



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

**Bachelor of Science (Honours) Biotechnology**

**Programme Code: BSB**

**12044**

**Duration – 3 Years Full Time**

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

**AMITY UNIVERSITY RAJASTHAN**

**JAIPUR**

# BSc Biotechnology

## Credit Summary Sheet

Semester	Core (CC)	Domain Electives (DE)	VA	Open Electives(OE)	Total
1	16	3	4	-	25
2	16	3	4	3	28
3	13	3	4	3	25
4	15	3	4	3	27
5	22	3	4	3	34
6	25				25
<b>Total</b>	<b>107</b>	<b>15</b>	<b>20</b>	<b>12</b>	<b>164</b>

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

## **PROGRAMME LEARNING OUTCOMES**

- Provide students with a good foundation of knowledge and hands-on practical experience of the different fields of biotechnology.
- Cultivate an integrated perspective of different courses of biotechnology.
- Equip students with various valuable transferable skills like presentation techniques, communication skills, exposure to problem solving, teamwork and the use of information technology.
- Aid the students of this 3-year programme to bridge the gap between industry and academia

**Minor Track: Introductory Biotechnology**

Course Code	Course Title	Category	Lectures (L) Hours Per Week	Tutorial (T) Hours Per Week	Practical (P) Hours Per Week	Total Credits
BSB 203	Microbiology	CC	3			3
BSB 301	Molecular Biology	CC	2			2
BSB 401	Recombinant DNA Technology	CC	3			3
BSB 501	Plant Biotechnology	CC	3			3
					<b>Total</b>	<b>11</b>

<b>B. Sc. (Hon.) Biotechnology</b>						
<b>Semester I</b>						
<b>Code</b>	<b>Course</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P/FW</b>	<b>Credit Units</b>
BSB 101	Biochemistry	CC	3	-	-	3
BSB 102	Bioanalytical Techniques	CC	2	-	-	2
BSB103	Cell Biology	CC	3	-	-	3
BSB104	Plant science- I	CC	2	-	-	2
BSB 105	Chemistry – I	CC	2	-	-	2
BSB 121	Biochemistry -Lab	CC	-	-	2	1
BSB123	Cell Biology -Lab	CC	-	-	2	1
BSB124	Plant science- I-Lab	CC	-	-	2	1
BSB 125	Chemistry – I-Lab	CC	-	-	2	1
<b>DE Electives: Student has to select 1 course from the list of following DE electives</b>						
BSB130	Biochemical basis of disease	DE	3	-	-	3
BSB131		DE				
BSB132		DE				
AND001	ANANDAM-I	VA	-	-	-	2
BCS 101	English	VA	1	-	-	1
BSS 103	Understanding Self for Effectiveness – I	VA	1	-	-	1
FLT 101 FLG 101 FLS 101 FLC 101	Foreign Language - I French German Spanish Chinese	VA	2	-	-	2
<b>Total</b>						<b>25</b>

<b>B. Sc. (Hon.) Biotechnology</b>						
<b>Semester II</b>						
<b>Code</b>	<b>Course</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P/FW</b>	<b>Credit Units</b>
BSB 201	Metabolic Regulation	CC	3	-	-	3
BSB 202	Plant science -II	CC	2	-	-	2
BSB 203	Microbiology	CC	3	-	-	3
BSB 204	Chemistry - II	CC	2	-	-	2
BSB 205	Genetics	CC	2	-	-	2
BSB 222	Plant science –II -Lab	CC	-	-	2	1
BSB 223	Microbiology-Lab	CC	-	-	2	1
BSB 224	Chemistry - II-Lab	CC	-	-	2	1
BSB 225	Genetics-Lab	CC	-	-	2	1
<b>DE Electives: Student has to select 1 course from the list of following DE electives</b>						
BSB 230	Term Paper	DE	3	-	-	3
BSB 231	Bioinformatics	DE				
BSB 232	Enzyme technology	DE				
OE II	Open elective II	OE	3	-	-	3
AND002	<b>ANANDAM-II</b>	VA	-	-	-	2
BCS 201	English	VA	1	-	-	1
BSS 203	Behavioral Science – II	VA	1	-	-	1
FLT 201 FLG 201 FLS 201 FLC 201	Foreign Language - II French German Spanish Chinese	VA	2	-	-	2
<b>Total</b>						<b>28</b>

<b>B. Sc. (Hon.) Biotechnology</b>						
<b>Semester III</b>						
<b>Code</b>	<b>Course</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P/FW</b>	<b>Credit Units</b>
BSB 301	Molecular Biology	CC	2	-	-	2
BSB 302	Animal science- I	CC	3	-	-	3
BSB 303	Chemistry - III	CC	2	-	-	2
BSB 321	Molecular Biology -Lab	CC	-	-	2	1
BSB 323	Chemistry - III-Lab	CC	-	-	2	1
<b>DE Electives: Student has to select 1 course from the list of following DE electives</b>						
BSB 330	Term Paper	DE	3	-	-	3
BSB 331	Protein engineering	DE				
BSB 332	Food Biotechnology	DE				
OE3	Open Elective III	OE	3	-	-	3
AND003	<b>ANANDAM-III</b>	VA	-	-	-	2
EVS001	Environmental Sciences	CC	4	-	-	4
BCS 301	Communication Skills – I	VA	1	-	-	1
BSS 303	Understanding Self for Effectiveness – III	VA	1	-	-	1
FLT 301 FLG 301 FLS 301 FLC 301	Foreign Language - III French German Spanish Chinese	VA	2	-	-	2
<b>Total</b>						<b>25</b>

**NEW**

<b>B. Sc. (Hon.) Biotechnology</b>						
<b>Semester III</b>						
<b>Code</b>	<b>Course</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P/FW</b>	<b>Credit Units</b>
BSB 301	Molecular Biology	CC	2	-	-	2
<b>BSB 302</b>	<b>Animal science</b>	<b>CC</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>3</b>
<b>BSB 303</b>	<b>Chemistry - III</b>	<b>CC</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>2</b>
BSB 321	Molecular Biology -Lab	CC	-	-	2	1
BSB 323	Chemistry Lab	CC				2
<b>DE Electives: Student has to select 1 course from the list of following DE electives</b>						
BSB 330	Term Paper	DE	3	-	-	3
BSB 331	Protein engineering	DE				
BSB 332	Food Biotechnology	DE				
OE3	Open Elective III	OE	3	-	-	3
AND003	ANANDAM-III	VA	-	-	-	2
EVS001	Environmental Sciences	CC	4	-	-	4
BCS 301	Communication Skills – I	VA	1	-	-	1
BSS 303	Understanding Self for Effectiveness – III	VA	1	-	-	1
FLT 301 FLG 301 FLS 301 FLC 301	Foreign Language - III French German Spanish Chinese	VA	2	-	-	2
<b>Total</b>						<b>25</b>

<b>B. Sc. (Hon.) Biotechnology</b>						
<b>Semester IV</b>						
<b>Code</b>	<b>Course</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P/FW</b>	<b>Credit Units</b>
BSB 401	Recombinant DNA Technology	CC	3	-	-	3
BSB 402	Structural Biology	CC	2	-	-	2
BSB 403	Immunology & Immunotechnology	CC	2	-	-	2
<b>BSB 404</b>	<b>Scientific Writing</b>	<b>CC</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>3</b>
<b>BSB 405</b>	<b>Biomaterials and biomimetics</b>	<b>CC</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>2</b>
BSB 421	Recombinant DNA Technology -Lab	CC	-	-	2	1
BSB 422	Structural Biology-Lab	CC	-	-	2	1
BSB 423	Immunology & Immunotechnology-Lab	CC	-	-	2	1
<b>DE Electives: Student has to select 1 course from the list of following DE electives</b>						
BSB 430	Term Paper & Industry Visit	DE	3	-	-	3
BSB 431	Downstream processing	DE				
BSB 432	Pharmaceutical Technology & Biotechnology	DE				
OE IV	Open elective IV	OE	3	-	-	3
AND004	ANANDAM-IV	VA	-	-	-	2
BCS 401	Communication Skills – II	VA	1	-	-	1
BSS 403	Understanding Self for Effectiveness – IV	VA	1	-	-	1
FLT 401 FLG 401 FLS 401 FLC 401	Foreign Language - IV French German Spanish Chinese	VA	2	-	-	2
<b>Total</b>						<b>27</b>

<b>B. Sc. (Hon.) Biotechnology</b>						
<b>Semester V</b>						
<b>Code</b>	<b>Course</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P/FW</b>	<b>Credit Units</b>
BSB 501	Plant Biotechnology	CC	3	-	-	3
BSB 502	Animal Biotechnology	CC	3	-	-	3
<b>BSB 503</b>	<b>Bioenterpreneurship</b>	<b>CC</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>3</b>
BSB 504	Genomics & Proteomics	CC	3	1	-	4
BSB505	Clinical Research & Pharmacovigilance	CC	3	-		3
BSB550	Industrial Training Evaluation	CC	-	-	-	3
BSB 521	Plant Biotechnology -Lab	CC	-	-	2	1
BSB 522	Animal Biotechnology-Lab	CC	-	-	2	1
BSB 524	Genomics & Proteomics-Lab	CC	-	-	2	1
<b>DE Electives: Student has to select 1 course from the list of following DE electives</b>						
<b>BSB 530</b>	<b>Statistics for Biology</b>	<b>DE</b>	3	-	-	3
BSB 531	Bioprocess technology	DE				
<b>BSB 532</b>	<b>IPR &amp; regulatory affairs</b>	<b>DE</b>				
OE V	Open elective V	OE		-	-	3
AND005	ANANDAM-V	VA	-	-	-	2
BCS 501	Communication Skills - III	VA	1	-	-	1
BSS 503	Understanding Self for Effectiveness - V	VA	1	-	-	1
FLT 501 FLG 501 FLS 501 FLC 501	Foreign Language - V French German Spanish Chinese	VA VA VA VA VA	2	-	-	2
<b>Total</b>						<b>34</b>

**B.Sc Biotechnology: 6<sup>th</sup> SEMESTER**

<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>Lectures (L) Hours Per Week</b>	<b>Tutorial (T) Hours Per Week</b>	<b>Practical (P) Hours Per Week</b>	<b>Total Credits</b>
BSB660	Project /Dissertation	CC	-	-	-	25
	<b>TOTAL</b>					<b>25</b>

**BIOCHEMISTRY****Course Code: BSB 101****Credit Units: 03****Course Objective:**

Biochemistry will be taught to the students in the first year itself, which will act as a foundation for all further courses in Biotechnology. The students will be familiarized with structures and functions of biomolecules and basic energetic that governs the biological reactions.

**Module I: Introduction, Aims and Scope:**

Chemical foundation of biology: Acid, Base, Buffer, pH, pK, Properties of water, oxidation-reduction properties, hydrophilic and hydrophobic groups in biomolecules

**Module II: Nature and Perspective of Biological materials**

Introduction to Biomolecules. Types of chemical bonds, Covalent and non covalent interactions in biology. Hormones and growth factors. High energy biomolecules ATP, GTP & Creatine phosphate.

**Module III:****Carbohydrates and Lipids**

Classification, nomenclature, types, structures, properties. Properties and structures of few biologically essential polysaccharides. Structure of glycoproteins and protein polysaccharides. Classification, nomenclature, types, structures, properties. Biological Membranes: Function and properties. Lipoproteins and lipopolysaccharides.

**Module IV:****Proteins:**

Classification, structural organization of proteins, Types and properties of amino acids, name and abbreviations Characters of Peptide bonds

**Module V****Nucleic acids:**

Structure and properties of nucleic acids (DNA & RNA), Types and structures of nitrogenous bases and nucleotides

**Examination Scheme:**

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

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

- Conn, E., & Stumpf, P. (2009). Outlines of biochemistry, 7<sup>th</sup> Ed. John Wiley & Sons.
- Jain, J. L. (2004). Fundamentals of biochemistry, 6<sup>th</sup> Ed. S. chand.
- Berg, J. M., Tymoczko, J. L., & Stryer, L. (2002). Biochemistry, 7<sup>th</sup> Ed. WH Freeman and Co.

**References:**

- Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). Lehninger principles of biochemistry. 7<sup>th</sup> Ed. Macmillan.

**BIOANALYTICAL TECHNIQUES****Course Code: BSB 102****Credit Units: 02****Course Objective:**

The student will be exposed to principles, instrumentation & application of various instruments & techniques used in biological field.

**Module I: Instruments, basic principles and usage**

pH meter, absorption and emission spectroscopy, Principle and law of absorption, fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), polarography, centrifugation, atomic absorption, NMR, X-ray crystallography, Radioisotope tracer techniques and autoradiography

**Module II: Chromatography techniques**

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

**Module III: Electrophoresis**

SDS polyacrylamide electrophoresis, immunoelectrophoresis, Isoelectric focussing.

**Examination Scheme:**

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

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

- Wilson, K., & Walker, J. (2010). Principles and techniques of biochemistry and molecular biology, 7<sup>th</sup> Ed. Cambridge university press.
- Webster, J. G. (2004). Bioinstrumentation, 4<sup>th</sup> Ed. Wiley.
- Upadhyay, A & Nath, N. (2004). Biophysical chemistry, principle and techniques, 4<sup>th</sup> Ed. Himalaya Publishing House.

**References:**

- Van Impe, J. F., Vanrolleghem, P. A., & Iserentant, D. M. (2013). Advanced instrumentation, data interpretation, and control of biotechnological processes. 4<sup>th</sup> Ed. Springer Science & Business Media.
- Hollas, J. M. (2004). Modern spectroscopy. 4<sup>th</sup> Ed. John Wiley & Sons.

## Cell Biology

**Course Code: BSB 103**

**Credit Units: 03**

### Course Objective:

The objective of this course is to provide a conceptual frame work for dealing with the evolving understanding of cell. The students will learn about cell as a unit of living systems, its various organelles, their structure, function and metabolic processes.

### Module I: Cell as a basic unit of living systems

The cell theory, precellular evolution; broad classification of cell types: archaeobacteria, PPLOs, bacteria, eukaryotic microbes, plant – and animal cells; cell, tissue, organ and organisms, different levels of organization.

### Module II: Ultrastructure of the cell membrane and cell organelles

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

### Module III: Chromosomes

Structural organisation of chromosomes, chromatids, centromere, telomere, chromatin, nucleosome organisations; eu-and heterochromatin.

### Module IV: Cell division and cell cycle

Cell cycle, interphase, mitosis and meiosis

### Module V: Cell – Cell interaction and differentiation

Cell locomotion (amoeboid, flagellar and ciliar); cell senescence and death (apoptosis). Mechanism of cell differentiation (e.g., RBC); difference between normal and cancer cells.

### Examination Scheme:

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

### Text & References:

#### Text:

- Alberts, B., Bray, A., Johnson, J., Lewis, M., Roff, K., Robert, P., Walter & K. Roberts, (2013). Essential Cell Biology: An Introduction to the Molecular Biology of the Cell. 4<sup>th</sup> Ed. D. Garland Publishing Company.
- Robertis, D. (1987). Cell and molecular biology. 8<sup>th</sup> Ed. Saunders college publishing.

#### References:

- Lodish, H. (2008). Molecular cell biology. 7<sup>th</sup> Ed. Macmillan.

## PLANT SCIENCE- I

Course Code: BSB 104

Credit Units: 02

**Course Objective:**

The objective of this course is to familiarize the students with the classification, morphology, reproduction and economic importance of various groups of lower plants which will provide the basic knowledge for the employment of these plants to study plant biotechnology.

**Module I: Algae and Lichen**

General characters of algae, Various habitat, Cell structure in algae (special reference flagilla, stigma, Neuromotor apparatus and pigments), Classification of algae (F. E. Fritsch), Economic importance of algae, Life cycle of *Polysiphonia* General character, thallus structure and reproduction in Lichen. General character, taxonomy and economic importance of bryophytes, life cycle of *Marchantia*

**Module II: Pteridophytes**

General character and taxonomy of pteridophytes, heterospory and seed habit in pteridophytes, stelar system in pteridophytes and life cycle of *Marsilea*.

**Module III Gymnosperm and Angiosperm**

General character and taxonomy of gymnosperms, life cycle of *Pinus*, economic importance of pteridophytes and gymnosperms. General character and taxonomy of angiosperms, Description of Lamiaceae, Malvaceae, Euphorbiaceae, Poaceae, Cucurbitaceae and Rutaceae. Economically important plants for cereals, fibre, oil, timber and medicinal value.

**Examination Scheme:**

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

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

- Gangulee, H. C., & Kar, A. K. (1989). College Botany, Vol-II, 5<sup>th</sup> Ed. Books & Allied Pvt. Ltd., Calcutta.
- Singh, V. (2010). A text book of Botany. 4<sup>th</sup> Ed. Rastogi Publications.

**References:**

- Chapman, V. J., & Chapman, D. J. (1973). The algae (Vol. 2, pp. XIV-XIV). 2<sup>nd</sup> Ed. London: Macmillan.
- Kumar, H. D. (1990). Introductory Phycology. 2<sup>nd</sup> Ed. Affiliated East West.
- Kumar, H. D., & Singh, H. N. (1995). A Textbook of Algae Ed. 4<sup>th</sup> Ed. East–West Press Pvt. Ltd. New Delhi.
- Parihar, N. S. (1961). Bryophyta (Vol. 1). 4<sup>th</sup> Ed. Central Book Depot.
- Parihar, N. S. (1965). Pteridophytes. 4<sup>th</sup> Ed. Central Book Depot.

## CHEMISTRY – I

Course Code: BSB 105

Credit Units:02

**Course Objective:**

The objective of this course is to educate the students about molecules, their energy to form bonds, metallurgy of elements, kinetic theory of gases, Vander walls equation and also enzymatic catalysis.

**INORGANIC****Module I**

Chemical bonds and molecules, Shapes of simple molecules, bond energy, bond length, resonance and Hydrogen bond. Radioactivity: Natural and artificial, group displacement law, half life period, binding energy, nuclear reaction equations, isotopes, tracers, radio dating, Application of radioactivity. Periodic table: Modern periodic table, periodicity in properties of elements, atomic radii, ionic and covalent radii, ionization energies, electron affinity, electro-negativity. Metallurgy of S block elements (Na, K, Be, Mg, Ca)

**PHYSICAL****Module II**

Gases: Kinetic theory of gases, Vander Waal's equation, critical constants, Liquefaction of gases.

**Module III**

Chemical-Kinetics: Velocity of a reaction, Law of mass action; determination of rate constants for first and second order reactions, collision theory of bimolecular reactions.

Catalysis: Promoters and Poisons, Enzyme catalysis.

**Examination Scheme:**

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

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

- Prakash, S. (2000). Advanced inorganic chemistry (Vol. 1). 19<sup>th</sup> Ed. S. Chand.
- Soni, P. L., & Katyal, M. (1977). A Text-Book of Inorganic Chemistry. 20<sup>th</sup> Ed. Sultan Chand & Sons.
- Puri, B. R., Sharma, L. R., & Madan, S. P. (1993). Principles of Physical Chemistry, 46<sup>th</sup> Ed. Shoban Lal Nagin Chand & Co.

**References:**

- Puri, B. R., Sharma, L. R., & Madan, S. P. (1993). Principles of Physical Chemistry, 4<sup>th</sup> Ed. Shoban Lal Nagin Chand & Co.

**BIOCHEMISTRY LAB****Course Code: BSB 121****Credit Units:01****Course Contents:****Module I:**

Preparation of buffer,

Colour reactions of Carbohydrates (Molischs test, iodine test, Saliwanoff test, Fehlings/  
Benedicts test, Bials test)

Estimation of carbohydrate using spectrophotometer

**Module II:**

Colour reactions of amino acids

Estimation of protein by Bradford method

**Module III**

Blood Cholestrol estimation

Estimation of nucleic acid by spectrophotometer using UV range.

**Examination Scheme:**

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

**CELL BIOLOGY LAB****Course Code: BSB 123****Credit Units:01****Course Contents:****Module I:**

Cytological preparations, Fixation, dehydration and staining

**Module II**

Squash preparation of meiotic and mitotic cells.

**Module III**

Karyotyping, Embedding and sectioning.

**Examination Scheme:**

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

**PLANT SCIENCE LAB – I****Course Code: BSB 124****Credit Units:01****Course Contents:****Module I****Introduction to Algae and bryophyte**

Polysiphonia and Marchantia.

**Module II****Introduction to pteridophyte and gymnosperm**

Various steles in pteridophytes, Marsilea. and Pinus.

**Module III****Taxonomy of some selected families of flowering plants-** Lamiaceae, Malvaceae,

Euphorbiaceae, Poaceae, Cucurbitaceae and Rutaceae.

**Module IV****Economic Botany**

Economically important plants for food, fibre, oil, timber and medicinal value.

**Examination Scheme:**

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

**CHEMISTRY LAB - I****Course Code: BSB 125****Credit Units:01****Course Contents:****INORGANIC CHEMISTRY****Module I**Volumetric analysis: Oxidation-reduction titration using  $\text{KMnO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$ **Module II**

Iodometry titrations: Estimation of sodium thiosulphate &amp; potassium dichromate.

**Module III**

Preparation of the following inorganic compounds: Prussian blue from iron fillings, chrome alum, cuprous chloride and potassium trioxalatochromate.

**PHYSICAL CHEMISTRY****Module IV**

Determination of surface tension and viscosity of liquids

**Module V**

Heat of neutralisation of a strong acid and a strong base.

**Module VI**Solubility curve of  $\text{KNO}_3$  or benzoic acid.**Examination Scheme:**

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

**BIOPHYSICS**

Course Code: BSB 131

Credit Units: 03

**Course Objective:**

The objective of this course is to educate the students about molecules, their energy to form bonds. The students will be familiarized with structures and functions of biomolecules and basic energetic that governs the biological reactions.

**Unit I - Thermodynamics**

Laws of thermodynamics, concept of free energy, unavailable energy and entropy, heat content of food, bomb calorimetry, chemical kinetics – rate, order, molecularity of reactions and energy of activation.

**II – Bioenergetics**

Energy requirements in cell metabolism, role and structure of mitochondria, high energy phosphate bond, electron transfer phenomenon and biological transfer.

**Unit III - Biophysical properties**

Surface tension, adsorption, diffusion, osmosis, dialysis and colloids

**Unit IV – Molecular alphabets of life**

Amino acids, nucleic acid bases and lipids, classification and properties of amino acids, peptides and poly peptides. Nucleosides, nucleotides, polynucleotides, pentose and hexose poly saccharides.

**Examination Scheme:**

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

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

- Patrick F. Dillon, (2012). Biophysics 3<sup>rd</sup> Ed. Cambridge University Press.
- Bloomfield V A & Harrington R E, (2012) Biophysics: An Introduction 2<sup>nd</sup> Ed. Springer.

**References:**

- Nolting, B, (2011), Methods in Modern Biophysics 3<sup>rd</sup> Ed. Springer.
- Cotterill, R. (2003). Biophysics: An introduction. 1<sup>st</sup> Ed. John Wiley & Sons.

**BASICS IN BIOTECHNOLOGY****Course Code: BSB 132****Credit Units: 03****Course Objective**

Understanding the fundamental principles of biotechnology and its application in agriculture, veterinary sciences, medical sciences, industry and environment.

**Course Contents:****UNIT I**

History of biotechnology, scope of biotechnology, introduction of genetic engineering, plant and animal tissue culture.

**UNIT II**

Fermentation technology, immobilized enzymes, vaccines, antibodies and hybridoma technology, diagnostics, embryo transfer technology, sexing of embryo, transgenics.

**UNIT III**

Genome, genome mapping, physical maps, genetic maps, different types of DNA markers and their applications.

**UNIT IV**

Application of biotechnology in agriculture, veterinary sciences, pharmaceutical industry, food industry, chemical industry and environment.

**UNIT V**

Introduction and historical perspective: Discovery of microbial world, spontaneous generation, methods in microbiology: sterilization, culture media, pure culture techniques, antibiotics and mode of action.

**Examination Scheme:**

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

**Text and Reference Books:**

- Course Becker, J. M. , Cold Well, G. A. & Zachgo, E. A. (2007). Biotechnology a Laboratory, Academic Press .
- Brown, C. M., Campbell , I., & Priest, F. G. (2005). Introduction to Biotechnology, Panima.
- Singh, B. D. (2006). Biotechnology Ey xpanding Horiozon, Kalyani.

**BIOCHEMICAL BASIS IN DISEASES**

CREDIT UNITS: 3

Course Objective:

The students will be familiarized with biochemical basis of the various diseases and disorders that afflict the living organisms.

Module 1: Nutritional and Inborn disorders

Alkaptonuria, Phenylketonuria, Glycogen and Lipid storage diseases, SCID, Clotting disorders.

Module 2: Nutritional deficiency based diseases

Kwashiorkar, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Osteomalacia, Osteoporosis, Wilson's disease.

Module 3: Life style diseases

Obesity, Cardiovascular diseases, Atherosclerosis, Diabetes mellitus-II. Inflammatory Bowel Disease (IBD).

Module 4: Hormonal Imbalances

Outline of hormone action and imbalances leading to disease - precocious puberty, hyper and hypopituitarism. Hyper and hypothyroidism.

Module 5: Infectious diseases

Viral infection (polio, measles, mumps, influenza, HIV); Bacterial infections (tetanus, diphtheria, tuberculosis, typhoid, cholera); Protozoan (Plasmodium and Trypanosoma) and parasitic infections.

**SUGGESTED READINGS**

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7
3. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer, L., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.
4. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

# METABOLIC REGULATION

**Course Code: BSB 201**

**Credit Units:03**

**Course Objective:**

The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

**Module I**

**Carbohydrate metabolism**- Glycolysis pathway, Fates of pyruvate, Metabolic sources of Acetyl Co-A, Citric acid cycle, Amphibolic nature of the Citric acid cycle, Electron transport chain and oxidative phosphorylation, Glycogen breakdown and synthesis, Glycogen storage and its diseases, Gluconeogenesis, Glyoxylate pathway, Pentose phosphate pathway

**Module II**

**Lipid metabolism** - Beta oxidation of Fatty acids, Ketone bodies, Fatty acid biosynthesis, Regulation of fatty acid metabolism.

**Module III**

**Amino acid metabolism** -Amino acid deamination, Urea cycle, Amino acids as biosynthetic precursors, Biosynthesis of non essential amino acids, Nitrogen fixation.

**Module IV**

**Nucleotide Metabolism** –Biosynthesis and catabolic pathways of Purines and Pyrimidines, Metabolic disorders-SCID, GOUT.

**Module V**

**Enzymes** - Classification and nomenclature of enzymes, Regulation of enzyme activity, Kinetics of enzyme catalyzed reactions.

**Examination Scheme:**

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

**Text & References:**

**Text:**

- Granner, R. K. M. D. K., & Rodwell, P. A. M. V. W. (2006). Harper's Illustrated Biochemistry. 30<sup>th</sup> Ed. McGraw-Hill Medical.
- Berg, J. M., Tymoczko, J. L., & Stryer, L. (2002). Biochemistry. 7<sup>th</sup> Ed. WH Freeman and Co.
- U Satyanarayana, (2013) Biochemistry 4<sup>th</sup> Ed. Elsevier.

**References:**

- Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). Lehninger principles of biochemistry. 7<sup>th</sup> Ed. Macmillan.

## PLANT SCIENCE – II

Course Code: BSB 202

Credit Units: 02

**Course Objective:**

The objective of this course is to acquaint the students with the details of molecular transport in plants and basics of photosynthesis.

**Module I**

Diffusion, osmosis, permeability, imbibition, plasmolysis, osmotic potential, water potential and matrix potential. Absorption of water: Passive and active absorption, Ascent of sap, Transpiration, guttation and significance of transpiration, factors affecting transpiration and Modern mechanism of stomatal closing and opening mechanism Minerals and their role in plant physiology, mechanism of absorption of mineral salts (Donnan's equilibrium, Ion exchange, diffusion, facilitated diffusion, active transport, symport, antiport) and hydroponics.

**Module II**

Importance of photosynthesis, role of pigments, Light reaction, Dark reaction-C3 cycle Photo respiration, C4 Cycle, CAM cycle and factors affecting photosynthesis, Glycolysis Krebs cycle, Factors affecting respiration and RQ.

**Module III**

Plant tissue and its classification, Structure of Xylem and Phloem, Leaf anatomy, Structure and function of cambium (normal), Anomalous behavior of cambium in *Achyranthes*, *Boerhaavia*, *Bignonia* and *Dracaena*, Root-stem transition Structure of anther and microsporogenesis, development of the male gametophyte and pollen dispersal, Structure of ovule, megasporogenesis and development of the female gametophyte with particular reference to *Polygonum* type, Endosperm and types, Fertilisation and development of embryo onagrad type.

**Examination Scheme:**

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

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

- Taiz, L., & Zeiger, E. (2006). Stress physiology. 5<sup>th</sup> Ed. Plant physiology.
- Singh, V., Pande, P.C. & Jain, D.K., (2013). A text book of botany (angiosperms-taxonomy, economic botany, anatomy, embryology and morphogenesis) 4<sup>th</sup> Ed. Rastogi Publications.

**Reference:**

- Bhojwani, S.S & Bhatnagar S.P., (2014). The Embryology of Angiosperms by S.S. Bhojwani, S.P. Bhatnagar, 6<sup>th</sup> Ed. Vikas Publishing House Pvt. Ltd.
- Esau, K, (2011). Anatomy of Seed Plants 2<sup>nd</sup> Ed. Wiley Publications.

**MICROBIOLOGY****Course Code: BSB 203****Credit Units: 03****Course Objective:**

The basic knowledge of Microbiology gained in this semester would be applied in the various disciplines like evolution, Immunology & Industrial fermentation.

**Course Contents:****Module I: History of Microbiology and Ultra Structure of Prokaryotic cell**

Introduction, contribution of Scientists (Leeuwenhoek, Pasteur, Koch etc.), role of microorganisms in transformation of organic matter and in the causation of diseases. Pasteur's experiments, microscopy (optical, TEM and SEM), concept of microbial species and strains; general outline of various forms of micro-organisms. Nature of the microbial cell surface, Prokaryotic structure and function - cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions, gram positive and gram negative bacteria and endospores

**Module II Microbial nutrition and growth**

The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, Diauxic growth, culture collection and maintenance of cultures.

**Module III Microbial Taxonomy**

Microbial evolution, systematics and taxonomy - new approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, and characteristics of primary domains, taxonomy, nomenclature and Bergey's manual, Archaeobacteria

**Module IV: Control of microorganisms and Host-parasite relationship**

Methods of sterilization & disinfection (Physical agents & chemical agents) Antibiotics with special reference to antibacterial & antifungal antibiotics, mode of actions, drug resistance. Host-parasite relationship (Normal micro flora of skin, oral cavity, gastrointestinal tract), types of toxins (Exo, endo, entero) and their structure and mode of actions,

**Module V Industrial Microbiology**

Introduction to industrially important microbes and microbial fermentative products (Production of antibiotics with special reference to penicillin & streptomycin, enzymes), food products from microbes (Dairy & SCP etc)

**Examination Scheme:**

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

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

1. Prescott, Herley, Klein (2002). Microbiology, 5<sup>th</sup> edn. C.B.S. Publishers.
2. Pelczar M.J., Chan E.C.S. and Kreig, N.R. Microbiology VI Edition, Tata McGraw Hill.
3. Jayaram Paniker C.K. (2009) Ananthnarayan and Paniker's Textbook of Microbiology, 8<sup>th</sup> edn. Orient BlackSwan.

**Reference:**

1. Stanier, R. (2009). General Microbiology, 5<sup>th</sup> Edn, Macmillian.
2. Salisbury, Whitaker and Hall, Principles of Fermentation Technology, Aditya Books Pvt. Ltd.

**CHEMISTRY – II****Course Code: BSB 204****Credit Units: 02****Course Objective:**

The students will acquire knowledge about the compounds of carbon mainly hydrocarbon. They will be acquainted with the methods of qualitative and quantitative analysis of elements of hydrocarbons and methods of preparation of these compounds. They will get knowledge about the behavior of chemical and physical reactions along with electrolysis process.

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

Organic chemistry as chemistry of carbon compounds, Methods of purification, tests of purity: qualitative and quantitative elemental analysis, determination of molecular masses: calculation of Empirical and Molecular formula, Structural formula. Tetrahedral concept of carbon compounds; nomenclature of organic compounds; Isomerism; stereo-isomerism, geometrical and optical isomerism.

**Module II**

Grignard reagent; preparation and uses, Alcohol; ethanol, propanol, glycerol; Monocarboxylic acids and their simple derivatives, descriptive studies of dicarboxylic acids, viz. malic, oxalic, tartaric, maleic, General methods of preparation of aliphatic aldehydes and ketones, Keto-enol tautomerism; aceto-acetic ester and malonic ester.

**Module III**

**Chemical equilibrium:** Reversible reactions, equilibrium law, equilibrium constant, factors influencing equilibrium states.

**Electrochemistry:** Electrolysis, laws of electrolysis, ionisation constant, specific, equivalent and molecular conductance, common ion effect; Hydrogen ion concentration, pH value, Theory of acid base indicators, buffer solutions, hydrolysis of salts and solubility product simple calculations based on these concepts.

**Examination Scheme:**

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

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

- Bahl, B. S. (2006). Text Book of Organic Chemistry 18<sup>th</sup> Ed. S. Chand & Co. Ltd.
- Puri, B. R., Sharma, L. R., & Madan, S. P. (2013). Principles of Physical Chemistry. 46<sup>th</sup> Ed. Vishal Publishing Co.

**References:**

- Bahl, A. (2010). Advanced organic chemistry. 3<sup>rd</sup> Ed. S Chand & Company Limited.
- I.L. Finar & S, Pearsons (1973). Organic Chemistry Vol.I & II 6<sup>th</sup> Ed. Pearson India.
- N, Haider. (2011), Fundamentals of Organic Chemistry 5<sup>th</sup> Ed. S. Chand & Co. Ltd.

**GENETICS****Course Code: BSB 205****Credit Units: 02****Course Objective:**

The objective of the course is to focus on the basic principles of genetics incorporating the concepts of classical, molecular genetics. Compilation is required for recent advances in genetic principles for strong foundation in Biotechnology. The objective of the course is to focus on basic principles of inheritance

## Course Contents:

### Module I

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

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

### Module II

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

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

### Module III

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

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

## Examination Scheme:

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

## Text & References:

### Text:

- Principles of Genetics, E. J. Gardner, John Wiley & Sons Inc.
- Genetics, P.K. Gupta, Rastogi Publication.

### References:

- Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, Pearson Education.
- Genetics, M.W. Strickberger, Prentice Hall College Division.
- Genetics, P.J. Russell, Benjamin/Cummings.
- Genetics, R. Goodenough, International Thomson Publishing.
- Introduction to Genetic Analysis, A.J. F. Griffiths, W.H. Freeman and Company.
- Principles of Genetics, D.P. Snustad & M.J. Simmons, John Wiley and Sons Inc.
- Molecular Biology of the Gene (Fifth Edition), J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison – Wesley Publishing.

## PLANT SCIENCE LAB - II

Course Code: BSB 222

Credit Units: 01

**Module I****Plant physiology**

Demonstration of osmosis.

Effect of wind on rate of transpiration (Ganon's potometer)

Comparison of stomatal frequency using  $\text{CoCl}_2$ .

Demonstration of hydroponic system.

Effect of light quality on photosynthesis and plant metabolites.

Determination of RQ for various plant materials.

**Module II****Plant Histology**

Leaf anatomy (monocot and dicot)

Primary and secondary structure of stem and root (monocot and dicot)

Anomalous behavior of cambium in *Achyranthes*, *Boerhaavia*, *Bignonia* and *Dracaena***Module III****Embryology of angiosperms**

Study of permanent slides of the: L.S. ovule types and L.S. caryopsis

Preparing glycerin mounted slides of T.S. anther, pollen, germinating pollen.

Separation of endosperm, ruminant endosperm

Isolation of embryo from seed.

**Examination Scheme:**

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

**MICROBIOLOGY-Lab**

Course Code: BSB 223

Credit Units: 01

**Module I**

Aseptic techniques:

Cleaning of glassware

Preparation of media, cotton plugging and sterilization.

**Module II**

Isolation of microorganisms from air, water and soil samples: dilution, pour plating and colony purification.

Enumeration of microorganisms: total vs. viable counts.

**Module III**

Microscopic examination of bacteria by gram staining.

Endospore staining.

Capsule staining.

Negative staining

Observe the microbes in living condition by hanging drop method.

Fungal slide preparation and study of characteristics of fungi.

Antibiotic sensitivity test.

**Examination Scheme:**

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

## CHEMISTRY LAB – II

Course Code: BSB 224

Credit Units: 01

## INORGANIC CHEMISTRY

## Module I

Qualitative analysis of inorganic mixtures, containing not more than four ionic species (excluding insoluble substances) out of the following:

$\text{Pb}^{2+}$ ,  $\text{Hg}^{2+}$ ,  $\text{Hg}_2^{2+}$ ,  $\text{Ag}^{1+}$ ,  $\text{Bi}^{3+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{As}^{3+}$ ,  $\text{Sn}^{2+}$ ,  $\text{Sn}^{4+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{NH}_4^{1+}$ ,  $\text{K}^{1+}$ ,  $\text{CO}_3^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{NO}_2^{1-}$ ,  $\text{CH}_3\text{COO}^{1-}$ ,  $\text{F}^{1-}$ ,  $\text{Cl}^{1-}$ ,  $\text{Br}^{1-}$ ,  $\text{I}^{1-}$ ,  $\text{NO}_3^{1-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{C}_2\text{O}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{BO}_3^{3-}$ .

## Module II

Purification of Organic compounds by crystallization (from water or alcohol) and distillation.

## Examination Scheme:

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

**GENETICS –Lab****Course Code: BSB 225****Credit Units: 01**

Study of gene interaction  
Study of chromosome structure & size  
Study of Genetics disorder in human  
Some more practical's will be designed from theory

**Examination Scheme:**

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

## TERM PAPER

**Course Code:           BSB 230**

**Credit Units: 03**

A term (or research) paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned. The progress of the paper will be monitored regularly by the faculty. At the end of the semester the detailed paper on the topic will be submitted to the faculty assigned. The evaluation will be done by Board of examiners comprising of the faculties.

### GUIDELINES FOR TERM PAPER

The procedure for writing a term paper may consists of the following steps:

1. Choosing a subject
2. Finding sources of materials
3. Collecting the notes
4. Outlining the paper
5. Writing the first draft
6. Editing & preparing the final paper

#### 1. Choosing a Subject

The subject chosen should not be too general.

#### 2. *Finding Sources of materials*

- a) The material sources should be not more than 10 years old unless the nature of the paper is such that it involves examining older writings from a historical point of view.
- b) Begin by making a list of subject-headings under which you might expect the subject to be listed.
- c) The sources could be books and magazines articles, news stories, periodicals, scientific journals etc.

#### 3. *Collecting the notes*

Skim through sources, locating the useful material, then make good notes of it, including quotes and information for footnotes.

- a) Get facts, not just opinions. Compare the facts with author's conclusion.
- b) In research studies, notice the methods and procedures, results & conclusions.
- c) Check cross references.

#### 4. *Outlining the paper*

- a) Review notes to find main sub-divisions of the subject.
- b) Sort the collected material again under each main division to find sub-sections for outline so that it begins to look more coherent and takes on a definite structure. If it does not, try going back and sorting again for main divisions, to see if another general pattern is possible.

#### 5. *Writing the first draft*

Write the paper around the outline, being sure that you indicate in the first part of the paper what its purpose is. You may follow the following:

- a) statement of purpose
- b) main body of the paper
- c) statement of summary and conclusion

Avoid short, bumpy sentences and long straggling sentences with more than one main ideas.

#### 6. *Editing & Preparing the final Paper*

- a) Before writing a term paper, you should ensure you have a question which you attempt to answer in your paper. This question should be kept in mind throughout the paper. Include only information/ details/ analyses of relevance to the question at hand. Sometimes, the relevance of a particular section may be clear to you but not to your readers. To avoid this, ensure you briefly explain the relevance of every section.
- b) Read the paper to ensure that the language is not awkward, and that it "flows" properly.
- c) Check for proper spelling, phrasing and sentence construction.

- d) Check for proper form on footnotes, quotes, and punctuation.
- e) Check to see that quotations serve one of the following purposes:
- f) Show evidence of what an author has said.
- g) Avoid misrepresentation through restatement.
- h) Save unnecessary writing when ideas have been well expressed by the original author.
- i) Check for proper form on tables and graphs. Be certain that any table or graph is self-explanatory.

Term papers should be composed of the following sections:

- 1) Title page
- 2) Table of contents
- 3) Introduction
- 4) Review
- 5) Discussion & Conclusion
- 6) References
- 7) Appendix

Generally, the introduction, discussion, conclusion and bibliography part should account for a third of the paper and the review part should be two thirds of the paper.

### **Discussion**

The discussion section either follows the results or may alternatively be integrated in the results section. The section should consist of a discussion of the results of the study focusing on the question posed in the research paper.

### **Conclusion**

The conclusion is often thought of as the easiest part of the paper but should by no means be disregarded. There are a number of key components which should not be omitted. These include:

- a) summary of question posed
- b) summary of findings
- c) summary of main limitations of the study at hand
- d) details of possibilities for related future research

### **References**

From the very beginning of a research project, you should be careful to note all details of articles gathered.

The bibliography should contain ALL references included in the paper. References not included in the text in any form should NOT be included in the bibliography.

The key to a good bibliography is consistency. Choose a particular convention and stick to this.

### **Conventions**

Monographs

Crystal, D. (2001), *Language and the internet*. Cambridge: Cambridge University Press.

### **Edited volumes**

Gass, S./Neu, J. (eds.) (1996), *Speech acts across cultures. Challenges to communication in a second language*. Berlin/ NY: Mouton de Gruyter.

[(eds.) is used when there is more than one editor; and (ed.) where there is only one editor. In German the abbreviation used is (Hrsg.) for Herausgeber].

### **Edited articles**

Schmidt, R./Shimura, A./Wang, Z./Jeong, H. (1996), *Suggestions to buy: Television commercials from the U.S., Japan, China, and Korea*. In: Gass, S./Neu, J. (eds.) (1996), *Speech acts across cultures. Challenges to communication in a second language*. Berlin/ NY: Mouton de Gruyter: 285-316.

### **Journal articles**

McQuarrie, E.F./Mick, D.G. (1992), *On resonance: A critical pluralistic inquiry into advertising rhetoric*. *Journal of consumer research* 19, 180-197.

### **Electronic book**

Chandler, D. (1994), *Semiotics for beginners* [HTML document]. Retrieved [5.10.'01] from the World Wide Web, <http://www.aber.ac.uk/media/Documents/S4B/>.

### **Electronic journal articles**

Watts, S. (2000) Teaching talk: Should students learn 'real German'? [HTML document]. German as a Foreign Language Journal [online] 1. Retrieved [12.09.'00] from the World Wide Web, <http://www.gfl-journal.com/>.

### **Other websites**

Verterhus, S.A. (n.y.), Anglicisms in German car advertising. The problem of gender assignment [HTML document]. Retrieved [13.10.'01] from the World Wide Web, <http://olaf.hiof.no/~sverrev/eng.html>.

### **Unpublished papers**

Takahashi, S./DuFon, M.A. (1989), Cross-linguistic influence in indirectness: The case of English directives performed by native Japanese speakers. Unpublished paper, Department of English as a Second Language, University of Hawai'i at Manoa, Honolulu.

### **Unpublished theses/ dissertations**

Möhl, S. (1996), Alltagssituationen im interkulturellen Vergleich: Realisierung von Kritik und Ablehnung im Deutschen und Englischen. Unpublished MA thesis, University of Hamburg.

Walsh, R. (1995), Language development and the year abroad: A study of oral grammatical accuracy amongst adult learners of German as a foreign language. Unpublished PhD dissertation, University College Dublin.

### **Appendix**

The appendix should be used for data collected (e.g. questionnaires, transcripts, ...) and for tables and graphs not included in the main text due to their subsidiary nature or to space constraints in the main text.

### **Assessment Scheme:**

#### **Continuous Evaluation:**

40%

(Based on abstract writing, interim draft, general approach, research orientation, readings undertaken etc.)

#### **Final Evaluation:**

60%

(Based on the organization of the paper, objectives/ problem profile/ issue outlining, comprehensiveness of the research, flow of the idea/ ideas, relevance of material used/ presented, outcomes vs. objectives, presentation/ viva etc.)

**BIOINFORMATICS****Course Code: BSB 231****Credit Units: 03****Course Objective:**

The objective is to describe data models and database management systems with an emphasis on biologically important techniques to store various data on DNA sequencing structures, genetic mapping, phylogenetic analysis. Multiple sequence alignment, protein structure prediction, and comparative genome analysis.

**Course contents:****Module I: Computers**

General introduction (characteristics, capabilities, generations), software, hardware : organization of hardware (input devices, memory, control unit arithmetic logic unit, output devices); software : (System software; application software, languages -low level, high level), interpreter, compiler, data processing; batch, on-line, real-time (examples from bioindustries; e.g. application of computers in co-ordination of solute concentration, ph, temperature, etc., of a fermenter in operation); internet application.

**Module II: Basic Bioinformatics**

Introduction to Internet, Search Engines (Google, Yahoo, Entrez etc)

**Module III: Biological Databases**

Sequence databases (EMBL, GenBank, DDBJ, -UNIPROT, PIR, TrEMBL), Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, etc), Cluster databases-An Introduction, Specialised databases (KEGG, etc), Database technologies (Flat-file), Structural databases (PDB)

**Module IV: Phylogenetic Analysis**

Trees-splits and metrics on trees, tree interpretation, Distance – additive, ultrameric and nonadditive distances, tree building methods, phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains, estimating the rate of change, likelihood and trees; analysis software. Annotation, comparison of different methods; ESTs – databases, clustering, gene discovery and identification, and functional classification.

**Module V: Genome analysis**

Annotation, comparison of different methods; ESTs – databases, clustering, gene discovery and identification, and functional classification. Reconstruction of metabolic pathways; Genome analysis, genome anatomy, genome rearrangements with inversions, signed inversions, gene identification, gene expression, expression analysis, gene identification and functional classification.

**Examination Scheme:**

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

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

- J.G. Brookshear (2014). Computer Science, 12<sup>th</sup> Ed. Pearson Education(singapore) Pte. Ltd.
- Attwood, T. K., & Parry-Smith, D. J. (2009). Introduction to Bioinformatics. 1<sup>st</sup> Ed. Benjamin Cummings press.

***References:***

- Lacroix, Z. (2003). Bioinformatics: managing scientific data (Vol. 6, No. 2). 1<sup>st</sup> Ed. Academic Press.
- Higgins, D., & Taylor, W. (2000). Bioinformatics Sequence. Structure and Databanks. Oxford University Press. 2<sup>nd</sup> Ed. OUP Oxford press.

**ENZYME TECHNOLOGY****Course Code: BSB 232****Credit Units: 03****Course Objective:**

The course aims to provide an understanding of the principles and application of proteins, secondary metabolites and enzyme biochemistry in therapeutic applications and clinical diagnosis. The theoretical understanding of biochemical systems would certainly help to interpret the results of laboratory experiments.

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

Introduction and scope, Nomenclature, Mechanism of Catalysis.

**Module II: Enzyme Kinetics**

Single substrate steady state kinetics; Michaelis Menten equation, Linear plots, King-Altman's method; Inhibitors and activators; Multisubstrate systems; ping-pong mechanism, Albery equation, Sigmoidal kinetics and Allosteric enzymes

**Module III**

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

**Module IV: Enzyme reactors**

Reactors for batch/continuous enzymatic processing, choice of reactor type; idealized enzyme reactor systems, Mass transfer in enzyme reactors: Steady state analysis of mass transfer and biochemical reaction in enzyme reaction.

**Module V: Bioprocess Design**

Physical parameters, reactor operational stability, Immobilized cells.

**Examination Scheme:**

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

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

- R.C.B. Currell & V.D. Mieras (2012). Biotechnological Innovations in Chemical Synthesis 4<sup>th</sup> Ed. Biotol Partners Staff.
- Chaplin, M. F., & Bucke, C. (1990). Enzyme technology 1<sup>st</sup> Ed. Cambridge University Press.

**References:**

- T, Palner (2001). Enzymes Biochemistry, Biotechnology, Clinical Chemistry 5<sup>th</sup> Ed. Horwood Publishing Ltd.
- Segal, I. H. (1993). Enzyme kinetics behaviour and analysis of rapid equilibrium and steady state enzyme systems 1<sup>st</sup> Ed. A Wiley-Interscience Publication.

# **ENGLISH**

**Course Code:** BCS 201

**Credit Units:**01

## **Course Objective:**

The course is intended to give a foundation of English Language. The literary texts are intended to help students to inculcate creative & aesthetic sensitivity and critical faculty through comprehension, appreciation and analysis of the prescribed literary texts. It will also help them to respond from different perspectives.

## **Course Contents:**

### **Module I: Vocabulary**

Use of Dictionary  
Use of Words: Diminutives, Homonyms & Homophones

### **Module II: Essentials of Grammar - I**

Articles  
Parts of Speech  
Tenses

### **Module III: Essentials of Grammar - II**

Sentence Structure  
Subject -Verb agreement  
Punctuation

### **Module IV: Communication**

The process and importance  
Principles & benefits of Effective Communication

### **Module V: Spoken English Communication**

Speech Drills  
Pronunciation and accent  
Stress and Intonation

### **Module VI: Communication Skills-I**

Developing listening skills  
Developing speaking skills

### **Module VII: Communication Skills-II**

Developing Reading Skills  
Developing writing Skills

### **Module VIII: Written English communication**

Progression of Thought/ideas  
Structure of Paragraph  
Structure of Essays

### **Module IX: Short Stories**

Of Studies, by Francis Bacon  
Dream Children, by Charles Lamb

The Necklace, by Guy de Maupassant  
A Shadow, by R.K.Narayan  
Glory at Twilight, Bhabani Bhattacharya

**Module X: Poems**

All the Worlds a Stage	Shakespeare
To Autumn	Keats
O! Captain, My Captain.	Walt Whitman
Where the Mind is Without Fear	Rabindranath Tagore
Psalm of Life	H.W. Longfellow

**Examination Scheme:**

<b>Components</b>	<b>A</b>	<b>CT</b>	<b>HA</b>	<b>EE</b>
<b>Weightage (%)</b>	05	15	10	70

**Text & References:**

- Madhulika Jha, Echoes, Orient Long Man
- Ramon & Prakash, Business Communication, Oxford.
- Sydney Greenbaum Oxford English Grammar, Oxford.
- Successful Communications, Malra Treece (Allyn and Bacon)
- Effective Technical Communication, M. Ashraf Rizvi.

## UNDERSTANDING SELF FOR EFFECTIVENESS - II (PROBLEM SOLVING AND CREATIVE THINKING)

**Course Code:** BSS 203

**Credit Units:**01

### **Course Objective:**

To enable the students:

Understand the process of problem solving and creative thinking.

Facilitation and enhancement of skills required for decision-making.

### **Course Contents:**

#### **Module I: Thinking as a tool for Problem Solving**

What is thinking: The Mind/Brain/Behaviour

Critical Thinking and Learning:

Making Predictions and Reasoning

Memory and Critical Thinking

Emotions and Critical Thinking

Thinking skills

#### **Module II: Hindrances to Problem Solving Process**

Perception

Expression

Emotion

Intellect

Work environment

#### **Module III: Problem Solving**

Recognizing and Defining a problem

Analyzing the problem (potential causes)

Developing possible alternatives

Evaluating Solutions

Resolution of problem

Implementation

Barriers to problem solving:

- Perception
- Expression
- Emotion
- Intellect
- Work environment

#### **Module IV: Plan of Action**

Construction of POA

Monitoring

Reviewing and analyzing the outcome

#### **Module V: Creative Thinking**

Definition and meaning of creativity

The nature of creative thinking

- Convergent and Divergent thinking
- Idea generation and evaluation (Brain Storming)
- Image generation and evaluation
- Debating

The six-phase model of Creative Thinking: ICEDIP model

#### **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:**

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

**Text & References:**

- Michael S. (1999). How to be a Better Problem Solver, Kogan Page, New Delhi.
- Geoff P. (1999). How to be a Better at creativity; by: Kogan Page, New Delhi, (1999)
- Richard Y. C., & Keith P., (1998). Wheeler Publishing, New Delhi.
- Phil Lowe Koge (1996). Page: Creativity and Problem Solving, New Delhi,
- Pfeiffer, J. W., (1996). Theories and Models in Applied Understanding Self for Effectiveness, Management Pfeiffer & Company.
- Bensley, A. D. (1998). Critical Thinking in Psychology – A Unified Skills Approach, Brooks/Cole Publishing Company.

## FRENCH - II

**Course Code:** FLT 201

**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 201**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 201**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 201**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:**

<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” Lesson 11-20

**MOLECULAR BIOLOGY****Course Code: BSB 301****Credit Units:02**

**Course objective:** Molecular biology is one of the most important subjects of the recent times. This course basically gives the cognizance to students about the various biological processes such as DNA replication, transcription and translation in both prokaryotes and eukaryotes. Further, it provides insight on the historical development of the field with major scientific breakthroughs.

**Course contents****Module I**

*Introduction to molecular biology:* Historical viewpoint of development of molecular biology, DNA: the chemical nature of gene, Watson and Crick's discovery, RNA, central dogma. DNA replication: Semiconservative manner of DNA replication, modes of replication, requirements of replication, bacterial DNA replication, eukaryotic DNA replication.

**Module II**

*Prokaryotic and eukaryotic transcription:* Structure and function of RNA polymerase, transcription initiation, elongation and termination (rho dependent and rho independent) processes in prokaryotes, transcription initiation, elongation and termination in eukaryotes, differences in prokaryotic and eukaryotic transcription.

**Module III**

*Prokaryotic and eukaryotic translation:* Overview of translation mechanisms in prokaryotes: translation initiation, elongation and termination in prokaryotes, Overview of translation mechanisms in eukaryotes: translation initiation, elongation and termination in eukaryotes, differences in prokaryotic and eukaryotic protein synthesis.

**Examination Scheme:**

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

**Text Books:**

- Genetics: A conceptual approach, Benjamin A. Pierce, W.H. Freeman and Company, New York, III edition, 2008.
- Gene VIII, Benjamin Lewin 2005, Oxford University Press.

**Reference Books:**

- Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing, 2007.
- Genome 3, T.A. Brown, John Willey & Sons Inc., 2003.
- Molecular Cloning: A Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press.

## Animal science

**Course Code: BSB 302**

**Credit Units:03**

### THEORY

#### Course Objective:

To acquaint students with the general characters and classification of Acoelomates to Pseudocoelomates and the affinities between different groups.

#### Course Contents:

##### Module I

General characteristics & classification of Amoeba & paramecium, Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*

##### Module II

Porifera: General characteristics and classification.

Cnidaria: General characteristics and classification; corals and coral reefs; polymorphism in Cnidaria. Ctenophora: General characteristics and Evolutionary significance

##### Module III

Platyhelminthes & Nematelminthes: General characteristics and classification. Life cycle and pathogenicity of *Fasciola* and *Ascaris lumbricoides*

Annelida: General characteristics and classification up to orders. Excretion in Annelida

##### Module IV

General characteristics and classification of Arthropoda, Mollusca and Echinodermata

##### Module V

Introduction to Chordates: General Characteristics; outline classification, Protochordata: Hemichordata, Urochordata and Cephalochordata.

Model organisms used in scientific research.

#### Examination Scheme

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	50

#### Text books:

1. Dhama, P.S. and Dhama, J.K. Invertebrate Zoology. 5th ed. New Delhi: R. Chand & Co.
2. R.L. Kotpal. Modern Text Book of Zoology. Invertebrates. 11<sup>th</sup> Edition Rastogi Publications

# Chemistry- III

**Course Code: BSB 303**

**Credit Units: 2**

## THEORY

### Course Objective:

The students will learn about the various laws and conditions which govern the behaviour of liquid and solution and the phases in which they exist under different conditions.

### Course Contents:

#### Module I: Inorganic chemistry

Acid and Bases: Elementary idea of Bronsted -Lowry and Lewis concept of acids and bases (Proton-donor acceptor and electron donor acceptor systems), Relative strengths of Lewis acids bases and the effect of substituents and the solvent on them. General properties of 3<sup>rd</sup> elements & Co-ordination Compounds: Molecular compounds, Werners coordination theory, IUPAC system of nomenclature of coordination compounds. Discussion of outer and inner orbit complexes.

#### Module II: Organic chemistry

General study of aromatic compounds, orientation of aromatic compounds, aromaticity. Study of preparation and properties of Toluene, Halogen substituted aromatic compounds; Chlorobenzene, benzene diazonium chloride, Phenols, nitrobenzene, aniline

#### Module II: Physical chemistry

Liquids: Vapor pressure, variation of vapour pressure of liquids with temperature (Clausius – Clapeyron Equation). Surface tension, viscosity, their experimental determination and applications. Osmosis and measurement of osmotic pressure. Effect of solutes on boiling points and freezing points of solutions. Energy, Work, Heat capacity. Laws of thermodynamics, Free Energy (G), Galvanic cells, standard electrode potential, types of electrodes, measurement of pH. Lambert-Beer's Law: Law of photochemical equivalence; photoelectric cell. Phosphorescence and fluorescence.

### Examination Scheme:

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

### Text & References:

#### Text:

- Test book of Inorganic Chemistry, P.L. Soni, Sultan Chand & Sons
- Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co.

#### References:

- Advanced Inorganic Chemistry Vol-I & II, Satya Prakash, G.D. Tuli, S.K. Basu, R.D. Madan, S. Chand & Co. Ltd.
- Simplified Course in Inorganic Chemistry, Madan & Tuli, S. Chand & Co. Ltd.
- Concise Inorganic Chemistry, J.D. Lee, Black Well Sciences
- Essentials of Physical Chemistry, Bahl & Tuli, S. Chand & Co. Ltd.
- Simplified course in Physical Chemistry, Madan & Tuli, S. Chand & Co. Ltd.
- Atkin's Physical Chemistry, Atkin, Oxford Press.
- Physical Chemistry, Vemulapalli, Printice Hall of India

**MOLECULAR BIOLOGY LAB**

Course Code: BSB 321

Credit Units:01

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

Preparation of DNA: genomic, Plasmid

**Module II**

Isolation of RNA

**Module III**

RFLP analysis

**Module IV**

Preparation of Competent Cells

**Examination Scheme:**

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

**CHEMISTRY LAB - III**

Course Code: BSB 323

Credit Units:01

**Course Contents:****INORGANIC CHEMISTRY****Module I**Gravimetric estimation of barium and  $\text{SO}_4^{2+}$  as  $\text{BaSO}_4$  ions, iron as  $\text{Fe}_2\text{O}_3$  and copper as  $\text{CuCNS}$ .**ORGANIC CHEMISTRY****Module II**

Detection of functional groups in mono-functional Organic Compounds. (aldehyde, ester, phenol, amine, amides, alcohols.)

**Examination Scheme:**

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

## TERM PAPER

**Course Code:           BSB 330**

**Credit Units: 03**

A term (or research) paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned. The progress of the paper will be monitored regularly by the faculty. At the end of the semester the detailed paper on the topic will be submitted to the faculty assigned. The evaluation will be done by Board of examiners comprising of the faculties.

### GUIDELINES FOR TERM PAPER

The procedure for writing a term paper may consists of the following steps:

7. Choosing a subject
8. Finding sources of materials
9. Collecting the notes
10. Outlining the paper
11. Writing the first draft
12. Editing & preparing the final paper

#### 1. Choosing a Subject

The subject chosen should not be too general.

#### **2. Finding Sources of materials**

- d) The material sources should be not more than 10 years old unless the nature of the paper is such that it involves examining older writings from a historical point of view.
- e) Begin by making a list of subject-headings under which you might expect the subject to be listed.
- f) The sources could be books and magazines articles, news stories, periodicals, scientific journals etc.

#### **3. Collecting the notes**

Skim through sources, locating the useful material, then make good notes of it, including quotes and information for footnotes.

- d) Get facts, not just opinions. Compare the facts with author's conclusion.
- e) In research studies, notice the methods and procedures, results & conclusions.
- f) Check cross references.

#### **4. Outlining the paper**

- c) Review notes to find main sub-divisions of the subject.
- d) Sort the collected material again under each main division to find sub-sections for outline so that it begins to look more coherent and takes on a definite structure. If it does not, try going back and sorting again for main divisions, to see if another general pattern is possible.

#### **5. Writing the first draft**

Write the paper around the outline, being sure that you indicate in the first part of the paper what its purpose is. You may follow the following:

- a) statement of purpose
- b) main body of the paper
- c) statement of summary and conclusion

Avoid short, bumpy sentences and long straggling sentences with more than one main ideas.

#### **6. Editing & Preparing the final Paper**

- j) Before writing a term paper, you should ensure you have a question which you attempt to answer in your paper. This question should be kept in mind throughout the paper. Include only information/ details/ analyses of relevance to the question at hand. Sometimes, the relevance of a particular section may be clear to you but not to your readers. To avoid this, ensure you briefly explain the relevance of every section.
- k) Read the paper to ensure that the language is not awkward, and that it "flows" properly.
- l) Check for proper spelling, phrasing and sentence construction.

- m) Check for proper form on footnotes, quotes, and punctuation.
- n) Check to see that quotations serve one of the following purposes:
- o) Show evidence of what an author has said.
- p) Avoid misrepresentation through restatement.
- q) Save unnecessary writing when ideas have been well expressed by the original author.
- r) Check for proper form on tables and graphs. Be certain that any table or graph is self-explanatory.

Term papers should be composed of the following sections:

- 8) Title page
- 9) Table of contents
- 10) Introduction
- 11) Review
- 12) Discussion & Conclusion
- 13) References
- 14) Appendix

Generally, the introduction, discussion, conclusion and bibliography part should account for a third of the paper and the review part should be two thirds of the paper.

### **Discussion**

The discussion section either follows the results or may alternatively be integrated in the results section. The section should consist of a discussion of the results of the study focusing on the question posed in the research paper.

### **Conclusion**

The conclusion is often thought of as the easiest part of the paper but should by no means be disregarded. There are a number of key components which should not be omitted. These include:

- e) summary of question posed
- f) summary of findings
- g) summary of main limitations of the study at hand
- h) details of possibilities for related future research

### **References**

From the very beginning of a research project, you should be careful to note all details of articles gathered.

The bibliography should contain ALL references included in the paper. References not included in the text in any form should NOT be included in the bibliography.

The key to a good bibliography is consistency. Choose a particular convention and stick to this.

### **Conventions**

Monographs

Crystal, D. (2001), *Language and the internet*. Cambridge: Cambridge University Press.

### **Edited volumes**

Gass, S./Neu, J. (eds.) (1996), *Speech acts across cultures. Challenges to communication in a second language*. Berlin/ NY: Mouton de Gruyter.

[(eds.) is used when there is more than one editor; and (ed.) where there is only one editor. In German the abbreviation used is (Hrsg.) for Herausgeber].

### **Edited articles**

Schmidt, R./Shimura, A./Wang, Z./Jeong, H. (1996), *Suggestions to buy: Television commercials from the U.S., Japan, China, and Korea*. In: Gass, S./Neu, J. (eds.) (1996), *Speech acts across cultures. Challenges to communication in a second language*. Berlin/ NY: Mouton de Gruyter: 285-316.

### **Journal articles**

McQuarrie, E.F./Mick, D.G. (1992), *On resonance: A critical pluralistic inquiry into advertising rhetoric*. *Journal of consumer research* 19, 180-197.

### **Electronic book**

Chandler, D. (1994), *Semiotics for beginners* [HTML document]. Retrieved [5.10.'01] from the World Wide Web, <http://www.aber.ac.uk/media/Documents/S4B/>.

**Electronic journal articles**

Watts, S. (2000) Teaching talk: Should students learn 'real German'? [HTML document]. German as a Foreign Language Journal [online] 1. Retrieved [12.09.'00] from the World Wide Web, <http://www.gfl-journal.com/>.

**Other websites**

Verterhus, S.A. (n.y.), Anglicisms in German car advertising. The problem of gender assignment [HTML document]. Retrieved [13.10.'01] from the World Wide Web, <http://olaf.hiof.no/~sverrev/eng.html>.

**Unpublished papers**

Takahashi, S./DuFon, M.A. (1989), Cross-linguistic influence in indirectness: The case of English directives performed by native Japanese speakers. Unpublished paper, Department of English as a Second Language, University of Hawai'i at Manoa, Honolulu.

**Unpublished theses/ dissertations**

Möhl, S. (1996), Alltagssituationen im interkulturellen Vergleich: Realisierung von Kritik und Ablehnung im Deutschen und Englischen. Unpublished MA thesis, University of Hamburg.

Walsh, R. (1995), Language development and the year abroad: A study of oral grammatical accuracy amongst adult learners of German as a foreign language. Unpublished PhD dissertation, University College Dublin.

**Appendix**

The appendix should be used for data collected (e.g. questionnaires, transcripts, ...) and for tables and graphs not included in the main text due to their subsidiary nature or to space constraints in the main text.

**Assessment Scheme:**

<b>Continuous Evaluation:</b> (Based on abstract writing, interim draft, general approach, research orientation, readings undertaken etc.)	40%
<b>Final Evaluation:</b> (Based on the organization of the paper, objectives/ problem profile/ issue outlining, comprehensiveness of the research, flow of the idea/ ideas, relevance of material used/ presented, outcomes vs. objectives, presentation/ viva etc.)	60%

# Protein Engineering

Course Code: BSB 331

Credit Units:03

## THEORY

### Course Objective:

This course will provide a broad grounding in concepts, techniques and issues involved in food products and their processing.

#### Module I

Protein structure: secondary structural elements, super-secondary structure, domains, mechanisms of protein folding, tertiary folds. Formation of oligomers. Protein solubility and interaction with solvents and solutes. The activity of proteins. Protein engineering principles.

#### Module II

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

#### Module III

Use of computer simulations and knowledge-based methods in the design process. De-novo design; making use of databases of sequence and structure.

#### Module IV

Protein engineering of enzyme: Rational and directed evolution, Mutational effect on engineered proteins, Engineered proteins;

#### Module V

Structure function design for protein design.

### Examination Scheme:

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

### Text & References:

### 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
- Database Annotation in Molecular Biology: Principles and Practice, Arthur M. Lesk
- Gene Cloning and DNA Analysis – An introduction (Fourth Edition), T.A. Brown
- Genes & Genomes, Maxine Singer and Paul Berg
- DNA : Structure and Function, Richard R. Sinden
- www.panimaText.com

# Food Biotechnology

Course Code: BSB 332

Credit Units:03

## THEORY

### Course Objective:

This course will provide a broad grounding in concepts, techniques and issues involved in food products and their processing.

### Course Contents:

#### Module I: Introduction

Scope and importance of food industry; RDT and other technologies involved in development of food products; Concept of 'functional food'; Advances and trends, ethical issues, quality control, legislation, FDA & FPO (India), patenting processes and products, consumer acceptance scenario for GM food products and GM crops.

#### Module II: Techniques used in Food Industry

Sterilization, isolation, screening and strain improvement, cell harvesting and disruption, recovery and purification, production of organic acids – citric acid, lactic acid and acetic acid; Gene cloning, production of recombinant proteins e.g. chymosin

#### Module III: Dairy Biotechnology

Starter cultures, prebiotics, probiotics – their use as flavor enhancers and disease/ infection combats, applications in production of cheese, butter, ice-cream, yoghurt; applications in biomedical research, e.g. recombinant LABs as vaccines; Modified milk proteins.

#### Module IV: Microbial, Plant and Animal Biotechnology

Production of SCP (Single cell protein), production of baker's yeast, brewing industry,

#### Module V

Applications of transgenic plants in food production, transgenic fish, and transgenic poultry.

### Examination Scheme:

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

### Text & References:

#### Text:

- Food Biotechnology - 2. 1988. R.D. King and P.S.J. Cheetham (Eds.). Elsevier Applied Science, NY.

#### References:

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

## RECOMBINANT DNA TECHNOLOGY

**Course Code: BSB 401**

**Credit Units: 03**

**Course Objective:**

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

**Module I: Introduction to Recombinant DNA Technology**

Importance of Gene Cloning and DNA Analysis, Vectors for Gene Cloning: Plasmids and Bacteriophages, Purification of DNA from bacterial, plant and animal cells.

**Module II: Basic Principles of Gene Cloning**

Manipulation of purified DNA-enzymes used in RDT, Restriction Mapping, Introduction of DNA into living cells, How to obtain a clone of a specific gene.

**Module III: Blotting techniques and hybridization**

Southern, Northern and Western blotting techniques, Radioactive and non-radioactive probes, Dot blots and slot blots, RFLP, AFLP.

**Module IV: Nucleic acid amplification and Sequencing**

Principles of PCR, designing of primers, Sanger's and Automated DNA sequencing

**Module V: Applications of gene cloning in biotechnology**

Production of proteins from cloned genes, Gene cloning in medicine (Pharmaceutical agents such as insulin, growth hormones, recombinant vaccines), gene therapy for genetic diseases.

**Examination Scheme:**

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

**Text & References:**

**Text:**

- Brown, T.A. (2010). Gene cloning and DNA analysis, 6<sup>th</sup> Ed. Wiley- Blackwell, A John Wiley & Sons, Ltd. Publication.

**References:**

- Primrose, S. B. and Twyman, R.M. (2006). Principles of Gene Manipulation and Genomics, 7<sup>th</sup> Ed. Blackwell Publication.
- Glick, B.R. and Pasternak J.J. (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4<sup>th</sup> Ed. ASM Press.

## STRUCTURAL BIOLOGY

**Course Code:** BSB 402

**Credit Units:** 03

**Course Objective:**

The course aims to provide an understanding of the principles and applications of proteins, enzymes and nucleic acids for their role in biochemical pathway as well as interactions among themselves.

**Course Contents:**

**Module I: Introduction to structural biology**

Structural biology: Introduction and applications. Basic structural principles, Proteins and poly peptide chains.

**Module II: Fundamentals of protein structure**

Structure of amino acids, primary structure of proteins, Secondary structure of proteins-helices, sheets, loops and turns. Supersecondary structures, Tertiary structure of proteins: alpha domain structures beta domain structures, alpha-beta domain structures, homo and hetero-dimers, trimers and tetramers.

**Module IV: Protein solubility and stabilization**

Salting in and salting out, Native, partially denatured and denatured proteins; Protein denaturation, Physical and chemical denaturants; Refolding

**Module V: Structure function and engineering**

Rational structure based drug design. Protein-DNA interactions. Drug-DNA interactions. Protein engineering and design of Protein structures.

**Examination Scheme:**

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

**Text & References:**

**Text:**

- Introduction to Protein Structure, C. Branden and J Tooze, Garland Publishing Company, New York. 2010.
- Textbook of Structural Biology, Anders Liljas, Lars Liljas and Poul, World Scientific Publishing Co Pte Ltd.

**References:**

- Protein Structure, M. Perutz, Oxford University Press.
- Structural Biology of Viruses, Wah Chiu, Roger M. Burnett and Robert Garce, Oxford University Press.
- Structure and Mechanism in Protein Science, Alan Fersht.

# Immunology & Immunotechnology

**Course Code: BSB 403**

**Credit Units: 02**

## Course Objective:

Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

## Course Contents:

### Module I

Immune system, immune response; Immunity: Innate and specific immunity, primary and secondary immune response, active and passive immune response, Humoral immunity and cell mediated immunity, Clonal selection theory Antibody structure, types and functions; concept of isotypes, allotypes, idiotypes. Antibody diversity, Monoclonal antibodies and their production

### Module II

Immune system: The organs of the immune system: structure and function - Thymus, bone marrow, spleen, MALT.

### Module III

Histocompatibility: structure of MHC class I, II & III antigens & their mode of antigen presentation, MHC restriction; Antigens & antigenicity Immunotechnology: ELISA, radioimmunoassay, Immunofluorescent assay. Precipitation and agglutination based assays.

## Examination Scheme:

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

## Text & References:

### Text:

Owen J., Punt J., and Stranford Sharon (2013): 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

## Scientific Writing

**Course Code: BSB 404**

**Credit Units:03**

### THEORY

The course addresses some of the more practical skills involved in writing about complex scientific information

#### Module 1

Introduction; Importance and basic rules of scientific writing; English in academic writing; Common error in Language; Structure of an original research article

#### Module 2

Writing an abstract; Literature review: Introduction, Source of literature; Process of literature review; Online literature databases; Literature management tools; Citing and Referencing; Different tools available, an Introduction to Mendeley and getting started with Mendeley, Add and managing references in Mendeley, Sharing, collaborating and other tools

#### Module 3

Ethics and Plagiarism Plagiarism: Introduction; Tools for the detection of plagiarism; Avoiding plagiarism

#### Module 4

Review Paper Writing, Research paper writing; Thesis Writing; Abstract/ Conference Paper/ Book/ Book Chapter writing;

#### Module 5

OERs: basic concept and licenses Open Educational Resources (OERs) for learning & Research; OERs development

#### Examination Scheme

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

Text book:

Katz, Michael Jay. From research to manuscript: A guide to scientific writing. Springer Science & Business Media, 2009. Boland, Angela, Gemma Cherry, and Rumona Dickson, eds. "Doing a systematic review: A student's guide." (2017). 2nd edition SAGE publications

References:

Wanderer, Nancy A. "Writing Better Opinions: Communicating with Candor, Clarity, and Style." Me. L. Rev. 54 (2002): 47.

## Biomaterials and biomimetics

BSB 405

2 Credit

### Theory

Typical biomimetically inspired biomaterials include nano-biomaterials, smart biomaterials, hybrid biomaterials, nano-biocomposites, hierarchically porous biomaterials and tissue scaffolds. This important book summarises key research in this important field.

### Module-I: Fundamentals

Definition of biomaterials, requirements & classification of biomaterials, Properties of biomaterials; Biocompatibility & toxicological screening of biomaterials

### Module-II: Implant Materials

Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking.

Classification according to thermosets, thermoplastics and elastomers. Importance of molecular structure, hydrophilic and hydrophobic surface properties, Biodegradable polymers for medical purposes, Definition of bioceramics, common types of bioceramics, the importance of wear resistance and low fracture toughness

### Module-III: Biomimetics

Hierarchical structure, mechanical properties and fabrication of biomimetic biomaterials; Biomimetic coatings for biomaterial surfaces, Inspiration from animals, self-healing materials, Biomimetic in photonics, Various applications of Biomimetic

### Examination Scheme:

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

### Text & References:

#### *Text:*

- A text book of Organic Chemistry, Bahl & Bahl, S. Chand & Co. Ltd.
- Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co.

#### *References:*

- Advanced Organic Chemistry, Bahl & Bahl, S. Chand & Co. Ltd.
- Organic Chemistry Vol. I & II, I.L. Finar
- Fundamentals of Organic Chemistry, Nafis Haider, S. Chand & Co. Ltd.
- Organic Chemistry Vol. I, II & III, Dr. Jagdamba Singh, L.D.S. Yadav, Pragati Prakashan.
- Essentials of Physical Chemistry, Bahl & Tuli, S. Chand & Co. Ltd.
- Simplified course in Physical Chemistry, Madan & Tuli, S. Chand & Co. Ltd.

## RECOMBINANT DNA TECHNOLOGY LAB

**Course Code: BSB 421****Credit Units: 01****Course Contents:****Module I:**

Isolation of Genomic DNA and plasmid DNA

**Module II:**

Polymerase Chain Reaction

**Module III**

Restriction digestion

**Examination Scheme:**

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

**STRUCTURAL BIOLOGY LAB****Course Code: BSB 422****Credit Units: 01****Course Contents:**

1. Crystallization of Lysozyme -pH driven and salt driven crystallization.
2. Study of change in salt concentration on protein precipitation.
3. Study of protein finger printing
4. Study of change in pH on protein solubility.
5. Protein structure analysis.
6. Protein ligand interaction studies.

**Examination Scheme:**

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

**IMMUNOLOGY AND IMMUNOTECHNOLOGY LAB****Course Code: BSB 423****Credit Units: 01****Course Contents:****Module I**

Blood film preparation &amp; identification of blood cells

**Module II**

Differential Leucocyte Count, Total Leucocyte Count

**Module III**

Agglutination Based Tests: Study of blood groups ,Widal test

**Module IV**

Study of ELISA.

**Examination Scheme:**

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

## TERM PAPER

**Course Code:           BSB 430**

**Credit Units: 03**

A term (or research) paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned. The progress of the paper will be monitored regularly by the faculty. At the end of the semester the detailed paper on the topic will be submitted to the faculty assigned. The evaluation will be done by Board of examiners comprising of the faculties.

### GUIDELINES FOR TERM PAPER

The procedure for writing a term paper may consists of the following steps:

13. Choosing a subject
14. Finding sources of materials
15. Collecting the notes
16. Outlining the paper
17. Writing the first draft
18. Editing & preparing the final paper

#### 1. Choosing a Subject

The subject chosen should not be too general.

#### 2. Finding Sources of materials

- g) The material sources should be not more than 10 years old unless the nature of the paper is such that it involves examining older writings from a historical point of view.
- h) Begin by making a list of subject-headings under which you might expect the subject to be listed.
- i) The sources could be books and magazines articles, news stories, periodicals, scientific journals etc.

#### 3. Collecting the notes

Skim through sources, locating the useful material, then make good notes of it, including quotes and information for footnotes.

- g) Get facts, not just opinions. Compare the facts with author's conclusion.
- h) In research studies, notice the methods and procedures, results & conclusions.
- i) Check cross references.

#### 4. Outlining the paper

- e) Review notes to find main sub-divisions of the subject.
- f) Sort the collected material again under each main division to find sub-sections for outline so that it begins to look more coherent and takes on a definite structure. If it does not, try going back and sorting again for main divisions, to see if another general pattern is possible.

#### 5. Writing the first draft

Write the paper around the outline, being sure that you indicate in the first part of the paper what its purpose is. You may follow the following:

- a) statement of purpose
- b) main body of the paper
- c) statement of summary and conclusion

Avoid short, bumpy sentences and long straggling sentences with more than one main ideas.

#### 6. Editing & Preparing the final Paper

- s) Before writing a term paper, you should ensure you have a question which you attempt to answer in your paper. This question should be kept in mind throughout the paper. Include only information/ details/ analyses of relevance to the question at hand. Sometimes, the relevance of a particular section may be clear to you but not to your readers. To avoid this, ensure you briefly explain the relevance of every section.
- t) Read the paper to ensure that the language is not awkward, and that it "flows" properly.
- u) Check for proper spelling, phrasing and sentence construction.

- v) Check for proper form on footnotes, quotes, and punctuation.
- w) Check to see that quotations serve one of the following purposes:
- x) Show evidence of what an author has said.
- y) Avoid misrepresentation through restatement.
- z) Save unnecessary writing when ideas have been well expressed by the original author.
- aa) Check for proper form on tables and graphs. Be certain that any table or graph is self-explanatory.

Term papers should be composed of the following sections:

- 15) Title page
- 16) Table of contents
- 17) Introduction
- 18) Review
- 19) Discussion & Conclusion
- 20) References
- 21) Appendix

Generally, the introduction, discussion, conclusion and bibliography part should account for a third of the paper and the review part should be two thirds of the paper.

### **Discussion**

The discussion section either follows the results or may alternatively be integrated in the results section. The section should consist of a discussion of the results of the study focusing on the question posed in the research paper.

### **Conclusion**

The conclusion is often thought of as the easiest part of the paper but should by no means be disregarded. There are a number of key components which should not be omitted. These include:

- i) summary of question posed
- j) summary of findings
- k) summary of main limitations of the study at hand
- l) details of possibilities for related future research

### **References**

From the very beginning of a research project, you should be careful to note all details of articles gathered.

The bibliography should contain ALL references included in the paper. References not included in the text in any form should NOT be included in the bibliography.

The key to a good bibliography is consistency. Choose a particular convention and stick to this.

### **Conventions**

Monographs

Crystal, D. (2001), *Language and the internet*. Cambridge: Cambridge University Press.

### **Edited volumes**

Gass, S./Neu, J. (eds.) (1996), *Speech acts across cultures. Challenges to communication in a second language*. Berlin/ NY: Mouton de Gruyter.

[(eds.) is used when there is more than one editor; and (ed.) where there is only one editor. In German the abbreviation used is (Hrsg.) for Herausgeber].

### **Edited articles**

Schmidt, R./Shimura, A./Wang, Z./Jeong, H. (1996), *Suggestions to buy: Television commercials from the U.S., Japan, China, and Korea*. In: Gass, S./Neu, J. (eds.) (1996), *Speech acts across cultures. Challenges to communication in a second language*. Berlin/ NY: Mouton de Gruyter: 285-316.

### **Journal articles**

McQuarrie, E.F./Mick, D.G. (1992), *On resonance: A critical pluralistic inquiry into advertising rhetoric*. *Journal of consumer research* 19, 180-197.

### **Electronic book**

Chandler, D. (1994), *Semiotics for beginners* [HTML document]. Retrieved [5.10.'01] from the World Wide Web, <http://www.aber.ac.uk/media/Documents/S4B/>.

**Electronic journal articles**

Watts, S. (2000) Teaching talk: Should students learn 'real German'? [HTML document]. German as a Foreign Language Journal [online] 1. Retrieved [12.09.'00] from the World Wide Web, <http://www.gfl-journal.com/>.

**Other websites**

Verterhus, S.A. (n.y.), Anglicisms in German car advertising. The problem of gender assignment [HTML document]. Retrieved [13.10.'01] from the World Wide Web, <http://olaf.hiof.no/~sverrev/eng.html>.

**Unpublished papers**

Takahashi, S./DuFon, M.A. (1989), Cross-linguistic influence in indirectness: The case of English directives performed by native Japanese speakers. Unpublished paper, Department of English as a Second Language, University of Hawai'i at Manoa, Honolulu.

**Unpublished theses/ dissertations**

Möhl, S. (1996), Alltagssituationen im interkulturellen Vergleich: Realisierung von Kritik und Ablehnung im Deutschen und Englischen. Unpublished MA thesis, University of Hamburg.

Walsh, R. (1995), Language development and the year abroad: A study of oral grammatical accuracy amongst adult learners of German as a foreign language. Unpublished PhD dissertation, University College Dublin.

**Appendix**

The appendix should be used for data collected (e.g. questionnaires, transcripts, ...) and for tables and graphs not included in the main text due to their subsidiary nature or to space constraints in the main text.

**Assessment Scheme:****Continuous Evaluation:**

40%

(Based on abstract writing, interim draft, general approach, research orientation, readings undertaken etc.)

**Final Evaluation:**

60%

(Based on the organization of the paper, objectives/ problem profile/ issue outlining, comprehensiveness of the research, flow of the idea/ ideas, relevance of material used/ presented, outcomes vs. objectives, presentation/ viva etc.)

## DOWNSTREAM PROCESSING

**Course Code: BSB 431**

**Credit Units: 03**

**Course Objective:**

The syllabus will help the students to characterize the Bioproducts due to downstreaming process of biotechnological importance.

**Course Contents:**

**Module I**

Characteristics of Bioproducts; Coagulation, Flocculation and conditioning of broth.

**Module II**

Mechanical separation; Cell disruption techniques, Protein precipitation and separation

**Module III**

Aqueous- two- phase extraction, Adsorption-desorption processes, Chromatographic methods of separation based on size, charge, hydrophobic interactions and biological affinity

**Module IV**

Membrane based separation; Dialysis, Electrodialysis; Micro filtration, Ultra filtration; Electrophoresis,

**Module V**

Crystallization; Drying

**Examination Scheme:**

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

**Text & References:**

**Text:**

- Biochemical Engineering Fundamentals, J.E. Bailey and D.F. Ollis, McGraw-Hill.
- Bioseparations, P.A. Belter, E.L. Cussler and W.S. Hu, John Wiley and Sons Inc. Bioseparations: Downstream Processing for Biotechnology, P.A. Belter et al, John Wiley and Sons Inc.

**References:**

- 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. Willson, C.C. Painton and S.E. Builder, American Chemical Society.

# PHARMACEUTICAL TECHNOLOGY & BIOTECHNOLOGY

**Course Code: BSB 432**

**Credit Units: 03**

## Theory

### Course Objective:

The main objectives for biotechnology students 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

### Module –I:

**Pharmaceutical calculations:** Posology, calculation of doses for infants, adults and elderly patients; Enlarging and reducing recipes percentage solutions, allegation, alcohol dilution, proof spirit, isotonic solutions, displacement value etc.

### Module-II

**Pharmacopoeias & Formularies:** IP,BP,USP, Drug & cosmetic act and rules, Good manufacturing practices, Good laboratories practices and requirements of premises, plant and equipment for pharmaceutical products including Master & Batch formula records. (Schedule-M).

### Module III

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

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

### Module-IV

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

### Module-V

**Antibiotics:** Historical development of antibiotics. Antimicrobial spectrum and methods used for their standardization. Classification of antimicrobial drugs based on mechanism of action. Problems arising with use of Antimicrobial drugs (Toxicity, Hypersensitivity reactions, Drug resistance, Super-infection, Nutritional deficiencies.

**Antibiotics fermentation:** General history, Raw materials, manufacturing process and quality control.

### Examination Scheme:

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

### Suggested Books:

1. Pharmaceutical Biotechnology, by Daan J. A. Crommelin, Robert D. Sindelar. Informa Healthcare USA, Inc, 3<sup>rd</sup> edition.
2. Textbook of Pharmaceutical Biotechnology, By Chandrakant Kokate, Pramod H.J, SS Jalalpure , Publisher: Elsevier India Pvt Ltd.
3. Vyas SP, Dixit VK."Pharmaceutical Biotechnology", 1st edition ,2007, CBS Publishers & Distributors, New Delhi
4. Textbook Of Physical Pharmaceutics by C.V.S. Subrahmanyam, Vallabh Prakashan.
5. Text book of Pharmaceutical Engineering by C.V.S. Subrahmanyam, Vallabh Prakashan.

## Communication Skills - II

**Course Code:** BCS 401

**Credit Units:**01

### Course Objective:

To teach the participants strategies for improving academic reading and writing. Emphasis is placed on increasing fluency, deepening vocabulary, and refining academic language proficiency.

### Course Contents:

#### Module I: Social Communication Skills

Small Talk  
Conversational English  
Appropriateness  
Building rapport

#### Module II: Context Based Speaking

In general situations  
In specific professional situations  
Discussion and associated vocabulary  
Simulations/Role Play

#### Module III: Professional Skills

Presentations  
Negotiations  
Meetings  
Telephony Skills

### 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:

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

## Understanding Self for Effectiveness IV

**Course Code:** BSS 403

**Credit Units:**01

### **Course Objective:**

To inculcate an elementary level of understanding of group/team functions  
To develop team-spirit and to know the importance of working in teams

### **Course Contents:**

#### **Module I: Group formation**

Definition and Characteristics  
Importance of groups  
Classification of groups  
Stages of group formation  
Benefits of group formation

#### **Module II: Group Functions**

External Conditions affecting group functioning: Authority, Structure, Org. Resources, Organizational policies etc.  
Internal conditions affecting group functioning: Roles, Norms, Conformity, Status, Cohesiveness, Size, Inter group conflict.  
Group Cohesiveness and Group Conflict  
Adjustment in Groups

#### **Module III: Teams**

Meaning and nature of teams  
External and Internal factors effecting team  
Building Effective Teams  
Consensus Building  
Collaboration

#### **Module IV: Leadership**

Meaning, Nature and Functions  
Self leadership  
Leadership styles in organization  
Leadership in Teams

#### **Module V: Power to empower: Individual and Teams**

Meaning and Nature  
Types of power  
Relevance in organization and Society

#### **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

### **Text & References:**

- Organizational Behaviour, Davis, K.
- Hoover, Judhith D. Effective Small Group and Team Communication, 2002, Harcourt College Publishers
- Dick, Mc Cann & Margerison, Charles: Team Management, 1992 Edition, viva books
- LaFasto and Larson: When Teams Work Best, 2001, Response Books (Sage), New Delhi
- Smither Robert D.; The Psychology of Work and Human Performance, 1994, Harper Collins College Publishers

## FRENCH - IV

**Course Code:** FLT 401

**Credit Units:**02

### Course Objective:

To enable students:

- To develop strategies of comprehension of texts of different origin
- To present facts, projects, plans with precision

### Course Contents:

**Module C: pp. 104 – 139 : Unités 8,9**

#### Contenu lexical : Unité 8: Découvrir le passé

1. parler du passé, des habitudes et des changements.
2. parler de la famille, raconter une suite d'événements/préciser leur date et leur durée.
3. connaître quelques moments de l'histoire

#### Unité 9: Entreprendre

1. faire un projet de la réalisation: (exprimer un besoin, préciser les étapes d'une réalisation)
2. parler d'une entreprise
3. parler du futur

#### Contenu grammatical:

1. Imparfait
2. Pronom « en »
3. Futur
4. Discours rapporté au présent
5. Passé récent
6. Présent progressif

### 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 - IV****Course Code:** FLG 401**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 Advanced Grammar Language and Professional Jargon

**Course Contents:****Module I: Present perfect tense**

Present perfect tense, usage and applicability

Usage of this tense to indicate near past

Universal applicability of this tense in German

**Module II: Letter writing**

To acquaint the students with the form of writing informal letters.

**Module III: Interchanging prepositions**

Usage of prepositions with both accusative and dative cases

Usage of verbs fixed with prepositions

Emphasizing on the action and position factor

**Module IV: Past tense**

Introduction to simple past tense

Learning the verb forms in past tense

Making a list of all verbs in the past tense and the participle forms

**Module V: Reading a Fairy Tale**

Comprehension and narration

Rotkäppchen

Froschprinzessin

Die Fremdsprache

**Module VI: Genitive case**

Genitive case – Explain the concept of possession in genitive

Mentioning the structure of weak nouns

**Module VII: Genitive prepositions**

Discuss the genitive prepositions and their usage: (während, wegen, statt, trotz)

**Module VIII: Picture Description**

Firstly recognize the persons or things in the picture and identify the situation depicted in the picture;

Secondly answer questions of general meaning in context to the picture and also talk about the personal experiences which come to your mind upon seeing the picture.

**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 – IV****Course Code:** FLS 401**Credit Units:**02**Course Objective:**

To enable students acquire working knowledge of the language; to give them vocabulary, grammar, voice modulations/intonations to handle everyday Spanish situations with ease.

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

Revision of earlier semester modules  
Introduction to Present Continuous Tense (Gerunds)

**Module II**

Translation with Present Continuous Tense  
Introduction to Gustar, Parecer, Apetecer, doler

**Module III**

Imperatives (positive and negative commands of regular verbs)

**Module IV**

Commercial/business vocabulary

**Module V**

Simple conversation with help of texts and vocabulary  
En la recepcion del hotel  
En el restaurante  
En la agencia de viajes  
En la tienda/supermercado

**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 Sin Fronteras (Nivel – Elemental)

## CHINESE – IV

**Course Code:** FLC 401

**Credit Units:**02

**Course Objective:**

How many characters are there? The early Qing dynasty dictionary included nearly 50,000 characters the vast majority of which were rare accumulated characters over the centuries. An educate person in China can probably recognize around 6000 characters. 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**

Dialogue Practice  
Observe picture and answer the question  
Pronunciation and intonation  
Character writing and stroke order.  
Electronic items

**Module II**

Traveling – The Scenery is very beautiful  
Weather and climate  
Grammar question with – “bu shi .... Ma?”  
The construction “yao ... le” (Used to indicate that an action is going to take place)  
Time words “yiqian”, “yiwai” (Before and after).  
The adverb “geng”.

**Module III**

Going to a friend house for a visit meeting his family and talking about their customs.  
Fallen sick and going to the Doctor, the doctor examines, takes temperature and writes prescription.  
Aspect particle “guo” shows that an action has happened some time in the past.  
Progressive aspect of an actin “zhengzai” Also the use if “zhe” with it.  
To welcome someone and to see off someone .... I cant go the airport to see you off... etc.

**Module IV**

Shipment. Is this the place to checking luggage?  
Basic dialogue on – Where do u work?  
Basic dialogue on – This is my address  
Basic dialogue on – I understand Chinese  
Basic dialogue on – What job do u do?  
Basic dialogue on – What time is it now?

**Module V**

Basic dialogue on – What day (date) is it today?  
Basic dialogue on – What is the weather like here.  
Basic dialogue on – Do u like Chinese food?  
Basic dialogue on – I am planning to go to China.

**Examination Scheme:**

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

## PLANT BIOTECHNOLOGY

Course Code: BSB 501

Credit Units: 03

### Course Objective:

The course aims to make the students understand the basic techniques of plant tissue culture. The application of Plant Biotechnology covers major areas related to commercial applications. Regeneration of plants through *in vitro* techniques offers a practical strategy for micropropagation.

#### Module I: Introduction to *in vitro* methods

Terms and definitions. Beginning of *in vitro* cultures in our country (ovary and ovule culture, *in vitro* pollination and fertilization. Embryo culture, embryo rescue after wide hybridization, and its applications. Endosperm culture and production of triploids.

#### Module II: Introduction to the processes of embryogenesis and organogenesis and their practical applications

Micropropagation, axillary bud, shoot-tip and meristem culture. Haploids and their applications. Somaclonal variations and applications (Treasure your exceptions).

#### Module III: Introduction to protoplast isolation

Principles of protoplast isolation and applications. Testing of viability of isolated protoplasts. Various steps in the regeneration of protoplasts. Introduction of somatic hybridization. Various methods for fusing protoplasts, chemical and electrical. Cybrids- definition and application.

#### Module IV: Use of plant cell, protoplasts and tissue culture for genetic manipulation of plants

Introduction to *A. tumefaciens*. Tumor formation on plants using *A. tumefaciens* (Monocots vs. Dicots). Practical application of genetic transformation

**Module V.** Transgenic crops with new traits herbicide tolerance, insect and disease resistance, oral vaccines. Secondary metabolites via tissue culture.

### Examination Scheme:

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

### Text & References:

#### Text:

- M.K. Razdan. An Introduction to Plant Tissue Culture. Oxford and IBH Publishing

#### References:

- J.H. Dodds and L.K. Roberts. Experiments in Plant Tissue Culture. Cambridge University Press
- K.M.O. Caldenty, W.H. Barz and H.L. Wills, Plant Biotechnology and Transgenic Plants. Marcel Dekker
- J. Hammond, P. McGarvy and V. Yusibov. Plant Biotechnology. Springer Verlag.
- T-J Fu, G. Singh and W.R. Curtis. Plant Cell & Tissue Culture for the production of Food Ingredients. Kluwer Academic/Plenum Press
- S.S. Bhojwani and M.K. Razdan. Plant Tissue Culture: Theory & Practice. Elsevier Health Sciences

## ANIMAL BIOTECHNOLOGY

Course Code: BSB 502

Credit Units: 03

### Course Objective:

The aim of the course is to provide equal importance to areas like *in vitro* fertilization, animal cell and tissue culture, hormone vaccine and important enzyme production through animal biotechnology.

### Course Contents:

#### Module I

Introduction of animal cell culture substrate, culture media,

#### Module II

Preservation and maintenance of cell lines.

#### Module III

Vaccines: Design, production and administration

#### Module IV

Transgenic animals. In vitro fertilization and embryo transfer technology, cryopreservation of embryos

#### Module V

Pharmaceutical products: Human protein replacement. Gene therapy: types, vectors, methods, safety and advances

### Examination Scheme:

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

### Text & References:

#### Text:

- R.I Freshney. Culture of Animal Cells. Wiley-Leiss.

#### References:

- J.R.W. Masters. Animal Cell Culture – A Practical approach. Oxford.
- M. Clynes. Animal Cell Culture Techniques. Springer Verlag.
- M. Butler and M. Dawson. Cell Culture Lab Fax. Bios scientific Publications Ltd.
- R. Basega. Cell Growth and Division – A Practical approach. IRL Press.
- Moo-Young, Alan T. Bullm Howard Dalton. Comprehensive Biotechnology. Panima Publication.

**BIOENTREPRENEURSHIP****Course Code: BSB 503****Credit Units: 03****Course Objective:**

The aim of this course is to develop the understanding of management of entrepreneurship. The objective is to acquaint the students with various aspects of entrepreneurship business.

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

**Need, scope and types of entrepreneurship management of self and understanding human behaviour, business ethics, performance appraisal, and (SWOT) analysis.**

**Module II**

Market survey techniques, Criteria for the principles of product selection and development, Elements of Marketing & Sales Management- (a) Nature of product and market strategy (b) Packaging and advertising (c) After Sales Service (d) Pricing techniques. financial incentives, books of accounts and financial statements.

**Module III**

Technical feasibility of the project, plant layout & process planning for the product, Quality Control, Critical Path Method (CPM) and Project Evaluation Review Techniques (PERT) as planning tools for establishing SSI

**Module IV**

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 V**

Funding Opportunities & Incentives, Government Initiatives for Startups; Success stories: Biocon, Sea6 Energy, MedGenome, Bharat Biotech, GANIT Labs, Forus Health

**Examination Scheme:**

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

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

- Ronald N. Forthfer and Eun Sun Lee. Introduction to Biostatistics. Elsevier.
- S.P. Gupta. Statistical Methodology. S. Chand & Co.
- S.C. Gupta. Fundamentals of Statistics. S.Chand & Co.

*References:*

- K. Visweswara Rao. Biostatistics: A manual of Statistical Methodology for use in Health, Nutrition and Anthropology. Jaypee Brothers
- Kaushal, T.L. Statistical Analysis. Kalyani Publishers
- Potri, D. Statistical Methods. Kalyani Publishers.

## GENOMICS & PROTEOMICS

**Course Code: BSB 504**

**Credit Units: 04**

### Course Objective:

The course helps in developing a detailed understanding of eukaryotic genome complexity and organization. The students will be familiarised with the techniques in Genomics. The course helps in developing a detailed understanding of the analysis of Proteome. The major techniques and methods used will be dealt with in detail.

### Course Contents:

#### Module I

The origin of genomes; Acquisition of new Genes; DNA sequencing-chemical and enzymatic methods; Restriction mapping.

#### Module II

DNA & RNA fingerprinting; The Human Genome; Phylogeny. SAGE, ESTs, AFLP & RFLP analysis.

#### Module III

Basic principles of protein structure. 2D – gel electrophoresis, mass spectroscopy.

#### Module IV

Modeling of three-dimensional structure of a protein; Modeling mutants

#### Module V

Clinical and biomedical applications of genomics and proteomics, Molecular diagnostics designs; Global market of gene and protein based diagnostics

### Examination Scheme:

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

### Text & References:

#### Text:

- A.D. Baxevanis and B.F.F. Ouellette. Bioinformatics: A practical guide to the analysis of genes and proteins. John Wiley and Sons Inc.
- T. Palzkill. Proteomics. Kluwer Academic Publishers

#### References:

- Bioinformatics: Sequence and Genome Analysis, D.W. Mount, Cold Spring Harbor Laboratory Press
- DNA Micro arrays: A Practical Approach, M. Schlena, Oxford University Press.
- B. Liu. Statistical Genomics: Linkage, Mapping and QTL Analysis. CRC Press.
- M. Schlena. DNA Micro arrays: A Practical Approach. Oxford University Press.

**CLINICAL RESEARCH & PHARMACOVIGILANCE****Course Code: BSB 505****Credit Units: 03****UNIT-I****Basics of general Pharmacology & Drug discovery process**

Drug, Receptors, Dosage forms, routes of drug administration, drug receptor interactions, drug drug interactions, drug resistance, drug tolerance, drug dependence, Pharmacokinetic (ADME) and Pharmacodynamic of drugs, Adverse drug effects.

General introduction about Drug discovery and development process, Bioavailability /Bioequivalence Studies and Pharmacovigilance.

Repurposing of drugs

**UNIT-II**

**Basics of Clinical trials** - Basics of clinical trials, Introduction and history of clinical trials, Types of clinical trials, Inclusion and exclusion criteria, Primary and Secondary outcome/endpoint of clinical trials, Needs of Clinical trials and Phases of clinical trials.

**UNIT-III****Various Key documents, application filling and Ethical regulation of Clinical trials:**

- Investigator Brochure (IB), Protocol & Amendment in Protocol , Case Report Form (CRF),
- Informed Consent Form (ICF) , Essential Documents in Clinical Trial Good Clinical Practice: ICH guidelines, Indian GCP guidelines (CDSCO guidelines),
- Investigational new drug (IND) / clinical trial exception (CTX) / clinical trial authorization (CTA) application
- New drug application (NDA/ANDA) / marketing authorization application (MAA)
- ICMR Guideline - Ethical Guideline for Biomedical Research on Human Subjects & Schedule Y
- Ethical Codes – The Declaration of Helsinki.

**UNIT-IV****Clinical trial design:** Need of clinical trial design

Treatment studies- Randomized controlled trial, Adaptive clinical trial, Nonrandomized trial, Observational studies- Cohort study, Case control study, Cross sectional study, Ecological study

**UNIT-V****Pharmacovigilance:**

**Introduction to adverse drug reactions:** Definitions and classification of ADRs, Detection and reporting, Causality assessment, Severity and seriousness assessment , Predictability and preventability assessment, Management of adverse drug reactions.

**Introduction to pharmacovigilance:** History and development of pharmacovigilance, Importance of safety monitoring / Why pharmacovigilance

**National and international scenario:** Pharmacovigilance in India, Pharmacovigilance global perspective, WHO international drug monitoring programme

**Adverse drug reaction reporting:** Introduction to reporting systems, Spontaneous reporting system , Reporting to regulatory authorities , Guidelines for reporting ADRs in biomedical literature

**Drug dictionaries and coding in pharmacovigilance:** WHO adverse reaction terminologies, MedDRA and Standardised MedDRA queries.

**Reference Books**

1. Methodology of Clinical Drug Trials, 2nd Edition. Spriet A., Dupin-Spriet T., Simon P. Publisher: Karger.
2. Design and Analysis of Clinical Trials: Concepts and Methodologies, 3rd Edition. SheinChung Chow, Jen-Pei Liu. Publisher: Wiley.
3. New Drug Development: Design, Methodology, and Analysis, by J. Rick Turner, Published by John Wiley & Sons, 2007.
4. Essentials of Medical Pharmacology by K D Tripathi, Published by JAYPEE Brothers Medical Publishers (P) Ltd. 7<sup>th</sup> Edition 2010.
5. Drug Discovery and Clinical Research, by S.K Gupta, Published by JAYPEE Brothers Medical Publishers (P) Ltd.
6. A Textbook of Pharmacovigilance: Concept and Practice, by Guru Prasad Mohanta, Published by PharmaMed Press/BSP Books (2015).
7. An Introduction to Pharmacovigilance, by Patrick Waller, Published by October 2009, Wiley-Blackwell.

**INDUSTRIAL TRAINING EVALUATION****Course Code: BSB 550****Credit Units: 03****Methodology**

The students will go to various research institutes/R&D Labs of industries to learn various biotechnological tools and procedures and their utility in commercial applications. The aim of this training is to train the students in the various industrial/Research aspects of commercialization of biotechnological systems.

The students will be supervised by the internal faculty during the tenure of training.

The students shall submit a dissertation on the training undertaken which shall be evaluated by the concerned internal faculty. The Viva Voce shall then be conducted by an external Examiner

**Examination Scheme:**

Dissertation:	50
Viva Voce:	50
<b>Total:</b>	<b>100</b>

**PLANT BIOTECHNOLOGY LAB****Course Code: BSB 521****Credit Units: 01****Course Contents:****Module I**

Sterilization techniques of glass wares & equipments.  
 Preparation of cotton plugs & culture media .  
 Preparation and sterilization .of different explants.  
 Inoculation of explants on culture media.

**Module II**

Culture of plant embryos/seeds.  
 Callus culture.  
 Testing of seed viability.

**Module III**

Culture of plant embryos/seeds; callus culture; meristem; haploid culture; seed test viability.

**Examination Scheme:**

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

## ANIMAL BIOTECHNOLOGY LAB

**Course Code: BSB 522**

**Credit Units: 01**

### Course Contents:

#### Module I

Culture of animal cell line

#### Module II

Preparation of competent cells by calcium chloride method

#### Module III

Study of toxicity on cell lines

### Examination Scheme:

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

## GENOMICS AND PROTEOMICS LAB

**Course Code: BSB 524**

**Credit Units: 01**

### Course Contents:

#### Module I

Electrophoretic separation of plasmid DNA.  
Restriction, digestion & ligation of DNA.

#### Module II

Gene finding tools and genome annotation- Gen Scan, Net Gene, Hmm gene.

#### Module III

Comparison of two given genomes- Mummer.

#### Module IV

Homology modeling of 3-D structure from amino acid sequence: SWISS- MODELLER  
Graphics tools: SWISS- PDB Viewer.

### Examination Scheme:

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



## **TERM PAPER**

**Course Code: BTB 530**

**Credit Units: 03**

### **METHODOLOGY**

A term (or research) paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned. The progress of the paper will be monitored regularly by the faculty. At the end of the semester the detailed paper on the topic will be submitted to the faculty assigned. The evaluation will be done by Board of examiners comprising of the faculties.

### **GUIDELINES FOR TERM PAPER**

The procedure for writing a term paper may consists of the following steps:

19. Choosing a subject
20. Finding sources of materials
21. Collecting the notes
22. Outlining the paper
23. Writing the first draft
24. Editing & preparing the final paper

#### **1. Choosing a Subject**

The subject chosen should not be too general.

#### **2. Finding Sources of materials**

- j) The material sources should be not more than 10 years old unless the nature of the paper is such that it involves examining older writings from a historical point of view.
- k) Begin by making a list of subject-headings under which you might expect the subject to be listed.
- l) The sources could be books and magazines articles, news stories, periodicals, scientific journals etc.

#### **3. Collecting the notes**

Skim through sources, locating the useful material, then make good notes of it, including quotes and information for footnotes.

- j) Get facts, not just opinions. Compare the facts with author's conclusion.
- k) In research studies, notice the methods and procedures, results & conclusions.
- l) Check cross references.

#### **4. Outlining the paper**

- g) Review notes to find main sub-divisions of the subject.
- h) Sort the collected material again under each main division to find sub-sections for outline so that it begins to look more coherent and takes on a definite structure. If it does not, try going back and sorting again for main divisions, to see if another general pattern is possible.

#### **5. Writing the first draft**

Write the paper around the outline, being sure that you indicate in the first part of the paper what its purpose is. You may follow the following:

- a) statement of purpose
- b) main body of the paper
- c) statement of summary and conclusion

Avoid short, bumpy sentences and long straggling sentences with more than one main ideas.

#### **6. Editing & Preparing the final Paper**

- a) Before writing a term paper, you should ensure you have a question which you attempt to answer in your paper. This question should be kept in mind throughout the paper. Include only information/ details/ analyses of relevance to the question at hand. Sometimes, the relevance of a particular section may be clear to you but not to your readers. To avoid this, ensure you briefly explain the relevance of every section.
- b) Read the paper to ensure that the language is not awkward, and that it "flows" properly.
- c) Check for proper spelling, phrasing and sentence construction.
- d) Check for proper form on footnotes, quotes, and punctuation.
- e) Check to see that quotations serve one of the following purposes:
  - (i) Show evidence of what an author has said.
  - (ii) Avoid misrepresentation through restatement.
  - (iii) Save unnecessary writing when ideas have been well expressed by the original author.
- f) Check for proper form on tables and graphs. Be certain that any table or graph is self-explanatory.

Term papers should be composed of the following sections:

- 22) Title page
- 23) Table of contents
- 24) Introduction
- 25) Review
- 26) Discussion & Conclusion
- 27) References
- 28) Appendix

Generally, the introduction, discussion, conclusion and bibliography part should account for a third of the paper and the review part should be two thirds of the paper.

### **Discussion**

The discussion section either follows the results or may alternatively be integrated in the results section. The section should consist of a discussion of the results of the study focusing on the question posed in the research paper.

### **Conclusion**

The conclusion is often thought of as the easiest part of the paper but should by no means be disregarded. There are a number of key components which should not be omitted. These include:

- m) summary of question posed
- n) summary of findings
- o) summary of main limitations of the study at hand
- p) details of possibilities for related future research

### **References**

From the very beginning of a research project, you should be careful to note all details of articles gathered.

The bibliography should contain ALL references included in the paper. References not included in the text in any form should NOT be included in the bibliography.

The key to a good bibliography is consistency. Choose a particular convention and stick to this.

### **Bibliographical conventions**

Monographs

Crystal, D. (2001), Language and the internet. Cambridge: Cambridge University Press.

### **Edited Volumes**

Gass, S./Neu, J. (eds.) (1996), Speech acts across cultures. Challenges to communication in a second language. Berlin/ NY: Mouton de Gruyter.

[(eds.) is used when there is more than one editor; and (ed.) where there is only one editor. In German the abbreviation used is (Hrsg.) for Herausgeber].

**Edited Articles**

Schmidt, R./Shimura, A./Wang, Z./Jeong, H. (1996), Suggestions to buy: Television commercials from the U.S., Japan, China, and Korea. In: Gass, S./Neu, J. (eds.) (1996), Speech acts across cultures. Challenges to communication in a second language. Berlin/ NY: Mouton de Gruyter: 285-316.

**Journal Articles**

McQuarrie, E.F./Mick, D.G. (1992), On resonance: A critical pluralistic inquiry into advertising rhetoric. Journal of consumer research 19, 180-197.

**Electronic Book**

Chandler, D. (1994), Semiotics for beginners [HTML document]. Retrieved [5.10.'01] from the World Wide Web, <http://www.aber.ac.uk/media/Documents/S4B/>.

**Electronic Journal Articles**

Watts, S. (2000) Teaching talk: Should students learn 'real German'? [HTML document]. German as a Foreign Language Journal [online] 1. Retrieved [12.09.'00] from the World Wide Web, <http://www.gfl-journal.com/>.

**Other Websites**

Verterhus, S.A. (n.y.), Anglicisms in German car advertising. The problem of gender assignment [HTML document]. Retrieved [13.10.'01] from the World Wide Web, <http://olaf.hiof.no/~sverrev/eng.html>.

**Unpublished Papers**

Takahashi, S./DuFon, M.A. (1989), Cross-linguistic influence in indirectness: The case of English directives performed by native Japanese speakers. Unpublished paper, Department of English as a Second Language, University of Hawai'i at Manoa, Honolulu.

**Unpublished Theses/ Dissertations**

Möhl, S. (1996), Alltagssituationen im interkulturellen Vergleich: Realisierung von Kritik und Ablehnung im Deutschen und Englischen. Unpublished MA thesis, University of Hamburg.  
Walsh, R. (1995), Language development and the year abroad: A study of oral grammatical accuracy amongst adult learners of German as a foreign language. Unpublished PhD dissertation, University College Dublin.

**Appendix**

The appendix should be used for data collected (e.g. questionnaires, transcripts, ...) and for tables and graphs not included in the main text due to their subsidiary nature or to space constraints in the main text.

**Assessment Scheme:**

**Continuous Evaluation:** 40%  
(Based on abstract writing, interim draft, general approach, research orientation, readings undertaken etc.)

**Final Evaluation:** 60%  
(Based on the organization of the paper, objectives/ problem profile/ issue outlining, comprehensiveness of the research, flow of the idea/ ideas, relevance of material used/

presented, outcomes vs. objectives, presentation/ viva etc.)

## BIOPROCESS TECHNOLOGY

**Course Code: BSB 531**

**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, Cell culture techniques; Inoculum development and aseptic transfers. Different types of pumps, valves, and line materials, piping conventions etc. used in Biochemical Process

**Module II**

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

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

**Amino Acid:** Genetic Control of metabolic pathway.

**Lysine:** Indirect and direct fermentation – mechanism of ph of metabolic block in accumulation of L- lysine by inhibition and repression mechanism.

**Module III**

**Biomass:** Bakers and distillers yeast production using various raw materials, “bios” factors for growth, Crabtree effect, harvesting, different forms and uses. What are mushroom, different forms of common mushroom production from agro based raw materials and uses. Biofertilizers, biocompost and biopesticides

**Module IV**

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

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

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

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

**Module V**

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

**Examination Scheme:**

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

**Text & References:**

- Biochemical Engineering- Kinetics, Mass Transport, Reactors and Gene Expression, W F Weith, John Wiley and Sons Inc
- Biochemical Engineering, S Aiba, A E Humphery and N F Millis, University of Tokyo Press

## **BSc Biotechnology (Syllabus)**

- Bioprocess Engineering Basic Concepts, M.L. Shuler and F. Kargi, Prentice Hall
- Bioprocess Engineering, B.K. Lydersen, K.L. Nelson, B.K. Lydersen and N. D'Elia, John Wiley and Sons Inc.
- Bioprocess Engineering Principles, P Doran, Academic Press
- Biotechnology. A Textbook of Industrial Microbiology, W. Crueger and a. Crueger, Sinauer Associates.
- Principles of Fermentation Technology, P.F. Stanbury and A. Whitaker, Pergamon Press
- Process Engineering in Biotechnology, A T Jackson , Prentice Hall

**IPR & REGULATORY AFFAIRS**

**Course Code: BSB 532**

**Credit Units: 02**

**Course Objective:**

It will familiarize the students of the IPR issues and regulatory issues pertaining to health care industries. The unit will also cover the regulatory legislation and associated approvals and permissions required to conduct high-quality single-centre, national and international clinical trials.. Ethical issues will be considered throughout the unit.

**Module-I**

General Principles of Intellectual Property: Copyright, Trademark, Inventions-Patentable, Geographical Indications, Industrial Designs, Integrated Circuits, Trade Secrets. Patents: need of patents, major types of patents, International registration of patents, patent term and extension The Patents Act, 1970 – Salient features.

Organization: Intellectual Property Rights, World Trade Organization (WTO), World Intellectual Property Organization (WIPO), Paris Convention, Berne Convention, TRIPS Agreement, the Doha Declaration, Patent Cooperation Treaty (PCT), Madrid Protocol.

**Module-II**

New Drug Application: Steps involved in the development of new drug. New drug applications as per WHO guidelines and abbreviated NDA. Requirement and guidelines on clinical trials, Investigational New Drug Application(IND).

**Module-III**

Regulatory affairs and its importance.

Biosafety- definitions - DBT guidelines on biosafety in conducting research in biology/biotechnology - Regulations of Genetically modified Organisms in India- Biosafety regulation for transgenic plants and animals - labeling of GM foods.Role and responsibility ofDBT, BCIL, BRAI, DSIR, IBSC, RCGM, Animal Ethics Committee, Human Ethics Committee, FSSAI, CDSCO and USFDA

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**Examination Scheme:**

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10X3	50

**Suggested Books:**

1. Drug Regulatory Affairs by Dr. N.S. Vyawahare and SachinItkar, NiraliPrakashan.

## **BSc Biotechnology (Syllabus)**

2. Pharmaceutical Regulatory Affairs by C.V.S. Subrahmanyam& J. ThimmaSetty, VallabhPrakashan.
3. Quality Assurance of Pharmaceutics Vol I & II of WHO publications, 1999.
4. GMPs by Mehra
5. How to Practice GMP by P.P.Sharma.
6. GMP of Pharmaceuticals by Willing and Stoker.