance of self disclosure  
 Guidelines for effective communication during conflicts

**Module III: Communication Climate: Foundation of Interpersonal Relationships**

Elements of satisfying relationships  
 Conforming and Disconfirming Communication  
 Culturally Relevant Communication  
 Guideline for Creating and Sustaining Healthy Climate

**Module IV: Interpersonal Communication**

Imperatives for Interpersonal Communication  
 Models – Linear, Interaction and Transaction  
 Patterns – Complementary, Symmetrical and Parallel  
 Types – Self and Other Oriented  
 Steps to improve Interpersonal Communication

**Module V: Interpersonal Relationship Development**

Relationship circle – Peer/ Colleague, Superior and Subordinate  
 Initiating and establishing IPR  
 Escalating, maintaining and terminating IPR  
 Direct and indirect strategies of terminating relationship  
 Model of ending relationship

**Module VI: End-of-Semester Appraisal**

Viva based on personal journal  
 Assessment of Behavioural change as a result of training  
 Exit Level Rating by Self and Observer

**Examination Scheme:**

Components	SAP	A	Mid Term Test (CT)	VIVA	Journal for Success (JOS)
Weightage (%)	20	05	20	30	25

**Text & References:**

- Vangelist L. Anita, Mark N. Knapp, Inter Personal Communication and Human Relationships: Third Edition, Allyn and Bacon
- Julia T. Wood. Interpersonal Communication everyday encounter
- Simons, Christine, Naylor, Belinda: Effective Communication for Managers, 1997 1<sup>st</sup> Edition Cassell
- Harvard Business School, Effective Communication: United States of America
- Beebe, Beebe and Redmond; Interpersonal Communication, 1996; Allyn and Bacon Publishers.

**FRENCH - II****Course Code:** FLT 211**Credit Units:**02**Course Objective:**

- To enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French.
- To make them learn the basic rules of French Grammar.

**Course Contents:****Module A: pp.38 – 47 : Unité 3 : Objectif 3, 4, 5, 6****Module B: pp. 47 to 75 Unité 4, 5****Contenu lexical:****Unité 3: Organiser son temps**

1. donner/demander des informations sur un emploi du temps, un horaire SNCF – Imaginer un dialogue
2. rédiger un message/ une lettre pour ...
  - i) prendre un rendez-vous/ accepter et confirmer/ annuler
  - ii) inviter/accepter/refuser
3. Faire un programme d'activités  
imaginer une conversation téléphonique/un dialogue  
Propositions- interroger, répondre

**Unité 4: Découvrir son environnement**

1. situer un lieu
2. s'orienter, s'informer sur un itinéraire.
3. Chercher, décrire un logement
4. connaître les rythmes de la vie

**Unité 5: s'informer**

1. demander/donner des informations sur un emploi du temps passé.
2. donner une explication, exprimer le doute ou la certitude.
3. découvrir les relations entre les mots
4. savoir s'informer

**Contenu grammatical:**

1. Adjectifs démonstratifs
2. Adjectifs possessifs/exprimer la possession à l'aide de :  
i. « de » ii. A+nom/pronom disjoint
3. Conjugaison pronominale – négative, interrogative -  
construction à l'infinitif
4. Impératif/exprimer l'obligation/l'interdiction à l'aide de « il faut... »/ «il ne faut pas... »
5. passé composé
6. Questions directes/indirectes

**Examination Scheme:**

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

**Text & References:**

- le livre à suivre: Campus: Tome 1

**GERMAN – II****Course Code:** FLG 211**Credit Units:**02**Course Objective:**

To enable the students to converse, read and write in the language with the help of the basic rules of grammar, which will later help them to strengthen their language.

To give the students an insight into the culture, geography, political situation and economic opportunities available in Germany

Introduction to Grammar to consolidate the language base learnt in Semester I

**Course Contents:****Module I: Everything about Time and Time periods**

Time and times of the day.

Weekdays, months, seasons.

Adverbs of time and time related prepositions

**Module II: Irregular verbs**

Introduction to irregular verbs like to be, and others, to learn the conjugations of the same, (fahren, essen, lessen, schlafen, sprechen und ähnliche).

**Module III: Separable verbs**

To comprehend the change in meaning that the verbs undergo when used as such

Treatment of such verbs with separable prefixes

**Module IV: Reading and comprehension**

Reading and deciphering railway schedules/school time table

Usage of separable verbs in the above context

**Module V: Accusative case**

Accusative case with the relevant articles

Introduction to 2 different kinds of sentences – Nominative and Accusative

**Module VI: Accusative personal pronouns**

Nominative and accusative in comparison

Emphasizing on the universal applicability of the pronouns to both persons and objects

**Module VII: Accusative prepositions**

Accusative prepositions with their use

Both theoretical and figurative use

**Module VIII: Dialogues**

Dialogue reading: 'In the market place'

'At the Hotel'

**Examination Scheme:**

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

**Text & References:**

- Wolfgang Hieber, Lernziel Deutsch
- Hans-Heinrich Wangler, Sprachkurs Deutsch
- Schulz Griesbach, Deutsche Sprachlehre für Ausländer
- P.L Aneja, Deutsch Interessant- 1, 2 & 3
- Rosa-Maria Dallapiazza et al, Tangram Aktuell A1/1,2
- Braun, Nieder, Schmöe, Deutsch als Fremdsprache 1A, Grundkurs

**SPANISH – II****Course Code:** FLS 211**Credit Units:**02**Course Objective:**

To enable students acquire more vocabulary, grammar, Verbal Phrases to understand simple texts and start describing any person or object in Simple Present Tense.

**Course Contents:****Module I**

Revision of earlier modules.

**Module II**

Some more AR/ER/IR verbs. Introduction to root changing and irregular AR/ER/IR ending verbs

**Module III**

More verbal phrases (eg, Dios Mio, Que lastima etc), adverbs (*bueno/malo, muy, mucho, bastante, poco*). Simple texts based on grammar and vocabulary done in earlier modules.

**Module IV**

Possessive pronouns

**Module V**

Writing/speaking essays like my friend, my house, my school/institution, myself....descriptions of people, objects etc, computer/internet related vocabulary

**Examination Scheme:**

<b>Components</b>	<b>CT1</b>	<b>CT2</b>	<b>C</b>	<b>I</b>	<b>V</b>	<b>A</b>
<b>Weightage (%)</b>	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

**Text & References:**

- Español, En Directo I A
- Español Sin Fronteras

**CHINESE – II****Course Code:** FLC 211**Credit Units:**02**Course Objective:**

Chinese is a tonal language where each syllable in isolation has its definite tone (flat, falling, rising and rising/falling), and same syllables with different tones mean different things. When you say, “ma” with a third tone, it mean horse and “ma” with the first tone is Mother. The course aims at familiarizing the student with the basic aspects of speaking ability of Mandarin, the language of Mainland China. The course aims at training students in practical skills and nurturing them to interact with a Chinese person.

**Course Contents:****Module I**

Drills

Practice reading aloud

Observe Picture and answer the question.

Tone practice.

Practice using the language both by speaking and by taking notes.

Introduction of basic sentence patterns.

Measure words.

Glad to meet you.

**Module II**

Where do you live?

Learning different colors.

Tones of “bu”

Buying things and how muchit costs?

Dialogue on change of Money.

More sentence patterns on Days and Weekdays.

How to tell time. Saying the units of time in Chinese. Learning to say useful phrases like – 8:00, 11:25, 10:30 P.M. everyday, afternoon, evening, night, morning 3:58, one hour, to begin, to end ..... etc.

Morning, Afternoon, Evening, Night.

**Module III**

Use of words of location like-li, wais hang, xia

Furniture – table, chair, bed, bookshelf,.. etc.

Description of room, house or hostel room.. eg what is placed where and how many things are there in it?

Review Lessons – Preview Lessons.

Expression ‘yao’, ‘xiang’ and ‘yaoshi’ (if).

Days of week, months in a year etc.

I am learning Chinese. Is Chinese difficult?

**Module IV**

Counting from 1-1000

Use of “chang-chang”.

Making an Inquiry – What time is it now? Where is the Post Office?

Days of the week. Months in a year.

Use of Preposition – “zai”, “gen”.

Use of interrogative pronoun – “duoshao” and “ji”.

“Whose”??? Sweater etc is it?

Different Games and going out for exercise in the morning.

**Module V**

The verb “qu”

Going to the library issuing a book from the library

Going to the cinema hall, buying tickets

Going to the post office, buying stamps

Going to the market to buy things.. etc

Going to the buy clothes .... Etc.

Hobby. I also like swimming.

Comprehension and answer questions based on it.

**Examination Scheme:**

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

**Text & References:**

- “Elementary Chinese Reader Part I” Lesson 11-20

**BIOPROCESS PLANT DESIGN****Course Code: MTB301****Credit Units:03****Course Objective:**

The Objective of this paper is to include not only application of chemical engineering principles/ unit operation to bioprocess system but also to include the principles of disciplines of mechanical, electrical and industrial engineering to design a completely economically optimal process using living or subcomponent of cells

**Course Contents:****Module I**

Introduction; General design information; Mass and energy balance; Flow sheeting; Piping and instrumentation.

**Module II**

Materials of construction for bioprocess plants; Mechanical design of process equipment; Vessels for biotechnology application.

**Module III**

Design of bioreactors; Design considerations for maintaining sterility of process streams processing equipment; Selection and specification of equipment for handling fluids and solids; Selection, specification design of heat and mass transfer equipment used in bioprocess industries

**Module IV**

Design of facilities for cleaning of process equipment used in biochemical industries; Utilities for biotechnology production plants; Process economics

**Module V**

Bioprocess validation; Safety Considerations; Case studies.

**Examination Scheme:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

**Text & References:****Text:**

- Process Plan Layout and Piping Design, E. Bausbacher, R. Hunt, Prentice Hall PTR.
- Chemical Engineering, R.K. Sinnott, J.M. Coulson and J.F. Richardsons, Butterworth- Heinemann.
- Applied Process design for Chemical and Petrochemical Plants, E. E. Ludwig, Butterworth- Heinemann.

**References:**

- Chemical Engineers Handbook, R.H. Perry and D.W. Green, McGraw- Hill.
- Plant Design and Economics for Chemical Engineers, M. Peters and K. Timmerhaus.

## DOWNSTREAM PROCESSING

**Course Code: MTB 302**

**Credit Units:03**

### Course Objective:

The syllabus will help the students to characterize the Bioproducts of biotechnological importance and to get expertise in their downstream processing.

### Course Contents:

#### Module I

Characteristics of Bioproducts, Conditioning of broth, Mechanical separation, Filtration, Centrifugation, Cell disruption techniques, Protein precipitation and separation.

#### Module II

Aqueous - two-phase extraction; Adsorption-desorption processes; Membrane based separation: Dialysis, Electro dialysis, Micro filtration, Ultra filtration.

#### Module III

Chromatographic methods of separation based on size, charge, reverse phase, hydrophobic interactions, and biological affinity, HPLC, FPLC, MS-LC, Gas chromatography.

#### Module IV

Electrophoresis, principle, types on the basis of support media, 1D, 2D gel electrophoresis, continuous and capillary electrophoresis.

#### Module V

Crystallization, Drying, Case studies.

### Examination Scheme:

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

### Text & References:

#### Text:

- Bioseparations: Downstream Processing for Biotechnology, P.A. Belter et al, John Wiley and Sons Inc.

#### References:

- Practical Biochemistry, Principles & Techniques, Keith Wilson and John Walker
- Bioseparations: Principles and Techniques, Sivasankar, Prentice-Hall
- Biochemical Engineering Fundamentals, J.E. Bailey and D.F. Ollis, McGraw-Hill
- Biotreatment, Downstream Processing and Modelling (Advances in Biochemical Engineering/ Biotechnology, Vol 56), T. Scheper et al, Springer Verlag
- Chromatographic and Membrane Processes in Biotechnology, C.A. Costa and J.S. Cabral, Kluwer Academic Publisher
- Downstream Processing, J.P. Hamel, J.B. Hunter and S.K. Sikdar, American Chemical Society
- Protein Purification, M.R. Ladisch, R.C. Wilson, C.C. Painton and S.E. Builder, American Chemical Society

## NANOBIOTECHNOLOGY

**Course Code: MTB 303****Credit Units:03**

**Course objective:** Nanotechnology is one of the most important and influential fields in today's scenario. It holds tremendous potential and have shown significant impact on both basic and applied sciences. The major objective of this course is to introduce this contemporary area to the students so that they can apply their knowledge to develop new applications in the field of biomedicine.

**Course contents****Module I: Introduction to Nanotechnology**

Overview of nanotechnology developments, different nanostructured materials, various rules governing the health and safety standards related to the use of chemicals and nanomaterials, the physical environment required for working with nanomaterials.

**Module II: Investigation and manipulation of nanomaterials**

Construction, working principle and applications of electron microscopies, scanning probe microscopies, optical microscopies, Fourier transform infrared spectroscopy, X-ray photoelectron spectroscopy and X-ray diffraction for nanosciences and technology.

**Module III: Nanostructures for medicinal applications**

Overview of nanobiotechnology and nanomedicine with future perspectives. Biological barriers to nanocarrier-mediated delivery of therapeutic and imaging agents, nanoparticle contrast agents for molecular magnetic resonance imaging, micro- and nanoscale control of cellular environment for tissue engineering. Nanotechnology in cancer.

**Module IV: Societal implications of Nanoscience**

From the first industrial revolution to the nano revolution, implications of Nanoscience and nanotechnology on Society, Nano policies, Nano arms race, public perception and public involvement in the nano discourse, Harnessing nanotechnology for economic and social development.

**Module V: Nanomaterials and Toxicity**

Toxicity – nanoparticles in the environment – Health threats- nanomaterials and biotoxicity – Iron oxide – Titanium dioxide-dark studies – UV irradiation- In vivo - In Vitro and cytotoxicity studies.

**Examination Scheme:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

**Books:**

- Nanobiotechnology: Concepts, Applications and Perspectives by Christof M. Niemeyer and Chad A. Mirkin, First Wiley 2006, ISBN: 978-3-527-60591-0.
- Nanobiotechnology II: More Concepts and Applications by Chad A. Mirkin and Christof M. Niemeyer, Wiley 2007, ISBN: 978-3-527-31673-1.
- Nano: The essentials - Understanding the nanoscience and technology by T. Pradeep, Tata McGraw-Hill Publishing Company Limited 2008, ISBN-10:0-07-154829-7 / 0071548297.

## RECOMBINANT DNA TECHNOLOGY

**Course Code: MTB 304**

**Credit Units:03**

### Course Objective:

A complete understanding of molecular techniques like DNA sequencing, restriction mapping, PCR for the cloning and expression of genes implication can be obtained through the course. The successful application of biotechnology largely depends on these advanced molecular techniques.

### Course Contents:

#### Module I

Basic tools, specialized enzymes and specialized cloning vectors (e.g. Antarctic Phosphatase), Specialized cloning vectors (e.g. TOPO, TA, Gateway)

#### Module II: Gene isolation

Expression libraries and their screening, Techniques for analysis of genomic libraries (e.g. 3' RACE, 5' RACE, chromosome walking, chromosome jumping), T-DNA and transposon mediated gene traps

#### Module III: Heterologous gene expression (bacteria and yeast)

Advances in engineering of genes (codon optimization, translational enhancers, mRNA stabilizing factors), vectors (targeting signals, selection markers, purification and solubility tags) and hosts for overexpression and analysis

#### Module IV: Studying gene regulation and control

In-vitro transcription translation, run-on assays, protein-protein and protein-DNA interactions, promoter characterization, differential display. Manipulation of gene expression: Genome wide mutagenesis, gene silencing, RNAi, aptamers, constitutive and tissue specific promoters, expression enhancing elements, terminator technology

#### Module V:

##### Automation and robotic advances in RDT

DNA & protein isolation (alternatives to conventional methods) and sequencing (example from Human Genome Project and other sequencing projects), PCR machines, imaging and gel documentation

##### Laboratory, industrial and environmental applications of RDT

High throughput research, disease diagnosis and cure, forensics, DNA vaccines, drug discovery, maintaining genetic diversity, transgenic technology, marker-free GMOs

### Examination Scheme:

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

### Text & References:

#### Text:

- Recombinant DNA by J.D. Watson et al., W.H. Freeman and Company
- Recombinant DNA Technology by T. A. Brown
- Principles of Gene Manipulation: An Introduction to Genetic Engineering by R.W. Old and S. B Primrose, Blackwell Science Inc

#### References:

- Molecular Biotechnology: Principles and Applications of Recombinant DNA by B.R. Grick and J.J. Pasternak, ASM Press
- Molecular and Cellular Cells Methods in Biology and Medicine by P.B. Kaufman, W. Wu, D. Kim and C.J. Cseke, CRC Press.
- "Milestones in Biotechnology: Classic Papers on Genetic Engineering" by J.A. Bavies and W.S. Reznikoff, Butterworth Heinemann.
- "Gene Expression Technology" by D.V. Goeddel in Methods in Methods in Enzymology, Academic Press Inc.
- "DNA Cloning: A Practical Approach" by D.M. Glover and B.D. Hames, IRL Press.

## GENOMICS AND PROTEOMICS

**Course Code: MTB 305**

**Credit Units:02**

**Course Objective:**

The course helps in developing a detailed understanding of eukaryotic 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.

**Course Contents:**

**GENOMICS**

**Module I: Introduction to Genomics**

Contents of genomes, Molecular markers, Bioinformatics for the analysis of sequence data.

**Module II: Transcriptomes**

Genome expression; RNA Contents,

Strategies for large-scale sequencing projects. The structure, function and evolution of the human genome. The human genome project. Human disease genes.

**PROTEOMICS**

**Module III: 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 solute. The activity of protein. Protein engineering principles.

**Module IV**

Fundamental methods used in proteomics, Relationship between protein structure and function. Post translational protein modification. Protein - protein interaction.

**Examination Scheme:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

**Text & References:**

**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.
- Gene cloning and DNA analysis – An introduction (fourth edition), T.A. Brown.

## DOWNSTREAM PROCESSING LAB

**Course Code: MTB 322**

**Credit Units: 01**

**Course Objective:**

The laboratory will help the students to extract different bioproducts during their characterization since any of these products may be of biotechnological importance. They can be exploited in exploring the future biotechnology.

**Course Contents:**

**Module I**

Conventional filtration and membrane based filtration

**Module II**

Protein precipitation and recovery

**Module III**

Aqueous two-phase separation

**Module IV**

Ion exchange chromatography

**Module V**

Gel Permeation chromatography

**Module VI**

Electrophoresis

**Examination Scheme:**

IA				EE		
Practical (Mid Term)	Viva	Regular Performance	Attendance	Practical (End Term)	Practical Record	Viva
20	15	10	05	25	10	15

**Note:** Minor variation could be there depending on the examiner.

**NANOBIOTECHNOLOGY LAB****Course Code: MTB 323****Credit units : 1**

1. Demonstration about occupational health and safety (OHS) or workplace health and safety (WHS) in nanotechnology.
2. Preparation of aqua regia, its handling and role in washing glass-wares for metal nanoparticles synthesis.
3. Surface plasmon resonance (SPR) properties of silver nanoparticles synthesised by plant extracts.
4. Optimization of temperature for metal nanoparticles preparation using biological molecules.
5. Investigation of UV-Vis spectroscopic feature of metal nanoparticles developed after temperature optimization.
6. Construction of bimetallic nanoparticles and their studies on their optical properties.
7. Interaction of nanoparticles with biological cells (Haemolysis or antimicrobial potential of metal nanoparticles).
8. Preparation of polymeric film for nanomedicine applications.
9. Functionalization of nanoparticles with drug or fluorescent molecules and confirmation of functionalization.

**Examination Scheme:**

IA				EE		
Practical (Mid Term)	Viva	Regular Performance	Attendance	Practical (End Term)	Practical Record	Viva
20	15	10	05	25	10	15

**Note:** Minor variation could be there depending on the examiner.

**RECOMBINANT DNA TECHNOLOGY LAB****Course Code: MTB 324****Credit Units: 01****Course Contents:**

1. Preparation and Transformation of competent cells by CaCl<sub>2</sub> method.
2. Restriction digestion
3. Ligation
4. Southern hybridization
5. Western blotting
6. RFLP
7. PCR

**Examination Scheme:**

IA				EE		
Practical (Mid Term)	Viva	Regular Performance	Attendance	Practical (End Term)	Practical Record	Viva
20	15	10	05	25	10	15

**Note:** Minor variation could be there depending on the examiner.

**GENOMICS AND PROTEOMICS LAB****Course Code: MTB 325****Credit Units: 01****Course Contents:**

1. Gene finding tools and Genome annotation
2. Comparison of two given genomes
3. Micro array and Micro array data analysis
4. Inference of protein function from structure
5. Two-hybrid methods

**Examination Scheme:**

<b>IA</b>				<b>EE</b>		
<b>Practical (Mid Term)</b>	<b>Viva</b>	<b>Regular Performance</b>	<b>Attendance</b>	<b>Practical (End Term)</b>	<b>Practical Record</b>	<b>Viva</b>
20	15	10	05	25	10	15

**Note:** Minor variation could be there depending on the examiner.

## ADVANCED FOOD TECHNOLOGY

**Course Code: MTB 330**

**Credit Units:03**

**Course Objective:**

The purpose of the food biotechnology major is to produce professional with a wide range of pertinent knowledge and skills in food chemistry, food microbiology and safety, quantitative skills, engineering and processing, marketing and consumer research.

**Course Contents:**

**Module I**

Processing and preservation technologies used in food industry: heating, drying, and baking, irradiation (infrared, microwave and radio frequency), concentration, freezing, chemical preservation, chilling, fermentation, a combination of those technologies.

**Module II**

Pre and post-harvest technologies for extension of storage life and better handling and transportation of fresh fruits and vegetables, to sustain freshness and reduce spoilage.

**Module III**

Development of environment - friendly packaging materials based on product characteristic and performance properties packaging materials, and finished package forms, process schedules for thermal processing of foods in cans, glass, tin-free steel and aluminum containers, and retortable pouches based on heat penetration studies and sterilization value.

**Module IV**

Starter culture, probiotics, prebiotics - their use as flavor enhancer and diseases/ infection combats, application in production of cheese, butter, ice-cream, yoghurt, application in biomedical research, e.g. recombinant LABs as vaccine; modified milk proteins.

**Module V**

Production of SCP (Single cell protein), baker's yeast, brewing industry, application of transgenic plants in food production, transgenic fish, transgenic poultry.

**Examination Scheme:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
<b>Weightage (%)</b>	15	5	10	10	10	50

**Text & References:**

*Text:*

- Food technology by Frazier.
- Food Microbiology, 2<sup>nd</sup> edition by Adams and Moss.

*References:*

- Introduction to food Biotechnology. Green, Perry Johnson 2002. CRC Press, Boca Raton Florida.
- Food Biotechnology- Techniques and application. Gauri S. Mittal 1992. Technomic Publishing Co., Inc., Lancaster.

## TISSUE ENGINEERING

**Course Code: MTB 331**

**Credit Units:03**

### Course Objective:

This course will cover topics related to the design and functional assessment of bioengineered tissue substitutes. Strategies for engineering tissues with a load-bearing function will be of particular focus. Strategies to study cell-surface and cell-cell interactions to physical stimuli, bioreactors, biological scaffolds and 3D cell-tissue constructs will be explored through recent papers.

### Course Contents:

#### Module I: Fundamentals of tissue engineering

Basic definition, History, Concepts and overview, Principles and components, current scope of development; use in therapeutics and in vitro testing

#### Module II: Engineering materials

Scaffolds: Functions, Types (ECM-like Scaffolds, Tissue-Derived Scaffolds, Fibrin Gel, Natural Sponge; Injectable Scaffolds, Elastic Scaffolds, Inorganic Scaffolds Composite Scaffolds). Biomaterials: properties, cellular adhesion, surface modifications. Polymers (Natural such as Protein and Polysaccharides; Synthetic such as Poly( $\alpha$ -hydroxyacids, Hydrogels and Polyurethanes), Composite.

#### Module III: Cell Sources:

**Fundamental properties of cells**, autologous, allogeneic, syngeneic, and xenogeneic cells, and genetically engineered cells, Stem and progenitor cells. Cell Extraction, Biomolecules /synthetic ECM: Growth Factors (Representative Growth factors), Delivery of Growth factors

#### Module IV: Tissue Culture & Engineering Design Aspects

Biomechanics aspects of tissue engineering: application of physical forces, Principles of Scaffold Design – Material considerations, 2 D cell expansion, 3D Tissue Architecture and Function Transport considerations, Bioreactors, Cell seeding and metabolism considerations, Design of Polymeric Scaffolds, Interface Biology – Biocompatibility/Immunogenicity.

#### Module V: Case Studies

Musculoskeletal Tissue Engineering, Cardiovascular Tissue Engineering, Neural Tissue Engineering, Visceral Tissue Engineering. Other Key Issues and Emerging Areas of Interest: Nanobiotechnology, Ethical Issues, FDA and Regulatory Issues, Tissue Engineering Market

### Examination Scheme:

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
<b>Weightage (%)</b>	15	5	10	10	10	50

### Text & References:

#### Text:

- Frontiers in Tissue Engineering (ISBN 0080426891), Patrick, Mikos, McIntire, Pergamon
- Principles of Tissue Engineering (ISBN 0124366309), Lanza, Langer, Vacanti, Academic Press

#### References:

- **Tissue Engineering: Engineering Principles for the Design of Replacement Organs and Tissues** By W. Mark Saltzman; Published Oxford University Press US, 2004, pp 523
- Tissue engineering Fundamentals and Applications By Yoshito Ikada, Published Elsevier, 2006, pp 469
- Tissue Engineering Methods & Protocols (ISBN 0896035166, Morgan and Yarmush, Humana Press.

**DRUG DISCOVERY & DEVELOPMENT****Course Code: MTB 332****Credit Units:03****Course Objective:**

The above course will be aimed to identify and design drugs that could be potentially useful in the identification of the candidate drugs, which have efficacy in cell culture or animal models, and thus the most effective compounds could be employed based on the above results for being moved through preclinical studies to clinical trials.

**Course Contents****Module: I****Drug discovery & development:**

General Introduction of drug design and development, Strategies for Target Identification and validation, Lead Identification and Optimization, Pre-Clinical Research and Clinical Research & Pharmacovigilance.

**Module: II****Drug development considerations:**

Introduction to Pharmacology, Sources of drugs, Dosage forms and routes of administration, mechanism of action, Combined effect of drugs, Factors modifying drug action, tolerance and dependence, Pharmacogenetics.

**Module: III****Pharmacokinetics:**

Pharmacokinetic, Pharmacodynamic and Toxicological considerations in drug development, Physiochemical properties of drugs in relations to their biological activity, Rout of drugs administrations, Various types of dosage formulations, Stability of drugs.

**Module: IV****Drug Receptor Theories:**

Principles of drug action, Mechanisms of drug action, Drug-receptor interactions, Types of drug targets, G-Protein coupled receptor, Ion Channels, Ligand Gated Ion Channels, Enzymatic drug receptor and Transducer mechanisms, Dose response relationship, Factors modifying drug action.

**Module: V****Rational Drug Design:**

Introduction, Types of drugs design: Legend based, Structure based, Rational drug discovery, Computer Aided drug design, De novo drug design methodologies.

Structure activity relationships in drug design, Statistical techniques behind QSAR, Molecular descriptors 3D QSAR and COMFA, Molecular modeling, Molecular docking and dynamics.

**Examination Scheme:**

Components	Mid Term	Attendance	Assignment/ Project/Seminar/Quiz	Class Test	Viva	EE
Weightage (%)	15	5	10	10	10	50

**Suggested Books:**

- New Drug Development: Design, Methodology, and Analysis, by J. Rick Turner, Published by John Wiley & Sons, 2007.
- Essentials of Medical Pharmacology by K D Tripathi, Published by JAYPEE Brothers Medical Publishers (P) Ltd. 7<sup>th</sup> Edition 2010.
- Biopharmaceutics & Pharmacokinetics by DM Brahmkar & SB Jaiswal, Published by Vallabh Prakashan; 3<sup>rd</sup> Edition 2012.
- Drug Discovery and Clinical Research, by S.K Gupta, Published by JAYPEE Brothers Medical Publishers (P) Ltd

## COMMUNICATION SKILLS - III

**Course Code: BCS311**

**Credit Units: 01**

### Course Objective:

To initiate the learners with the basic mechanics of writing skills and facilitate them with the core skills required for communication in the professional world.

### Course Contents:

#### Module I: Mechanics and Semantics of Sentences

Writing effective sentences

Style and Structure

#### Module II: Developing writing skills

Inter - office communication: Business Letter; E mails; Netiquette

Intra – office communication: Memos, Notices, Circulars, Minutes

Report Writing

#### Module III: Business Presentations

Planning, design and layout of presentation

Information Packaging

Audience analysis

Audio visual aids

Speaking with confidence

Case Studies

### Examination Scheme:

Components	CT1	CT2	CAF	V	GD	GP	A
Weightage (%)	20	20	25	10	10	10	5

CAF – Communication Assessment File

GD – Group Discussion

GP – Group Presentation

### Text & References:

- Krishnaswamy, N, Creative English for Communication, Macmillan
- Raman Prakash, Business Communication, Oxford.

## Behavioral Science III (Leading Through Teams)

**Course Code: BSS311**

**Credit Units: 01**

### Course Objective:

This course aims to enable students to:  
Understand the concept and building of teams  
Manage conflict and stress within team  
Facilitate better team management and organizational effectiveness through universal human values.

### Course Contents:

#### Module I: Teams: An Overview

Team Design Features: team vs. group  
Effective Team Mission and Vision  
Life Cycle of a Project Team  
Rationale of a Team, Goal Analysis and Team Roles

#### Module II: Team & Sociometry

Patterns of Interaction in a Team  
Sociometry: Method of studying attractions and repulsions in groups  
Construction of sociogram for studying interpersonal relations in a Team

#### Module III: Team Building

Types and Development of Team Building  
Stages of team growth  
Team performance curve  
Profiling your Team: Internal & External Dynamics  
Team Strategies for organizational vision  
Team communication

#### Module IV: Team Leadership & Conflict Management

Leadership styles in organizations  
Self Authorized team leadership  
Causes of team conflict  
Conflict management strategies  
Stress and Coping in teams

#### Module V: Global Teams and Universal Values

Management by values  
Pragmatic spirituality in life and organization  
Building global teams through universal human values  
Learning based on project work on Scriptures like Ramayana, Mahabharata, Gita etc.

#### Module VI: End-of-Semester Appraisal

Viva based on personal journal  
Assessment of Behavioural change as a result of training  
Exit Level Rating by Self and Observer

### Examination Scheme:

Components	SAP	A	Mid Term Test (CT)	VIVA	Journal for Success (JOS)
Weightage (%)	20	05	20	30	25

### Text & References:

- Organizational Behaviour, Davis, K.
- Hoover, Judith D. Effective Small Group and Team Communication, 2002, Harcourt College Publishers
- LaFasto and Larson: When Teams Work Best, 2001, Response Books (Sage), New Delhi
- Dick, Mc Cann & Margerison, Charles: Team Management, 1992 Edition, viva books
- J William Pfeiffer (ed.) Theories and Models in Applied Self Development and Interpersonal Skills, Vol 2, Group (1996); Pfeiffer & Company
- Smither Robert D.; The Psychology of Work and Human Performance, 1994, Harper Collins College Publishers

## FRENCH - III

**Course Code: FLT311**

**Credit Units: 02**

### Course Objective:

To provide the students with the know-how

- To master the current social communication skills in oral and in written.
- To enrich the formulations, the linguistic tools and vary the sentence construction without repetition.

### Course Contents:

**Module B: pp. 76 – 88 Unité 6**

**Module C: pp. 89 to103 Unité 7**

#### Contenu lexical: Unité 6: se faire plaisir

1. acheter : exprimer ses choix, décrire un objet (forme, dimension, poids et matières) payer
2. parler de la nourriture, deux façons d'exprimer la quantité, commander un repas au restaurant
3. parler des différentes occasions de faire la fête

#### Unité 7: Cultiver ses relations

1. maîtriser les actes de la communication sociale courante  
(Salutations, présentations, invitations, remerciements)
2. annoncer un événement, exprimer un souhait, remercier, s'excuser par écrit.
3. caractériser une personne (aspect physique et caractère)

#### Contenu grammatical:

1. accord des adjectifs qualificatifs
2. articles partitifs
3. Négations avec de, ne...rien/personne/plus
4. Questions avec combien, quel...
5. expressions de la quantité
6. ne...plus/toujours - encore
7. pronoms compléments directs et indirects
8. accord du participe passé (auxiliaire « avoir ») avec l'objet direct
9. Impératif avec un pronom complément direct ou indirect
10. construction avec « que » - Je crois que/ Je pense que/ Je sais que

### Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

### Text & References:

- le livre à suivre : Campus: Tome 1

**GERMAN - III****Course Code: FLG311****Credit Units: 02****Course Objective:**

To enable the students to converse, read and write in the language with the help of the basic rules of grammar, which will later help them to strengthen their language.

To give the students an insight into the culture, geography, political situation and economic opportunities available in Germany

**Course Contents:****Module I: Modal verbs**

Modal verbs with conjugations and usage

Imparting the finer nuances of the language

**Module II: Information about Germany (ongoing)**

Information about Germany in the form of presentations or “Referat”– neighbors, states and capitals, important cities and towns and characteristic features of the same, and also a few other topics related to Germany.

**Module III: Dative case**

Dative case, comparison with accusative case

Dative case with the relevant articles

Introduction to 3 different kinds of sentences – nominative, accusative and dative

**Module IV: Dative personal pronouns**

Nominative, accusative and dative pronouns in comparison

**Module V: Dative prepositions**

Dative preposition with their usage both theoretical and figurative use

**Module VI: Dialogues**

In the Restaurant,

At the Tourist Information Office,

A telephone conversation

**Module VII: Directions**

Names of the directions

Asking and telling the directions with the help of a roadmap

**Module VIII: Conjunctions**

To assimilate the knowledge of the conjunctions learnt indirectly so far

**Examination Scheme:**

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

**Text & References:**

- Wolfgang Hieber, Lernziel Deutsch
- Hans-Heinrich Wangler, Sprachkurs Deutsch
- Schulz Griesbach, Deutsche Sprachlehre für Ausländer
- P.L Aneja, Deutsch Interessant- 1, 2 & 3
- Rosa-Maria Dallapiazza et al, Tangram Aktuell A1/1,2
- Braun, Nieder, Schmöe, Deutsch als Fremdsprache 1A, Grundkurs

**SPANISH – III****Course Code: FLS311****Credit Units: 02****Course Objective:**

To enable students acquire knowledge of the Set/definite expressions (idiomatic expressions) in Spanish language and to handle some Spanish situations with ease.

**Course Contents:****Module I**

Revision of earlier semester modules

Set expressions (idiomatic expressions) with the verb *Tener, Poner, Ir....*

Weather

**Module II**

Introduction to *Gustar...* and all its forms. Revision of *Gustar* and usage of it

**Module III**

Translation of Spanish-English; English-Spanish. Practice sentences.

How to ask for directions (using *estar*)

Introduction to IR + A + INFINITIVE FORM OF A VERB

**Module IV**

Simple conversation with help of texts and vocabulary

En el restaurante

En el instituto

En el aeropuerto

**Module V**

Reflexives

**Examination Scheme:**

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

**Text & References:**

- Español, En Directo I A
- Español Sin Fronteras -Nivel Elemental

**CHINESE – III****Course Code: FLC311****Credit Units: 02****Course Objective:**

Foreign words are usually imported by translating the concept into Chinese, the emphasis is on the meaning rather than the sound. But the system runs into a problem because the underlying name of personal name is often obscure so they are almost always transcribed according to their pronunciation alone. The course aims at familiarizing the student with the basic aspects of speaking ability of Mandarin, the language of Mainland China. The course aims at training students in practical skills and nurturing them to interact with a Chinese person.

**Course Contents:****Module I**

Drills  
 Dialogue practice  
 Observe picture and answer the question.  
 Introduction of written characters.  
 Practice reading aloud  
 Practice using the language both by speaking and by taking notes.  
 Character writing and stroke order

**Module II**

Measure words  
 Position words e.g. inside, outside, middle, in front, behind, top, bottom, side, left, right, straight.  
 Directional words – beibian, xibian, nanbian, dongbian, zhongjian.  
 Our school and its different building locations.  
 What game do you like?  
 Difference between “hi” and “neng”, “key”.

**Module III**

Changing affirmative sentences to negative ones and vice versa  
 Human body parts.  
 Not feeling well words e.g. ; fever, cold, stomach ache, head ache.  
 Use of the modal particle “le”  
 Making a telephone call  
 Use of “jiu” and “cai” (Grammar portion)  
 Automobiles e.g. Bus, train, boat, car, bike etc.  
 Traveling, by train, by airplane, by bus, on the bike, by boat etc.

**Module IV**

The ordinal number “di”  
 “Mei” the demonstrative pronoun e.g. mei tian, mei nian etc.  
 use of to enter to exit  
 Structural particle “de” (Compliment of degree).  
 Going to the Park.  
 Description about class schedule during a week in school.  
 Grammar use of “li” and “cong”.  
 Comprehension reading followed by questions.

**Module V**

Persuasion-Please don't smoke.  
 Please speak slowly  
 Praise – This pictorial is very beautiful  
 Opposites e.g. Clean-Dirty, Little-More, Old-New, Young-Old, Easy-Difficult, Boy-Girl, Black-White, Big-Small, Slow-Fast ... etc.  
 Talking about studies and classmates  
 Use of “it doesn't matter”  
 Enquiring about a student, description about study method.  
 Grammar: Negation of a sentence with a verbal predicate.

**Examination Scheme:**

<b>Components</b>	<b>CT1</b>	<b>CT2</b>	<b>C</b>	<b>I</b>	<b>V</b>	<b>A</b>
<b>Weightage (%)</b>	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

**Text & References:**

- “Elementary Chinese Reader Part I, Part-2” Lesson 21-30

## PROJECT

**Course code:** MTB 460

**Credit Units:** 24

### GUIDELINES FOR PROJECT FILE

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation. Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

### In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated goals.
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen that may be useful to document for future reference.

### Report Layout

The report should contain the following components:

#### ➤ Title or Cover Page

The title page should contain the following information: Project Title; Student's Name; Course; Year; Supervisor's Name.

#### ➤ Acknowledgements (optional)

Acknowledgment to any advisory or financial assistance received in the course of work may be given.

#### ➤ Abstract

A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project

#### ➤ Table of Contents

Titles and subtitles are to correspond exactly with those in the text.

#### ➤ Introduction

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

#### ➤ Materials and Methods

This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.

#### ➤ Results and Discussion

Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various sections, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary never write in "point" form.

### ➤ **Conclusion**

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

### ➤ **Future prospects**

### ➤ **Appendices**

The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

### ➤ **References/ Bibliography**

This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

### **Examples**

#### **For research article**

Voravuthikunchai SP, Lortheeranuwat A, Ninprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic *Escherichia coli* O157: H7. *Clin Microbiol Infect*, 8 (suppl 1): 116–117.

#### **For book**

Kowalski, M. (1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), 7: 63-67

### **ASSESSMENT OF THE PROJECT FILE**

Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution.

Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project.

Project execution is concerned with assessing how much work has been put in.

The File should fulfill the following *assessment objectives*:

### **Range of Research Methods used to obtain information**

### **Execution of Research**

#### **Data Analysis**

Analyse Quantitative/ Qualitative information

Control Quality

#### **Draw Conclusions**

**Examination Scheme:** Evaluation will be done by external examiner

Project Report                      50

Viva Voce                              50

**Total**                                      **100**

**AANANDAM**  
**(RUSA – Govt. of Rajasthan)**

**Course Code: AND001/002/003**

**Credit:2 /sem**

**Ref:** 27.11, Academic Council of AUR

### **INTRODUCTION**

**Aanandam is a credited subject** that aims to instill **the joy of giving** and sharing in young people through community participation, helping them to be responsible citizens and be initiators of change for a healthy society. A daily act of goodness and charity will infuse the habit of community service in students. The faculty will emphasize shift in focus-Happiness is not in acquiring things, but permanent happiness comes from giving, sharing, and caring for someone.

The faculty will inspire students for Individual Social Responsibility (ISR) and will inculcate the qualities of compassion, an open mind, a willingness to do whatever is needed and positive attitude in students. Imagination and Creativity are to be appreciated. An aim and a vision are to be developed in students.

### **OUTCOME OF AANANDAM COURSE**

The student should develop:

- Awareness and empathy regarding community issues
- Interaction with the community and impact on society
- Interaction with mentor and development of Student teacher relationship
- Interaction among students, enlarge social network
- Cooperative and Communication skills and leadership qualities
- Critical thinking, Confidence and Efficiency

### **AANANDAM: COMMUNITY SERVICE**

- Community service programs are very effective for students' **personal** and **social**, ethical, and **academic** development. These effects depend on the characteristics of the programs chosen
- Involvement of students in community work has an impact on development of student **skills, creativity, critical thinking, and innovative powers. Passion and Positivity** are basic requirements for Community service
- They would **examine social challenges** /problems, **assess the needs** of the community, **evaluate** previous implemented projects, and **think of further solutions**
- They would learn to cooperate and collaborate with other agencies and inculcate leadership qualities.

### **BENEFITS TO THE STUDENTS**

Students should dedicate time as a volunteer as it helps them to:

- apply their knowledge and skills to solve specific community problem
- learn to plan, lead, and organize community events have a sense of belonging to their college campus and community and find something they are interested in doing during their free time
- make new friends, expand social network, and boost social skills and mental health.
- obtain employment

- be useful to society as it will protect them against stress, frustration, and depression

### ABOUT AANANDAM COURSE

Students are expected to engage in:

- An individual act of goodness – caring, sharing and giving (time and energy) everyday group activity – a project in service of the local community (Group Community Service Project)
- **Aanandam Day- will be celebrated once a month in the last week as decided by Director/HoIs.**
- **It is a credited subject. Marks/ Grades both will be entered in the marks sheet as per the university rules.**
- Two credits for a project in each semester
- 50 marks for each project to be completed in 4 Months.

### DIRECTIONS FOR STUDENTS

- Do at least one individual act of goodness each day and Record this act in a dedicated diary/register
- Share this dedicated diary/register in a 30-minute **Anandam period** with the mentor and share your experience with the class
- Students in **Semester scheme** must take up one Group Community Service Project per semester
- Students in **Annual scheme** must take up two Group Community Service Projects per year
- Take one Group Community Service Project from **August to November**
- Take one Group Community Service Project from **January to April**
- The students must take photographs to document their work
- The students can obtain certificate from the NGO/ Government Agency they are working with for Group Community Service Project
- The students may submit newspaper cuttings
- The students must participate in the **Aanandam Day** by displaying charts of their Group Community Service Project
- They can make power point presentations of their project which will help them get better grades

### ROLE OF FACULTY MENTOR

- The mentor will **maintain a register** wherein the entry of act of goodness will be tick mark and be submitted every day to the Director/HoIs
- Review every student's dedicated register to see if they have recorded an act of goodness for that day and mark in register. The **act will not be evaluated** - just if it was recorded or not. **(Be suggestive not judgmental)**
- In half an hour class some students and faculty will deliberate on the pleasure of giving and acts of goodness. This should be done by rotation so that all students get a chance to speak and express themselves
- The mentor will divide the class for the Group Community Service Project and record it in a register. **8-12 students can form a group** for project work.
- The students will opt the project of their choice.
- The mentors can mobilize the required resources and support for the projects. They can coordinate and collaborate with Government bodies or NGOs.
- The mentor will guide the students to write the Group Community Service Project Report.

- Mentors will review the project on monthly basis and submit the report to the nodal officer of the college to compile and share with higher authorities on Google spread sheet

### ROLE OF DIRECTOR/HOIS

- Allot one period of half an hour for Aanandam course
- Assign all faculty members as mentors for this period of half an hour for students
- Each faculty will have one class to mentor
- Appoint one faculty as department Aanandam Coordinator to monitor the program in their department and submit the monthly report to the University Nodal Officer which he/she will submit further to DCE – Govt. of Rajasthan.
- To coordinate the **Aanandam Day** activities
- To organize **Aanandam Day** in the last week of the month. A film or motivational lecture by some philanthropist (Bhamashah, Collector, Janpratinidhi) should be organized for the benefit of students (to motivate and inspire them for community service)
- Photographs of the **Aanandam Day** should be displayed in department and these should be uploaded in the gallery of University web page on HTE portal
- A **Project Assessment Committee** (PAC) to be constituted to assess the project report.

### PROJECT ASSESSMENT COMMITTEE

#### Formation of Project Assessment Committee

- **Director/HoIs**
- **One person from community**
- **Departmental Aanandam Coordinator**
- **Project Mentors (1 to 7 or more members)**

The number of mentors can vary depending on the number of projects and students in each department.

- University level PAC to be formed for university colleges and departments
- State level PAC to be formed at Commissionerate level for Universities

### PROJECTS: SUGGESTIVE LIST

The students and mentor as per their interest would support activities of community service such as:

- literacy programs, in today's digital age many organizations/individuals might also need help with email and websites
- livelihood projects,
- time giving activities to adopted communities (awareness regarding Govt. programmes) sports like yoga, meditation, drills, and physical exercises in adopted areas
- activities on arts and culture such as restoration of traditional art and culture and monuments.
- understand their responsibility in taking care of environment and appreciating cultural diversity
- While some students would be interested in awareness about environment such as protecting and preserving natural resources and animal species (the flora and the fauna). Plantation and animal care centers

- A few would be concerned with healthcare like medical and dental missions, first-aid training, etc.
- Another group may be formed for attending to old people(who have money but need assistance for market and groceries) [Time Bank]
- Another group may be formed for civic activities, awareness programmes.
- Local social problems to be taken up and solutions devised
- Innovations and Startups to be encouraged
- help plant a community garden, help out at a children's camp

## THE PROJECT REPORT

**The project report should be guided by the mentor and shall contain:**

- **Synopsis:** clearly stating objectives and activities to be undertaken. Problem identifying and problem-solving projects to be taken up.
- Details of the **Mentor and the Participants** are to be given (name of mentor, name of participants, phone number/mobile no, email, and address)
- Location / community where the work was carried out
- Details of Activities performed are to be given with date
- Number of beneficiaries and impact on the society(the object should be to empower the community and make them self-reliant)
- Photographs taken for documentation of work should be submitted
- Media coverage of the projects should be attached if any
- Students should also submit their certificates from the government bodies and or non government bodies they collaborate with, if any
- Photographs of **Display charts** or **ppt/video** prepared while presentation on the group community service in the **Aanandam Day** must be submitted along with the report
- The Group Community Service Project Report will be submitted by the Student group leader under the guidance of the mentor to the Director/HoIs of the Department.
- The Director/HoIs should get the best report (more than one if required) of the Group Community Service Project uploaded on the HTE website and on the University page
- The Director/HoIs will forward the best report of the department to the Nodal Officer of the University.
- University will forward the report to the state level committee.

## PROCEDURE FOR EVALUATION

- **Project Assessment Committee** will assess the Group Community Service Project Report
- submitted by the students, in the duly filled given format, based on:
- Submission of the student dedicated daily diary as per student attendance norms students' performance and interaction with the community
- presentation of the project report
- impact on society and the course outcome results

**Format for evaluation by Project Assessment Committee (Total max marks 50)**

- Submission of register of everyday activity mandatory (if register is not submitted by the student, he/she will not be evaluated and considered for the award)
- Report contains presentation /video (**max.10 marks**)
- Photographs of Students' participation and involvement of community (**max.10 marks**)
- Problem solving and challenging issues addressed/innovation (**max. 30 marks**)

## EVALUATION: GRADES EQUIVALENCE

Project Assessment Committee constituted will assess the projects  
For 4 months Group Community Service Project the grade equivalence is as follows:

**Total: 64 Hrs**

**Grading Marks**

**C grade =32 hrs**

**B grade >32hrs to <=44hrs**

**A grade >44hrs to <=54hrs**

**O grade >54hrs to <=64hrs**

**AWARD AND RECOGNITION DEPARTMENT, UNIVERSITY AND STATE LEVEL**

- Based on the impact on society and Aanandam project outcome one Group Community Service Project will be selected by the Project Assessment Committee at department level for award of best project of the Department.
- The best project report of the University will be submitted to the Director, College Education/ Department of Higher and Technical Education for contesting the state level award
- State Level Project Assessment Committee will evaluate projects received from all the universities (one each).
- A certificate/letter of appreciation to the winning teams (Nodal officer of the university, students, and mentor of the project) will be given