Khalsa College Amritsar

-An Autonomous College

Affiliated to Guru Nanak Dev University, Amritsar.

Session 2021-22

Syllabus: Biotechnology

Post-Graduate Department of Biotechnology

P.G. Department of Biotechnology

Program Objectives

1. To improve, broaden, and deepen the knowledge of the students in order to provide students with an adaptable, research-intensive curriculum that meet the needs of both academia and industry.
2. Enhancing career opportunities in industry, research locally and internationally, or serving as a foundation for further higher education through, cutting-edge laboratory exposures and dissertation-related activities that develop students' global competencies.
3. Fostering a value system among students in order to promote critical thinking and a thorough understanding of key bioethical concepts.
4. To inculcate the ability to work as entrepreneurs and technologists with strong ethics and communication abilities.

Program outcomes (POs)

PO-1. Developing a solid understanding of all concepts related to life science and core biology.
PO-2. Developing a scientific aptitude and a keen interest in biological sciences, which will aid in the formation of evaluative decisions.
PO-3. Creates an interdisciplinary approach by combining basic sciences and cutting-edge technology.
PO-4. Recognizing the world's needs and thinking rationally about how to meet them in an environmentally friendly manner.
PO-5. Applying the fundamentals of biotechnology to everyday life and societal upliftment.
PO-6. Developing abilities to manage personnel, space, inventory, and technical equipments.
PO-7. Adherence to safety and health regulations.
PO-8. The goal is to train long-term biotech professionals and researchers in advanced research methods.

Program specific outcome (PSOs)

B.Sc. Biotechnology

PSO-1. Gaining knowledge through theory and practicals
PSO-2. Establishing a solid foundation at the cellular, molecular, genetic, and metabolic levels.

PSO-3. Making agricultural practises more efficient through the use of plant tissue culture and recombinant DNA technology.

PSO-4. Understanding of biomolecules, including their formation and interaction.

PSO-5. Researching microorganisms and strain improvement for industrial applications.

PSO-6. Instilling safe laboratory practises and procedures.

PSO-7. Getting to know different techniques and how to use laboratory instruments.

M.Sc. Biotechnology

PSO-1. To provide a thorough introduction to concepts related to biotechnology and related subjects.

PSO-2. To be aware of current research and to have a working knowledge of genetic engineering, plant biotechnology, and agricultural biotechnology, as well as to present new biotechnologies.

PSO-3. Using various bioinformatic tools to collect, store, and access data.

PSO-4. Understanding environmental issues and keeping up with bioethics and clean gene technology.

PSO-5. Using standard programmes and algorithms to analyze data.

PSO-6. Studying scientific writing and ethics in the sciences.

PSO-7. Improving communication and presentation abilities.

CONTENTS

B.Sc. Biotechnology

Syllabus
SEM I to VI (2021-22)

KHALSA COLLEGE
AMRITSAR

B.Sc. BIOTECHNOLOGY (SEMESTER SYSTEM)

Semester- I

Scheme of Courses

Course No.	**Course Title**	**Total Periods per week**	**Total Periods per week**	**Total**	**Marks**
BTL101	Cell Biology	4	0	4	40 (30+10*)
BTP121	Cell Biology Lab	0	4	4	20 (15+5*)
BTL102	Botany-I	4	0	4	40(30+10*)
BTP122	Botany-I Lab	0	4	4	20 (15+5*)
BTL103	Biochemistry-I (Biomolecules)	4	0	4	40(30+10*)
BTP123	Biochemistry-I (Biomolecules) Lab	0	4	4	20 (15+5*)
BTL104	General Microbiology-I	4	0	4	40(30+10*)
BTP124	General Microbiology-I Lab	0	4	4	20 (15+5*)
BTL105	Chemistry-I (Inorganic Chemistry)	4	0	4	40 (30+10*)
BTP125	Chemistry-I (Inorganic Chemistry) Lab	0	4	4	20 (15+5*)
BTL106	Communicative English-I	4	0	4	50 (37+13*)
BTL107	Punjabi Compulsory s **OR # ਮੁੱਢਲੀ ਪੰਜਾਬੀ OR** ****Punjab History & Culture	4	0	4	50 (37+13*)
BTL108	*****Drug Abuse : Problem, Management and Prevention (Compulsory Course)	4	0	4	50 (37+13*)
	Total Credits	**32**	**20**	**52**	

Total Marks = 400

Note:

1. ***denotes Internal Assesment**
2. **#Special Paper in lieu of Punjabi Compulsory.**
3. ****For those students who are not domicile of Punjab**
4. *****This paper marks will not be included in the total marks.**

B.Sc. BIOTECHNOLOGY (SEMESTER SYSTEM)

Semester- II

Scheme of Courses

Course No.	**Course Title**	**Total Periods per week**	**Total Periods per week**	**Total**	**Marks**
BTL151	Zoology-I	4	0	4	40 (30+10*)
BTP171	Zoology-I Lab	0	4	4	20 (15+5*)
BTL152	Genetics	4	0	4	40 (30+10*)
BTP172	Genetics Lab	0	4	4	20 (15+5*)
BTL153	Biochemistry-II (Bioenergetics and Enzymology)	4	0	4	40 (30+10*)
BTP173	Biochemistry-II (Bioenergetics and Enzymology) Lab	0	4	4	20 (15+5*)
BTL154	General Microbiology-II	4	0	4	40 (30+10*)
BTP174	General Microbiology-II Lab	0	4	4	20 (15+5*)
BTL155	Biomathematics and Biostatistics	4	0	4	40 (30+10*)
BTL156	Communicative English-II	4	0	4	50 (37+13*)
BTL157	Punjabi Compulsory **OR** #ਮੁੱਢਲੀ ਪੰਜਾਬੀ **OR** **Punjab History & Culture	4	0	4	50 (37+13*)
BTL158	***Drug Abuse : Problem, Management and Prevention (Compulsory Course)	4	0	4	50 (37+13*)
	Total Credits	**32**	**16**	**48**	

Total Marks 380

Note:

1. ***denotes Internal Assesment**
2. **#Special Paper in lieu of Punjabi Compulsory.**
3. ****For those students who are not domicile of Punjab**
4. ******This paper marks will not be included in the total marks.**

B.Sc. (BIO-TECHNOLOGY) (SEMESTER SYSTEM)

SEMESTER-III

Course No.	**Course Title**	**Total Periods per week**	**Total Periods per week**	**Total**	**Marks**
BTL201	Fundamentals of biotechnology	4	0	4	40 (30+10*)
BTP221	Fundamentals of biotechnology Lab	0	4	4	20 (15+5*)
BTL202	Immunology-I	4	0	4	40 (30+10*)
BTP222	Immunology-I Lab	0	4	4	20 (15+5*)
BTL203	Chemistry-II (Organic)	4	0	4	40 (30+10*)
BTP223	Chemistry-II (Organic) Lab	0	4	4	20 (15+5*)
BTL204	Botany-II	4	0	4	40 (30+10*)
BTP224	Botany-II Lab	0	4	4	20 (15+5*)
BTL205	Biochemistry-III (Metabolism of Carbohydrates and Lipids)	4	0	4	40 (30+10*)
BTP225	Biochemistry-III (Metabolism of Carbohydrates and lipids) Lab	0	4	4	20 (15+5*)
BTL206	Molecular Biology	4	0	4	40 (30+10*)
BTP226	Molecular Biology Lab	0	4	4	20 (15+5*)
ESL-221	Environmental Studies-I (Compulsory Paper)	4	0	4	50***
	Total Credits	**28**	**24**	**52**	

Total Marks= 360

***Denotes internal assesment**

***** ESL-221 Environmental Studies (Compulsory Paper) marks will not be included in the Total marks.**

B.Sc. (BIO-TECHNOLOGY) (SEMESTER SYSTEM)

SEMESTER-IV

Course No.	**Course Title**	**Total Periods per week**	**Total Periods per week**	**Total**	**Marks**
BTL251	Industrial Biotechnology-I	4	0	4	40 (30+10*)
BTP271	Industrial Biotechnology-I Lab	0	4	4	20 (15+5*)
BTL252	Immunology-II	4	0	4	40 (30+10*)
BTP272	Immunology-II Lab	0	4	4	20 (15+5*)
BTL253	Biochemistry-IV (Metabolism of Proteins and Nucleic acid)	4	0	4	40 (30+10*)
BTP273	Biochemistry-IV (Metabolism of Proteins and Nucleic Acid) Lab	0	4	4	20 (15+5*)
BTL254	Skill Development in Biotechnology	4	0	4	40 (30+10*)
BTP274	Skill Development in Biotechnology Lab	0	4	4	20 (15+5*)
BTL255	Fundamental of Bioinformatics	4	0	4	40 (30+10*)
BTP275	Fundamental of Bioinformatics Lab	0	4	4	20 (15+5*)
BTL256	Zoology-II	4	0	4	40 (30+10*)
BTP276	Zoology-II lab	0	4	4	20 (15+5*)
BTP277	Industrial/Institutional Visit	-	-	-	20**
ESL222	Environmental Studies-II (Compulsory Paper)	4	0	4	50***
	Total Credits	**28**	**24**	**52**	

Total Marks=380

*** Denotes internal assessment**
**** Denotes no internal assessment in the subject (BTP277)**
*****ESL-222 Environmental Studies (Compulsory Paper) Marks will not be included in the total marks.**

B.Sc. (BIO-TECHNOLOGY) (SEMESTER SYSTEM)
SEMESTER V

Scheme of Courses

Sr.No.	Name of the Paper	Total Periods per week	Theory Marks (30+10*)	Total Periods per week	Practical Marks (15+5*)
BT-501.	rDNA Technology -A	3	40	4	20
BT-502.	Concepts of Plant Tissue Culture	3	40	4	20
BT-503.	Animal Tissue Culture	3	40	4	20
BT-504.	Patent Laws in Biotechnology	3	40		
BT-505.	Bioprocess Engineering - A	3	40	4	20
BT-506.	Biophysical and Biochemical Techniques – A	3	40	4	20
BT-507.	Physical, Organic & Inorganic aspects of Spectroscopy- A	3	40	4	20
BT-508.	Term Paper	6	-	-	20**
	(i) On recent advances in Life Sciences using Internet and library based resources. To be presented as hard Copy/CD/Floppy. Viva/ seminar should be conducted		**280**		**140**

Total Marks = 420

*** denotes internal assessment (BT-501 to BT-507)**
**** Denotes no internal assessment in the subject (BT-508)**

B.Sc. (BIO-TECHNOLOGY) (SEMESTER SYSTEM)

SEMESTER–VI

Scheme of Courses

Sr. No.Name of the Paper	**Total Periods per week**	**Theory Marks (30+10*)**	**Total Periods per week**	**Practical Marks (15+5*)**
BT-601. rDNA Technology –B	3	40	4	20
BT-602. Applications of Plant Tissue Culture	3	40	4	20
BT-603. Animal Biotechnology	3	40	4	20
BT-604. Intellectual Property Rights And Enterepreneurship	3	40	-	-
BT-605. Bioprocess Engineering – B	3	40		20**
BT-606. Biophysical and Biochemical Techniques – B	3	40	4	20
BT-607. Physical, Organic & Inorganic Aspects of Spectroscopy- B	3	40	4	20
BT-608. Educational Tour & Written illustrated Reports. Viva should be conducted				20**
		280		**140**

Total Marks = 420

*** Denotes internal assessment (BT-601 to BT-604, BT-606, BT-607)**
**** Denotes no internal assessment in the subject (BT-605 & BT-608)**

B.Sc. Biotechnology (Semester-I)
BTL101
Cell Biology

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. To make students understand the concept of cell as the basic entity of living systems and the level of organization from cell to organism.
2. To elaborate the concept of cell theory. Students will learn the characteristics of different cells :PPLO's, bacteria, eukaryotic microbes, plant and animal cells
3. To make students understand the structural organization of cell and function of different organalles.
4. Students will become aware how Cell Division takes place and learn about different stages of Cell Cycle, Cell-cell interaction, Cell locomotion
5. To make students aware of Biological Membranes, their supramolecular architecture, Solute transport; Model membranes and Liposomes.

Course content

Section-A

Cell as a basic unit of living systems. The cell theory Broad Classification of Cell Types: PPLO's, bacteria, eukaryotic microbes, plant and animal cells. A detailed classification of cell types within an organism. Cell, tissue, organ and organism as different levels of organizations of otherwise genetically similar cells.

Section-B

Structure and function of cell organelles, ultrastructure of cell membrane, cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin, microtubules etc.), Mitochondria, chloroplasts, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus, chromatin).

Section-C

Cell Division and Cell Cycle: mitosis, meiosis, stages of cell cycle, binary fission, amitosis and its regulation. Cell-cell interaction Cell locomotion (amoeboid, flagellar and ciliar).

Section-D

Biological Membranes: Supramolecular architecture of membranes; Solute transport across membranes; Model membranes and Liposomes.

Books Recommended:

- De-Robertis, F.D.P. and De-Robertis Jr. E.M.F. (1991) Cell and Molecular Biology, Saunders, Philadelphia.
- Lodish, H., Baltimore, D., Berk, A., Zipursky, S.L., Matsudaira, P. and Darnell, J. (1995).
- Molecular Cell Biology 3rd Edition, Scientific American Books Inc.
- Geoffrey, M. (2000). The Cell: A molecular approach 2nd Edition, ASM Press.

Course Outcome

At the end of this course

CO-1 Students will have learnt in depth about the Cell and the projections about the origin of the cell along with the key features of The Cell theory. Students will be able to differentiate prokaryotic and eukaryotic cells in details

CO-2 Students will have learnt about the structural details and functional organization of the cell, ultrastructure of cell membranes

CO-3 Students will have learnt about the structre and function of cell organelles (cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin, microtubules etc.), Mitochondria, chloroplasts, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus, chromatin).

CO-4 Students will have understood the concept of Cell Division and Cell Cycle in detailed fashion. Further they will have learnt about Cell-cell interaction Cell locomotion (amoeboid, flagellar and ciliar)

CO-5 Students will have gained enouged knowledge about **b**iological Membranes, about supramolecular architecture and solute transport across membranes; Model membranes and Liposomes.

B.Sc. Biotechnology (Semester-I)
BTP121
Cell Biology Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Course Objectives

1. To enable students to differentiate Prokaryotic and Eukaryotic cells
2. To enable Students study electron micrographs of various cell organelles
3. To enable students to prepare and study Permanent Slides:
4. To enable students to perform microscopic examination of Buccal Smear, Barr body
5. To enable students prepare Plant Tissue specimens by microtomy

Course content

1. Study of Cells:
(a) Prokaryotic cells: Lactobacillus, E. coli. Blue green algae.
(b) Eukaryotic cells: Testicular material (for studies of spermatogenesis)

2. Study of electron micrographs of various cell organelles-plasma membrane, Mitochondria, Golgi complex, Lysosomes, Endoplasmic Reticulum (smooth and granular), Cilia, Centrioles, inclusions like glycogen, lipids, etc.

3. Preparation of Permanent Slides: Principles and procedures- Section cutting of tissues and staining of tissues with Haematoxylin/eosin method.

4. Study of permanent slides of various tissues (gut region, liver, lung, spleen, kidney, pancreas, testis, ovary, tongue, skin etc.).

5. Preparation of Buccal Smear for microscopic examination.

6. Barr body observation in human squamous epithelial cells.

7. Microtomy of Plant Tissue specimens (Stem & Root)

Books Recommended:

1. Shah, V.C., Bhatavdekar, J., Chinoy, N.J. and Murthy, S.K. (1988). Essential techniques in Cell Biology.Anand Book Depot, Ahemadabad.
2. Celis, J.E. (1998) Cell Biology: A Laboratory handbook. Vol. 1-3. Academic Press, UK.

Course Outcome

At the end of this course students will be able to

CO-1 Define the characeristics and differentiate Prokaryotic cells (*Lactobacillus*, *E. coli*. Blue green algae) from Eukaryotic cells: Testicular material (for studies of spermatogenesis)

CO-2 Able to identify the electron micrographs of various cell organelles like plasma membrane, Mitochondria, Golgi complex, Lysosomes, Endoplasmic Reticulum (smooth and granular), Cilia, Centrioles, inclusions like glycogen, lipids, etc.

CO-3 Perform section cutting of tissues and learn staining methods (Haematoxylin/eosin method).of tissues for the preparation of permanent slides. Students will be able to study and identify permanent slides of various tissues (gut region, liver, lung, spleen, kidney, pancreas, testis, ovary, tongue, skin etc.).

CO-4 Handle the preparation and microscopic examination of Buccal Smear,observe Barr body in human squamous epithelial cells.

CO-5 Perform microtomy of Plant Tissue specimens.

BTL102
Botany-I

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

CO-1	To study the plant diversification and their different groups.
CO-2	To study the internal structure (anatomy) of plants (root, stem and leaf).
CO-3	The study the concept of reproduction (vegetative and sexual) in flowering plants.
CO-4	To study the plant identification, botanical descriptions and classification of flowering plants

Section-A

Diversity in plants: General characters of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. Concepts of species and hierarchical taxa, biological nomenclature.

Section-B

Anatomy of flowering plants: Meristems, simple and complex permanent tissues, internal structure of stem, root and leaf, secondary growth in stem and root of *Helianthus*.

Section-C

Reproduction in flowering plants: Structure and development of anther and male gametophyte, Structure and development of ovule and female gametophyte; Pollination (self and cross) and fertilization; structure and function of endosperm and embryo (dicot and monocot), polyembryony, self-incompatibility.

Section-D

Taxonomy of flowering plants: Artificial (Linnaeus), natural (Bentham & Hooker) and phylogenetic (Engler and Prantl) systems of classification; Terminology pertaining to floral description, General characteristics (including economic importance) of following families of angiosperms; giving examples of few important genera: Solanaceae: *Solanum/Petunia*, Rutaceae: *Citrus*, *Murraya*, Cruciferae- *Brassica*, Apiaceae (Umbelliferae) – *Coriander*, Asteraceae - *Helianthus*, Leguminosae –*Cassia*/*Acacia/Sweet pea*, Poaceae (Graminae)- *Triticum*

Books Recommended

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Academic Press, California, USA.
2. Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1999). Biology of Plants, 5th edition. W.H.Freeman and Co., Worth Publishers, New York.
3. Rudall, P. J. (2007). Anatomy of Flowering Plants: An Introduction to Structure andDevelopment (3rd Edition). Cambridge University Press, UK.
4. Bhojwani, S.S. and Bhatnagar, S.P. (2000). The Embryology of Angiosperms, 4th revised and enlarged edition. Vikas Publishing House, Delhi.
5. Hartmann, H.T. and Kestler, D.E. (1976). Plant Propagation: Principles and Practices, 3rd edition, Prentice Hall of India Pvt. Ltd., New Delhi.
6. Vashistha, P. C. (2016). Botany for degree students. S. Chand and Company, New Delhi

Course Outcomes

CO-1. To understand the diversity of plant kingdom

CO-2. To learn morphology and anatomy of plants

CO-3. To deeply understand the process of reproduction and the development of reproductive organs in flowering plants

CO-4. To learn different systems of classification of plants

CO-5. To learn different terminologies pertaining to floral description

CO-6. To understand the economic importance of plants belonging to different families

B.Sc (BIOTECHNOLOGY) SEMESTER–I

BTP-122
Botany – 1 Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Note. The question paper will be set by the examiner based on the syllabus

Course objectives

CO-1 To study micro and megasporogenesis and female gametophytes and endosperms.

CO-2 To study the internal structure (anatomy) of plants (root, stem and leaf).

CO-3 The study floral diagram and floral formula of different flowers.

CO-4 To study botanical descriptions and classification of flowering plants

Course content

Plant Anatomy: Anatomical studies of stem, root and leaf in *Helianthus* and maize plant.

Embryology: Study of the permanent slides pertaining to micro and megasporogenesis and female gametophytes and endosperms.

Taxonomy:

a) Description of flowers including floral diagram, floral formula, V.S. of flower of the representative genera of families mentioned in syllabus.
b) Identification and short morphological economic note on the specimens included in Unit IV of the theory paper

Course Outcomes

CO-1. To learn different terminologies pertaining to description of flowers

CO-2. To learn anatomy of plants

CO-3. To deeply understand the process of micro and megasporogenesis and female gametophytes and endosperms

BTL-103
Biochemistry-I (Biomolecules)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course objectives: Course contents are designed to enable students to learn:

1. Water as mother liquor of life, its properties, ionisation, relationship between pH and pK and cellular buffers.
2. Classification and properties of Carbohydrates, structure and function of disaccharides, Homo and Heteropolysaccharides Polysaccharides.
3. Classification and properties fatty acids, lipids, their structure and function.
4. Classification of amino acids, their chemical reactions, protein classification and structural organization.

Course content

Section-A

Water and its Properties: Role of water in life, Structure of water molecules, Physico-chemical properties of water, Dissociation and association constants, pH and buffers. pI, pka, HasselbachHendersson equation and its implications.

Section-B

Carbohydrates: Introduction, Monosaccharides: Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses, epimers, and anomers of glucose. Furanose and pyranose forms of glucose and fructose, Mutarotation, Structure and functions of monosaccharide derivatives, Disaccharides; concept of reducing and non-reducing sugars, Haworth projections of Maltose, lactose, and sucrose, Structural and functional properties of Polysaccharides: storage polysaccharides - starch and glycogen; Structural Polysaccharides - cellulose, and chitin; Heteropolysaccharides: Peptidoglycan, Proteoglycan, glycoproteins

Section-C

Lipids: Classification of lipids and fatty acids. General structure and function of major lipid subclasses, acylglycerols, phosphoglycerides, Sphingolipids, glycosphingolipids and terpenes, sterols, steroids.

Section-D

Proteins: Structure of amino acids, non-protein and rare amino acids and their chemical reactions. Structural organization of proteins (Primary, Secondary,Tertiary, Quaternary, A310 and domain structure, protein classification and function. Forces stabilizing Primary, Secondary and Tertiary protein structures

Books Recommended

1. David L. Nelson and Michael Cox (2017) Lehninger Principles of Biochemistry, 7th ed, WH Freeman
2. Jeremy M. Berg, Lubert Stryer, John Tymoczko , Gregory Gatto (2019) Biochemistry, 9th Ed., WH Freeman
3. Ferrier (2017) Lippincott's Illustrated Reviews Biochemistry, 7th Ed, Wolters Kluwer India Pvt. Ltd.

Course Outcomes

Upon completion of this course, students will be able to:

1. Learn water- a unique element in this universe along with its utility and its role as an elixir of life on the earth.

2. Cultivate knowledge about of 'Hydrates of Carbon' as most important energy producing molecules with in the living cell along with their diverse roles

3. Deeply understand the compositional related role of Lipids as group of diverse molecules compiles under single term, present as the most prominent components of the biological membranes along with their physiological roles.

4. Acquire apprehension about the composition and roles of proteins as biological macromolecular functional units of living cell along with their structural hierarchy.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BTP123

Biochemistry-I (Biomolecules) Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Note. The question paper will be set by the examiner based on the syllabus

Course objectives

Course contents are designed to enable students to

1. Understand the spectrum of light based upon different wavelengths.
2. Comprehend the laws governing the absorption of light by biomolecules.
3. Perform spectrophotometric investigations.
4. Know inside of the concept of acidity (pH), basicity (pOH) and ionisation in solutions as well as indicators.
5. Learn about the volumetric titrations.

Course content

1. Verification of Beer Lamberts Law for P-nitrophenol or cobalt chloride.
2. Determination of pKa value of P-nitrophenol
3. Estimation of carbohydrate in given solution by anthrone method.
4. Study the presence of reducing/non-reducing sugar in biological samples.
5. Protein estimation by Lowry's method
6. Protein estimation byBradford method.
7. Protein estimation by Biuret method.
8. The determination of acid value of a fat.
9. The determination of saponification value of a fat

Books Recommended

4. David L. Nelson and Michael Cox (2017) Lehninger Principles of Biochemistry, 7th ed, WH Freeman
5. Jeremy M. Berg, Lubert Stryer, John Tymoczko , Gregory Gatto (2019) Biochemistry, 9th Ed., WH Freeman
6. Ferrier (2017) Lippincott's Illustrated Reviews Biochemistry, 7th Ed, Wolters Kluwer India Pvt. Ltd.
7. J L Jain , Sunjay Jain , Nitin Jain (2016) Fundamentals of Biochemistry, 7th Ed, S Chand
8. Satyanarayana (2020) Biochemistry, 5th Ed, Elsevier

Course Outcomes

Upon completion of the course the student will be skilled in performing:

1. Spectrophotometric analysis viz. (Ultra violet and Visible) using spectrophotometer and colorimeter.
2. Quantitative estimations of Protein by different methods based upon the amino acid composition.
3. Carbohydrate content estimations and sample analysis for different types of sugars.
4. Quality characteristics analysis for fats viz. acid and saponification value.
5. Acid-base volumetric titrations along with pK determination.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BTL104

General Microbiology-I

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. To correlate the knowledge of fundamental Science's conceptual approach in the applied fields of Microbiology.
2: To make the pupils aware of the relation between Microbiology and Biotechnology.
3: The students made to learn all the realms of Microbiology (Mycology, Bacteriology, Virology etc.) in a comprehensive way.
4: The theoretical knowledge imparted by regular class work, assignments, class tests etc. will be further strengthened by use and application of ultra-modern instrumentation in world class labs to give first hand practical knowledge of Microbiology.
5: The students will be given exposure to latest happening in world around by arranging workshops, expert lectures by the intelligentsia from research/industry and academia.

Course content

Section-A

Introduction to Microbiology- Historical Perspective and Important discoveries related to Microbiology. Relationship between Microbiology and Biotechnology- The Microbial Biotechnology.General Features-Bacteria, Fungi, Neurospora, Yeast and Viruses.Microbes in extreme environments- the thermophiles, halophiles, acidophiles, psychrophiles and alkalophiles.

Section-B

Basic concept of Microbial growth & culture media and its components, Sterilization-Basic concept, physical and chemical methods of sterilization.Bacterial nutrition-Introduction, Nutritional forms of bacteria, Basic concept of Transport mechanisms of nutrients across microbial cell membranes.

Section-C

Principles and application of bright field, dark field phase contrast, fluorescence & immunofluorescence, electron microscopy.Gram positive and Gram negative bacteria. Nature of the Microbial Cell Surface and Structure and anatomy of bacterial cell walls, Types of bacterial flagella. Different types of bacterial staining.

Section-D

Bacterial Classification: Bacterial classification and taxonomy based on Bergey's Manual of Determinative bacteriology–General outline only. An introduction to Bacterial Serotypes. Microbial culture collection centres, Methods of Microbial preservation.

Books Recommended:

1. Davis, B.D., Dulbecco. R., Eisen, H.N. and Ginsberg, H.S. (1990). Microbiology: 4thEdition, Harper & Row, Publishers, Singapore.
2. Tortora, G.J., Funke, B.R. and Case, C.L. (1994). Microbiology: An introduction: 5thEdition, The Benjamin / Cummings Publishing Company, Inc.
3. Stanier, R.Y. (1995). General microbiology, MacMillan Press, Londan.
4. Pelczar, M.T. (1995). Microbiology, Tata McGraw Hill Publication, New Delhi.
5. Schlegel. H. G., (1995). General Microbiology 7th Edition, Cambridge Univ. Press.
6. Prescott and Dunn (1999). Industrial Microbiology 4th Edition, By S.K. Jain for CBS Publishers & Distributors.
7. Chander, M. And Puri, P. (2008).A Concise Course in Microbiology.Krishna Brothers Publishers, Old Railway Road, Jalandhar.
8. Postgate. J. (2000). Microbes & Man 4th Edition, Cambridge Univ. Press.
9. Tortora. G.J., Funke. B.R., 2001. Microbiology: An Introduction, Benjamin Cummings.

Course Outcome

CO-1. The objective of this course is to bring forth the concepts of microbial biotechnology. They will learn about general features of various micro-organisms, antibiotics.
CO-2. Bacterial growth curves and batch cultures
CO-3. Students will learn the principle, working and design of various microscopes.
CO-4. Students will gain knowledge on role of microbes in food industry.
CO-5. The students become fully acquainted to microbes as part of our daily life and now knew about fruits and fines coming from microbes.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BTP124

General Microbiology-I Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Note: The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. To correlate the knowledge of the theoratical fields of Microbiology with practical.
2. To make the pupils aware of the role of Microbiology in daily life.
3. The students made to learn all the general features and identification of various microbes such as fungi, bacteria, virus etc.
4. To teach them microbiology practicals applicable in dairy, diagnostics and other industries.
5. The students will be given opportunity to perform each and every experiment, get results and infer upon their findings.

Course Content

1. Aseptic techniques of sterilization.
2. Cleaning of glassware.
3. Preparation of media, cotton plugging and sterilization
4. Isolation of micro-organism from air, water and soil samples. Dilution and pour plating, Colony purification.
5. Identification of bacteria by simple staining, negative staining and Gram staining.
6. Detection of specific bacteria by Wet mount preparation method and Hanging drop mount method.

Books Recommended:

1. Cappuccino, J.G. and Sherman, N. (1999). Microbiology: A Laboratory Manual 4th Ed: Harlow, Addition-Wesley.
2. Dubey R.C. and Maheshwari (2012) Practical Microbiology 5th edition: S. Chand and company ltd.New Delhi.

Course Outcome

CO-1. The students become aware of role of microbes in daily life.

CO-2. They learn to maintain proper hygiene in day to day life.

CO-3. The have hands on experience of quality control testing in food, feed, diagnostic and water testing industry.

CO-4. The students learn planning and execution of the procedure involved in a systematic way.

CO-5. While performing in group they learn ethics of working and team spirit.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BTL105

Chemistry-I (Inorganic Chemistry)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course objectives

1. Coordination complexes, wernier theory, optical geometrical isomerism.
2. Valence bond theory based formation of complexes. Factors affecting stability of metal complexes, crown ethers, cryptands, podants like macrocyclic ligands.
3. Crystal field theory, high spin, low spin complexes, CFSE calculation, determination of term symbols of metal complexes.

Course content

Section-A

Introduction, Werner's coordination theory, naming of co-ordinate complexes.
Co-ordination numbers 1-12. Factors affecting co-ordination numbers and stereo-chemistry, Isomerism in coordination compounds.

Section-B

Valence bond theory for co-ordinate complexes, inner and outer orbital complexes, electro-neutrality and back bonding, limitations of V.B. theory.

Section-C

Stability of co-ordination compounds
Introduction Factors affecting the stability of metal ion complexes with general ligands
Alkali metal and alkaline earth metal chelators : Definition and few examples of macrocyclic ligands, macrocyclic effect, crown ethers &cryptands.

Section-D

Crystal field theory-Spliting of d-orbitals in octahedral, tetrahedral, cubic and square planer fields of ligands, calculations of C.F.S.E. in high spin and low spin octahedral and high spin tetrahedral complexes, factors affecting the 10 Dq value.
Spectroscopic terms for d^1-d^2 electronic configurations.

Books Recommended

1. G.L. Eichorn, Inorganic Biochemistry, Vol. I Elsevier,
2. J.E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry, 4th ed. Pearson Education, Singapore, 1999.
3. D.F.C Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, ELBS Oxford, 1991.
4.Cowan, J.A. (1997) – Inorganic Biochemistry – An Introduction, Wiley- VCH

Course outcomes

S. No.	On completing the course, student
CO1	Will learn about werner's theory, isomerism in coordination compounds, valence bond theory of transition metal complexes.
CO2	Learn about various theories like VBT, CFT for explain the bonding in co-ordination complexes.
CO3	Student will be able to explain the splitting pattern of d-orbitals under different geomateries and factor effecting splitting of orbitals.
CO4	Students will be able to derive spectroscopic terms of various configurations
CO5	will learn about crown ethers, cryptands and macrocyclic ligands and their applications

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BTP125

Chemistry-I (Inorganic Chemistry) Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Note. The question paper will be set by the examiner based on the syllabus

Course objectives

Students will understand

1. How to calculate normality, strength of unknown solutions through volumetric titration, and determine hardness of water by performing complexometric titration,
2. Able to find out Acid , Basic radicals or Cation and Anion from the mixture of Inorganic salts.

Course content

-Volumetric Analysis:

Iodimetry, Iodometry, Redox titrations using $K_2Cr_2O_7$ and KM_nO_4.

Complexometric titration using EDTA Ca^{2+},Mg^{2+}: in context with study of hardness of water.

Inorganic qualitative analysis:

Four ions (Two cations two anions).

A. Preliminary tests: Physical examination, Dry heating test, charcoal cavity test,

$Co(NO_3)_2$ test, flame test, borax bead test.

B. Acid radical analysis: metal ions

Course outcomes

S. No.	On completing the course,
CO1	Students will be able to perform volumetric analysis through iodimetric, iodometric and redox titrations and their utility.
CO2	Student will be able to carry out water analysis for its Hardness and amount of dipositive ion present.
CO3	Students will be able to perform the preliminary analysis on the mixture of two salts.
CO4	Learn to identify cations and anions in the mixture

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BTL-106
COMMUNICATION SKILLS IN ENGLISH-I

Credit Hours (Per Week): 4
Total Hours: 60

Time: 3 Hours **Max. Marks: 50**
Theory Marks: 37
Internal Assessment: 13

Suggested Pattern of Question Paper:
The question paper will consist of Seven skill–oriented questions from Reading and Writing Skills. The first 6 Questions carry 5 marks each. The 7th Question carries 7 marks. The questions shall be framed in a manner that students know clearly what is expected of them. There will be internal choice wherever possible.

I. Comprehension questions of an unseen passage
II. Personal letter Official/Business letters
III. Writing notices/agenda/resolution/ minutes for public circulation on topics of professional interest
IV. Writing resume or converting a biographical note into resume
V. Writing news report based on a given heading
VI. Do as directed
Articles Units 69-81
Conjunctions Units 113-120 (6×5=30 Marks)

VII. Translation from English to Vernacular (Punjabi/ Hindi) (Isolated Sentences) (1×7=7 Marks)

Course Objectives:
I: To develop competence in written communication.
II: To inculcate innovative and critical thinking among the students.
III: To enable them to grasp the application of communication theories.
IV: To acquire the knowledge of latest technology related with communication skills.
V: To provide knowledge of multifarious opportunities in the field of this programme.

Course Contents:
1. Reading Skills: Reading tactics and strategies; Reading purposes–kinds of purposes and associated comprehension; Reading for direct meanings; Reading for understanding concepts, details, coherence, logical progression and meanings of phrases/ expressions.
Activities:
a) Active reading of passages on general topics
b) Reading newspaper, articles, editorials etc.
c) Short questions based on content and development of ideas of a given paragraph.

2. Writing Skills: Guidelines for effective writing; writing styles for application, resume, personal letter, official/ business letter, memo, notices etc.
Activities:
a) Personal and business letters.
b) Converting a biographical note into a sequenced resume.
c) Writing notices for circulation/ boards.
d) Making notes of given passage with headings and sub-headings
e) Writing newspaper reports based on given heading.

Prescribed Book:
Murphy's English Grammar (by Raymond Murphy) CUP

Recommended Books:

1. *Oxford Guide to Effective Writing and Speaking* by John Seely.
2. *The Written Word* by Vandana R Singh, Oxford University Press

Course Outcomes:

The completion of this course enables students to:

1. Identify common errors in language and rectify them.
2. Develop and expand writing skills through controlled and guided activities.
3. Develop coherence, cohesion and competence in written discourse through intelligible pronunciation.
4. Develop the ability to handle the interview process confidently and learn the subtle nuances of an effective group discourse.
5. Communicate contextually in specific and professional situations with courtesy.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BTL-107
ਲਾਜ਼ਮੀ ਪੰਜਾਬੀ

ਸਮਾਂ : 3 ਘੰਟੇ ਕ੍ਰੈਡਿਟ ਪ੍ਰਤੀ ਹਫਤਾ : 04
ਕੁੱਲ ਘੰਟੇ : 60 ਥਿਊਰੀ ਅੰਕ : 37, ਇੰਟਰਨਲ ਅਸੈੱਸਮੈਂਟ : 13, ਕੁੱਲ ਅੰਕ : 50

ਕੋਰਸ ਦਾ ਉਦੇਸ਼ Course Objective

- ਵਿਦਿਆਰਥੀਆਂ ਵਿਚ ਸਾਹਿਤਕ ਰੁਚੀਆਂ ਪੈਦਾ ਕਰਨਾ।
- ਆਲੋਚਨਾਤਮਕ ਰੁਚੀਆਂ ਵਿਕਸਤ ਕਰਨਾ।
- ਮਾਤ ਭਾਸ਼ਾ ਦੀ ਸਮਝ ਨੂੰ ਵਿਕਸਤ ਕਰਨਾ

ਪਾਠ-ਕ੍ਰਮ

ਭਾਗ-ਪਹਿਲਾ

ਸਾਹਿਤ ਦੇ ਰੰਗ (ਭਾਗ ਪਹਿਲਾ -ਕਵਿਤਾ ਅਤੇ ਕਹਾਣੀ)
ਡਾ. ਮਹਿਲ ਸਿੰਘ (ਸੰਪਾ.), ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
(ਲੇਖਕ ਦਾ ਜੀਵਨ ਅਤੇ ਰਚਨਾ/ਸਾਰ/ਵਿਸ਼ਾ-ਵਸਤੂ)

ਭਾਗ-ਦੂਜਾ

ਇਤਿਹਾਸਿਕ ਯਾਦਾਂ
ਸ. ਸ. ਅਮੋਲ (ਸੰਪਾ.), ਪੰਜਾਬੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
(ਨਿਬੰਧ 1 ਤੋਂ 6 ਤਕ ਸਾਰ/ ਵਿਸ਼ਾ-ਵਸਤੂ/ਸ਼ੈਲੀ)

ਭਾਗ-ਤੀਜਾ

(ੳ) ਪੈਰ੍ਹਾ ਰਚਨਾ (ਤਿੰਨਾਂ ਵਿਚੋਂ ਇੱਕ)
(ਅ) ਪੈਰ੍ਹਾ ਪੜ੍ਹ ਕੇ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ

ਭਾਗ-ਚੌਥਾ

(ੳ) ਭਾਸ਼ਾ ਵੰਨਗੀਆਂ : ਭਾਸ਼ਾ ਦਾ ਟਕਸਾਲੀ ਰੂਪ, ਭਾਸ਼ਾ ਅਤੇ ਉਪ-ਭਾਸ਼ਾ ਵਿਚਲਾ ਅੰਤਰ, ਪੰਜਾਬੀ ਉਪ-ਭਾਸ਼ਾਵਾਂ ਦੇ ਪਛਾਣ-ਚਿੰਨ੍ਹ
(ਅ) ਪੰਜਾਬੀ ਭਾਸ਼ਾ - ਨਿਕਾਸ ਤੇ ਵਿਕਾਸ

ਅੰਕ-ਵੰਡ ਅਤੇ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਸਿਲੇਬਸ ਦੇ ਚਾਰ ਭਾਗ ਹਨ ਪਰ ਪ੍ਰਸ਼ਨ-ਪੱਤਰ ਦੇ ਪੰਜ ਭਾਗ ਹੋਣਗੇ।
2. ਪਹਿਲੇ ਚਾਰ ਭਾਗਾਂ ਵਿਚ 02-02 ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ। ਹਰੇਕ ਭਾਗ ਵਿਚੋਂ 01-01 ਪ੍ਰਸ਼ਨ ਕਰਨਾ ਲਾਜ਼ਮੀ ਹੋਵੇਗਾ। ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ (08) ਅੰਕ ਹੋਣਗੇ।
3. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਪੰਜਵੇਂ ਭਾਗ ਵਿਚ ਸਾਰੇ ਸਿਲੇਬਸ ਵਿਚੋਂ 01-01 ਅੰਕ ਦੇ ਛੇ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ, ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ 05 ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ ਦੇਣਾ ਲਾਜ਼ਮੀ ਹੋਵੇਗਾ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

ਨੋਟ : ਇੰਟਰਨਲ ਅਸੈੱਸਮੈਂਟ 13 ਅੰਕਾਂ ਦੀ ਹੈ, ਜੋ ਕਾਲਜ ਵੱਲੋਂ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਇਨ੍ਹਾਂ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ। ਇਸ ਪੇਪਰ ਦੇ ਕੁੱਲ ਅੰਕ 37+13 = 50 ਹਨ।

ਪਾਠ-ਕ੍ਰਮ ਨਤੀਜੇ Course Outcomes (COs)

- ਵਿਦਿਆਰਥੀ ਦੀ ਸਾਹਿਤਕ ਸੋਚ-ਸਮਝ ਵਿਕਸਤ ਹੋਵੇਗੀ।
- ਉਸ ਵਿਚ ਸਾਹਿਤ ਰੁਚੀਆਂ ਵਿਕਸਤ ਹੋਣਗੀਆਂ।
- ਉਸ ਵਿਚ ਸਾਹਿਤ ਸਿਰਜਣਾ ਦੀ ਸੰਭਾਵਨਾ ਵਧੇਗੀ।
- ਉਹ ਕਿਸੇ ਵੀ ਵਿਸ਼ੇ ਦਾ ਗਹਿਨ ਅਧਿਐਨ ਕਰਨ ਦੇ ਕਾਬਲ ਹੋਵੇਗਾ।
- ਉਹ ਮਾਤ ਭਾਸ਼ਾ ਦੇ ਵਿਕਾਸ ਵਿਚ ਵਿਸ਼ੇਸ ਯੋਗਦਾਨ ਪਾਉਣਗੇ।

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BTL-107

ਮੁਢਲੀ ਪੰਜਾਬੀ

(In Lieu of Compulsory Punjabi)

ਸਮਾਂ : 3 ਘੰਟੇ ਕ੍ਰੈਡਿਟ ਪ੍ਰਤੀ ਹਫਤਾ : 04

ਕੁੱਲ ਘੰਟੇ : 60 ਥਿਊਰੀ ਅੰਕ : 37, ਇੰਟਰਨਲ ਅਸੈੱਸਮੈਂਟ : 13, ਕੁੱਲ ਅੰਕ : 50

ਅੰਕ-ਵੰਡ ਅਤੇ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

- ਪਹਿਲੇ ਭਾਗ ਵਿਚੋਂ ਚਾਰ ਵਰਣਨਾਤਮਕ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਤਿੰਨ ਪ੍ਰਸ਼ਨਾਂ ਦਾ ਉੱਤਰ ਦੇਣਾ ਲਾਜ਼ਮੀ ਹੈ। ਹਰ ਪ੍ਰਸ਼ਨ ਦੇ ਚਾਰ-ਚਾਰ ਅੰਕ ਹਨ। ਭਾਗ ਦੂਸਰਾ ਵਿਚੋਂ ਦੋ-ਦੋ ਅੰਕ ਦੇ ਪੰਜ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ। ਸਾਰੇ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹਨ। ਭਾਗ ਤੀਸਰਾ ਵਿਚੋਂ ਤਿੰਨ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਹੱਲ ਕਰਨੇ ਲਾਜ਼ਮੀ ਹਨ ਜਿਨ੍ਹਾਂ ਦੇ ਪੰਜ-ਪੰਜ ਅੰਕ ਹਨ। ਭਾਗ ਚੌਥਾ ਵਿਚ ਪੰਜ ਅਸ਼ੁੱਧ ਸ਼ਬਦਾਂ ਨੂੰ ਸ਼ੁੱਧ ਕਰਕੇ ਲਿਖਣਾ ਹੋਵੇਗਾ।

ਨੋਟ: ਇੰਟਰਨਲ ਅਸੈੱਸਮੈਂਟ 13 ਅੰਕਾਂ ਦੀ ਹੈ, ਜੋ ਕਾਲਜ ਵੱਲੋਂ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਥਿਊਰੀ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ। ਇਸ ਪੇਪਰ ਦੇ ਕੁਲ ਅੰਕ 37+13 = 50 ਹਨ।

ਕੋਰਸ ਦਾ ਉਦੇਸ਼ Course Objective

- ਵਿਦਿਆਰਥੀ ਨੂੰ ਸ਼ੁੱਧ ਪੰਜਾਬੀ ਪੜ੍ਹਨਾ-ਲਿਖਣਾ ਸਿਖਾਉਣਾ।
- ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦੀਆਂ ਵਿਆਕਰਨਕ ਬਾਰੀਕੀਆਂ ਤੋਂ ਜਾਣੂ ਕਰਾਉਣਾ।
- ਸ਼ੁੱਧ ਸੰਚਾਰ ਨੂੰ ਵਿਕਸਤ ਕਰਨਾ।

ਪਾਠ-ਕ੍ਰਮ

ਭਾਗ-ਪਹਿਲਾ

(ਓ) ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਤੇ ਗੁਰਮੁਖੀ ਲਿਪੀ :

ਨਾਮਕਰਣ ਤੇ ਸੰਖੇਪ ਜਾਣ-ਪਛਾਣ : ਗੁਰਮੁਖੀ ਵਰਣਮਾਲਾ, ਅੱਖਰ ਕ੍ਰਮ, ਸਵਰ ਵਾਹਕ (ਓ, ਅ, ੲ), ਲਗਾਂ- ਮਾਤਰਾਂ, ਪੈਰ ਵਿਚ ਬਿੰਦੀ ਵਾਲੇ ਵਰਨ, ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਨ, ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ

(ਅ) ਸਿਖਲਾਈ ਤੇ ਅਭਿਆਸ

ਭਾਗ-ਦੂਜਾ

ਗੁਰਮੁਖੀ ਆਰਥੋਗਰਾਫ਼ੀ ਅਤੇ ਉਚਾਰਨ :

ਸਵਰ, ਵਿਅੰਜਨ : ਮੁਢਲੀ ਜਾਣ-ਪਛਾਣ ਅਤੇ ਉਚਾਰਨ, ਮੁਹਾਰਨੀ, ਲਗਾਂ-ਮਾਤਰਾਂ ਦੀ ਪਛਾਣ

ਭਾਗ-ਤੀਜਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਜੋੜ :

ਮੁਕਤਾ (ਦੋ ਅੱਖਰਾਂ ਵਾਲੇ ਸ਼ਬਦ, ਤਿੰਨ ਅੱਖਰਾਂ ਵਾਲੇ ਸ਼ਬਦ), ਸਿਹਾਰੀ ਵਾਲੇ ਸ਼ਬਦ, ਬਿਹਾਰੀ ਵਾਲੇ ਸ਼ਬਦ, ਔਂਕੜ ਵਾਲੇ ਸ਼ਬਦ, ਦੁਲੈਂਕੜ ਵਾਲੇ ਸ਼ਬਦ, ਲਾਂ ਵਾਲੇ ਸ਼ਬਦ, ਦੁਲਾਵਾਂ ਵਾਲੇ ਸ਼ਬਦ, ਹੋੜੇ ਵਾਲੇ ਸ਼ਬਦ, ਕਨੌੜੇ ਵਾਲੇ ਸ਼ਬਦ, ਲਗਾਖਰ (ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ) ਵਾਲੇ ਸ਼ਬਦ

ਭਾਗ-ਚੌਥਾ

ਸ਼ੁੱਧ-ਅਸ਼ੁੱਧ ਸ਼ਬਦ

ਪਾਠ-ਕ੍ਰਮ ਨਤੀਜੇ Course Outcomes (COs)

- ਵਿਦਿਆਰਥੀ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਤੇ ਗੁਰਮੁਖੀ ਲਿਪੀ ਦੀ ਸਿਖਲਾਈ ਵਿਚ ਮੁਹਾਰਤ ਹਾਸਿਲ ਕਰਨਗੇ।
- ਉਹ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਚ ਮੁਹਾਰਨੀ, ਲਗਾਂ-ਮਾਤਰਾਂ, ਸਵਰ ਅਤੇ ਵਿਅੰਜਨ ਦੀ ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ ਦੁਆਰਾ ਸਮਝ ਨੂੰ ਵਿਕਸਿਤ ਕਰਨਗੇ।
- ਉਹ ਪੰਜਾਬੀ ਸ਼ਬਦ-ਜੋੜਾਂ ਦੀ ਜਾਣਕਾਰੀ ਹਾਸਿਲ ਕਰ ਵਿਦਿਆਰਥੀ ਸ਼ੁੱਧ ਪੰਜਾਬੀ ਲਿਖਣ-ਪੜ੍ਹਨ ਦੇ ਸਮਰੱਥ ਹੋਣਗੇ।
- ਉਹ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦੇ ਵਿਆਕਰਨ ਪ੍ਰਬੰਧ ਦੀ ਜਾਣਕਾਰੀ ਹਾਸਿਲ ਕਰਨਗੇ।

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BT-107

Punjab History & Culture (From Earliest Times to C 320)

(Special Paper in lieu of Punjabi compulsory)

(For those students who are not domicile of Punjab)

Credit Hours (per week): 04
Total Hours: 60

Time: 3 Hours **Total. Marks: 50**

Theory: 37
Internal Assessment: 13

Instructions for the Paper Setter:

The question paper consists of five units: I, II, III, IV and V. Units I, II, III and IV will have two questions each. Each question carries 8 marks. The students are to attempt one question from each unit approximately in 800 words. Unit-V consists of 7 short answer type questions to be set from the entire syllabus. Students are to attempt any 5 questions in about 20 words each. Each question carries 1 mark.

Note: The examiner is to set the question paper in two languages: English & Hindi.

Course Objectives: The main objective of this course is to educate the history and culture of the Ancient Punjab to the students who are not domicile of the Punjab. It aims to familiarize these students with the physical features of ancient Punjab and its impact on its history and culture. It also provides them information about the different sources to construct the history and culture of the ancient Punjab. The course intends to provide knowledge of social, economic, religious life of the Harrapan civilization, Indo-Aryans, teachings and impact of Jainism and Buddhism in the Punjab.

Course content

Unit-I

1. Physical features of the Punjab and impact on history.
2. Sources of the ancient history of Punjab.

Unit-II

3. Harappan Civilization: Town planning; social, economic and religious life of the Indus Valley People.
4. The Indo-Aryans: Original home and settlement in Punjab.

Unit-III

5. Social, Religious and Economic life during Rig Vedic Age.
6. Social, Religious and Economic life during later Vedic Age.

Unit-IV

7. Teachings and impact of Buddhism.
8. Jainism in the Punjab.

Suggested Readings:-

1. L. Joshi (ed): History and Culture of the Punjab, Art-I, Patiala, 1989 (3rd

edition)
2. L.M. Joshi and Fauja Singh (ed); History of Punjab, Vol.I, Patiala 1977.
3. Budha Parkash: Glimpses of Ancient Punjab, Patiala, 1983.
4. B.N. Sharma: Life in Northern India, Delhi. 1966.

Course Outcomes:

After completion of the course, the students will be able to learn:

CO-1 The history and culture of the Ancient Punjab.CO-2 Physical features of ancient Punjab.

CO-3 The sources of the history of the Punjab.

CO-4 Social, economic, religious life of the Harrapan civilization and Vedic-Aryans.

CO-5 Teachings and impact of Jainism and Buddhism in the Punjab.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BTL108

DA1-Drug Abuse: Problem, Management and Prevention (Compulsory)

Problem Of Drug Abuse

Credit Hours (per week): 1.5 hrs.
Total Hours: 22.5 hrs.
Max. Marks: 50

Time: 3 Hours

Instructions for the Paper Setters:
Section–A (15 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying 05 marks. Answer to any of the questions should not exceed two pages.
Section–B (20 Marks): It will consist of four essay type questions. Candidates will be required to attempt two questions, each question carrying 10 marks. Answer to any of the questions should not exceed four pages.
Section–C: (15 Marks): It will consist of two questions. Candidate will be required to attempt one question only. Answer to the question should not exceed 5 pages.

Course Objectives
The course aims to:

CO-1.	Generate the awareness against drug abuse.
CO-2.	Describe a variety of models and theories of addiction and other problems related to substance abuse.
CO-3.	Describe the behavioral, psychological, physical health and social impact of psychoactive substances.
CO-4.	Provide culturally relevant formal and informal education programs that raise awareness and support for substance abuse prevention and the recovery process.
CO-5.	Describefactors that increase likelihood for an individual, community or group to be at risk of substance use disorders.

Course content

Unit-I

Meaning of Drug Abuse:
Meaning, Nature and Extent of Drug Abuse in India and Punjab.

Unit-II

Consequences of Drug Abuse for:

Individual	:	Education, Employment, Income.
Family	:	Violence.
Society	:	Crime.
Nation	:	Law and Order problem.

Unit-III

Management of Drug Abuse:

Medical Management: Medication for treatment and to reduce withdrawal effects.

Unit-IV

Psychiatric Management: Counselling, Behavioural and Cognitive therapy.
Social Management: Family, Group therapy and Environmental Intervention.

References:

1. Ahuja, Ram (2003), Social Problems in India, Rawat Publication, Jaipur.
2. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
3. Inciardi, J.A. 1981. The Drug Crime Connection. Beverly Hills: Sage Publications. 23
4. Jasjit Kaur Randhawa & Samreet Randhawa, "Drug Abuse-Problem, Management & Prevention", KLS, ISBN No. 978-81-936570-6-5, (2018).
5. Jasjit Kaur Randhawa & Samreet Randhawa, "Drug Abuse Problem, Management & Prevention", KLS, ISBN No. 978-81-936570-8-9, (2019).
6. Jasjit Kaur Randhawa & Samreet Randhawa, "ਡਰੱਗਜ਼ ਦੁਰਵਰਤੋਂ-(ਨਸ਼ਾਖੋਰੀ) ਸਮੱਸਿਆ, ਪ੍ਰਬੰਧਨ ਅਤੇ ਰੋਕਥਾਮ", KLS, ISBN No. 978-81-936570-7-1, (2018).
7. Jasjit Kaur Randhawa, "Drug Abuse -Management & Prevention", KLS, ISBN No. 978-93-81278-80-2, (2018).
8 . Kapoor. T. (1985) Drug epidemic among Indian Youth, New Delhi: Mittal Pub.
9. Modi, Ishwar and Modi, Shalini (1997) Drugs: Addiction and Prevention, Jaipur: Rawat Publication.
10. National Household Survey of Alcohol and Drug abuse. (2003) New Delhi, Clinical Epidemiological Unit, All India Institute of Medical Sciences, 2004.
11. Rama Gandotra & Jasjit Kaur Randhawa, "ਡਰੱਗਜ਼ ਦੁਰਵਰਤੋਂ-(ਨਸ਼ਾਖੋਰੀ) ਪ੍ਰਬੰਧਨ ਅਤੇ ਰੋਕਥਾਮ", KLS, ISBN No. 978-93-81278-87-1, (2018).
12. Sain, Bhim 1991, Drug Addiction Alcoholism, Smoking obscenity New Delhi: Mittal Publications.
13. Sandhu, Ranvinder Singh, 2009, Drug Addiction in Punjab: A Sociological Study. Amritsar: Guru Nanak Dev University.
14. Singh, Chandra Paul 2000. Alcohol and Dependence among Industrial Workers: Delhi: Shipra. 15. Sussman, S and Ames, S.L. (2008). Drug Abuse: Concepts, Prevention and Cessation, Cambridge University Press.
16. World Drug Report 2010, United Nations office of Drug and Crime.
17. World Drug Report 2011, United Nations office of Drug and Crime.

Course Outcomes:

The students will be able:

CO-1.	To describe issues of cultural identity, ethnic background, age and gender in prevention, treatment and recovery.
CO-2.	To describe warning sign, symptoms, and the course of substance use disorders.
CO-3.	To describe principles and philosophy of prevention, treatment and recovery.
CO-4.	To describe current and evidenced-based approaches practiced in the field of addictions.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTL151
Zoology-I

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives: The course aims to

1. Understand the metabolic activities in the body of animals.
2. Understand the various bio molecules present in the body.
3. Understand the structure and physiology of endocrine system.
4. Understand the structure and function of blood and heart.
5. Understand the process of digestion and the structure and function of associated glands.
6. Understand the structure and function of brain.
7. Understand the gaseous transport and the structure involved in gaseous transport.

Course content

Section–A

Introduction to Animal Kindom and its diversification:
Overview and General classification of Kingdom Animalia, General Characteristics of each group upto class level with an example.

Section–B

Digestive System: The alimentary canal and associated glands of Man. Digestion of dietary constituents, regulation of digestive processes and absorption. Extra and intra cellular digestion, enzymatic digestion and symbiotic digestion.
Respiratory System: Respiratory system of man, Transport of O2 and CO2, Oxygen dissociation curve of haemoglobin, Bohr effect, chloride shift, Haldane effect and control of breathing.

Section–C

Circulatory System: General plan of circulation in Man, structure of human heart. Origin and regulation of heart beat, Electrocardiogram, Cardiac output and Blood pressure, Composition and functions of blood and lymph, Blood clotting, blood groups including Rh-factor.
Excretory system: Structure of Kidney and nephron. Urine formation and osmoregulation.

Section–D

Skeletal system: Ultrastructure, chemical and physical basis of skeletal muscle contraction.
Neural Integration: Structure and functions of brain, Structure of neuron, resting membrane potential, Origin and propagation of impulse along the axon, synapse and myoneural junction.
Endocrine System: Structure and physiology of thyroid, parathyroid, adrenal, hypothalamus, pituitary, pancreas and gonads of man.

Course Outcomes

CO-1. To develop understanding of the various fundamental concepts related to physiology of digestion & absorption

CO-2. To develop understanding of circulatory system and blood components

CO-3. To familiarize students with topics related to nervous and muscular system and their working

CO-4. To teach students the various aspects of respiratory system and exchange of respiratory gases

CO-5. To develop an understanding of endocrine glands, their functioning and associated disorders

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTP171

Zoology-I Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Note. The question paper will be set by the examiner based on the syllabus.

Course Objectives: The course aims to

1. Study the digestive, circulatory and urinogenital systems of human.
2. Study various macromolecules present in food stuffs.
3. Demonstrate various blood tests in Man.
4. Demonstrate the temporary preparation of blood smear of mammals.

Course content

1. Study the following system of Human with the help of charts / models /videos:
   Digestive, Arterial, Venous and Urinogenital systems.
2. Analysis of food stuff for the presence of starch, protein and fats.
3. Determination of blood groups of human blood samples.
4. Recording of blood pressure of man.
5. Estimation of hemoglobin content.
6. Make a temporary preparation of the following:
   Blood smear of mammals.
7. Visit to clinical laboratory / hospital for demonstration of ECG, ECHO, X-ray, ultrasound, CT-scan and MRI.

As per UGC guidelines and instructions, the use of live materials is to be avoided and be replaced with models, simulated dissections and slides.

Books Reccommended

1. Sobti, R.C. & Nigam, S.K. (2002). Structural & function biology of chordates, Vishal Publishers, Jalandhar.
2. Sobti, R.C. & Sharma, V.L. (2005). Basics of Biotechnology: Introduction of Life Sciences.Vishal Publishers, Jalandhar.
3. Sobti, R.C. (2005). Introduction to Biotechnology, Part-2, Concepts Tools and Application, Vishal Publishers.

Course Outcomes

CO-1. Development skill for the observation of blood cells.
CO-2. Attain knowledge of qualitative analysis of macromolecules.
CO-3. Understand the structure and function of various systems of human.
CO-4. This also will provide a basic understanding of the experimental methods and designs that can be used for further study and research.

B.Sc (BIOTECHNOLOGY) SEMESTER–II

BTL-152

(Genetics)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30

Internal Assessment: 10

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. The objective of this course is to introduce the students with the concepts of chromosomal organisation, extra-chromosomal inheritance and chromosomal aberrations.
2. To inculcate the concepts of Mendel's laws of inheritance, crossing over, linkage and how the gene transfer from parents to offspring's.
3. To introduce students with the concept of extra Chromosomal (Cytoplasmic) inheritance like inheritance of mitochondrial DNA, chloroplast DNA, kappa articles in Paramecium, Sigma factor in Drosophila, cytoplasmic male sterility (CMS) in maize & its relevancy.
4. To enhance the hand-on experience in dermatographics, to prepare mitotic slides & the practical learning ability.
5. To introduces the students with concept of Basic Microbial Genetics: Conjugation, transduction & transformation and how the gene flows in a horizontal manner.

Course content

Section-A

Organization of Chromosomes: The structure of prokaryotic and eukaryotic chromosome (macromolecular organization and ultrastructure), karyotype, idiogram, centromere and telomere structure, significance of telomerase, euchromatin and heterochromatin, Special chromosomes: Polytene chromosomes and Lampbrush chromosomes, satellite DNA, the supercoiling of DNA.

Section-B

Mendel's Laws of Inheritance: Principle of segregation and Independent assortment, Monohybrid, dihybrid and trihybrid crosses, Back cross and test cross. Interaction of Genes: Incomplete inheritance and co-dominance, pleotropism, modification of F2 ratios: epistasis, complementary genes, supplementary genes, inhibitory genes, duplicate genes, lethality and collaborators genes. Multiple allelism.

Section-C

Linkage: Coupling and repulsion hypothesis, chromosomal theory of linkage, complete and incomplete linkage, linkage groups and significance of linkage. **Crossing Over:** Introduction, mechanism of meiotic crossing over, types of crossing over, factors affecting it and its significance.

Basic Microbial Genetics: Conjugation, transduction, transformation

Section-D

Extra Chromosomal (Cytoplasmic) Inheritance: features; inheritance of mitochondrial DNA, chloroplast DNA, kappa articles in *Paramecium*, Sigma factor in *Drosophila*, cytoplasmic male sterility (CMS) in maize.

Chromosomal aberrations: Structural: deletion, duplication, inversion, translocation; Numerical: polyploidy, aneuploidy; significance of chromosomal aberrations.

Course Outcome

CO-1. Comprehensive, detailed understanding of the chemical basis of heredity

CO-2. Comprehensive and detailed understanding of genetic methodology and how quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms.

CO-3. The ability to evaluate conclusions that are based on genetic data.

CO-4. Understanding the role of genetic technologies in industries related to biotechnology, pharmaceuticals, energy, and other fields.

CO-5. Teamwork and leadership skills including group analysis of data, working together in the research laboratory, joint compositions of written reports, substantive participation in research group meetings, etc.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTL172

Genetics Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Note. The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. To make students to solve numerical problem related to mendelism, paternity disputes & multiple alllelism.
2. An understanding of the inheritance and expression of human blood groups.
3. An understanding of the clinical relevance of genetic concepts.
4. Ability to the hand-on experience in dermatographics, to prepare mitotic slides & the practical learning ability.
5. Knowledge of Internet genetics resources.
6. An historical perspective of how genetics has evolved

Course content

1. Demonstration of Law of segregation and Independent assortment (use of coloured beads, capsules etc.).
2. Numerical problems on Mendelism and on modified F2 ratios.
3. Numerical problems on Paternity disputes (Blood groups)
4. Segregation demonstration in preserved material
5. Study of polytene chromosomes from permanent slides.
6. Dermatographics : Palm print taking and finger tip patterns.
7. Preparation and study of mitosis slides from onion root tips by squash method.

Course Outcome

CO-1. The students study the structural and numerical chromosomal aberrations and their consequences.

CO-2. To make students to solve numerical problem related to mendelism, paternity disputes & multiple alllelism.

CO-3. Students get to know about various syndromes in humans.

CO-4. Students will be able to understand the sex linked inherited characters and diseases.

CO-5. They get indepth knowledge about gene interaction, penetrance and expressivity.

CO-6. The student will demonstrate proficiency in understanding the basic structure of atom and interpret the inheritance of characters by using linkage and crossing over.

CO-7. The student can apply this in the identification of parents and recombinants.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTL153

Biochemistry-II (Bioenergetics and Enzymology)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course objectives

Course contents are designed to enable students to

1. Understand the laws governing energy relationships in metabolic conversions with in the living cells.
2. Learn roles of phosphorylated nucleotides and other compounds as universal energy carriers in biological reactions.
3. Gain knowledge Classification, nomenclature, regulation of enzymes, coenzymes, enzymatic reaction mechanisms.
4. Acquire understanding enzymatic reaction energetics in terms of mathematical relationships along with various inhibition mechanisms.

Course content

Section-A

Introduction to metabolism, catabolism, anabolism, Laws of Thermodyanamics and living system, Free energy change and direction of metabolism, Characteristics of Metabolic pathways, Compartmentation and Interorganmetabolism, Regulation & evolution of metabolic pathways

Section-B

ATP: Structure, Free energy change, energy coupling with ATP (Creatinine phosphokinase, NDP kinase, Adenylate kinase), metabolic roles of ATP; Experimental methods for studying metabolism, Energy rich metabolites, biological oxidation – Reduction reactions

Section-C

Introduction to Enzymes: Nomenclature, Classification and Characteristics of enzymes, Cofactors, Co-enzyme and Prosthetic group, Mechanism of Enzyme Action: Nature of active site, enzyme substrate complex, Factors responsible for catalytic efficiency of enzymes., Covalent catalysis, Acid base catalysis, Strain and distortion theory, Induced fit hypothesis.

Section-D

Enzyme Kinetics: A brief overview of enzyme energetics, MichaelisMenten equation. Derivation of MichaelisMenten equation and determination of Km and Vmax values

Enzyme inhibition: Reversible and Irreversible inhibition, Regulation of enzyme activity Isozymes and their importance

Course Outcomes:

Upon completion of this course, students will be able to:

1. Learn about types of biochemical reactions involved in the cellular metabolism along with their regulatory mechanisms as well as evolutionary aspects of metabolic pathways

2. Deeply understand the overall bioenergetics involved in coupled metabolic pathways along with involvement of energy rich compounds.

3. Acquire apprehension over basic enzymology of cellular metabolism along with catalytic reactions.

4. Learn about kinetics of the enzymatic reactions along with different types of regulation and inhibition mechanisms.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTP173

Biochemistry-II (Bioenergetics and Enzymology) Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Note. The question paper will be set by the examiner based on the syllabus.

Course Objectives

Course contents are designed to enable students to

1. Understand the basics of enzyme catalysed biological reactions.
2. Learn the energetics and other factors affecting the enzymatic activity.
3. Comprehend the metabolically important enzymes catalyzing the hydrolysis of phosphate esters.
4. Know inside out of the processes of the enzyme inhibition.

Course content

1. Estimation of Alpha-amylase activity from saliva.
2. Assay of acid phosphatase activity.
3. Effect of temperature on enzyme activity.
4. Effect of pH on enzyme activity
5. Determination of Km for acid phosphatase.
6. Competetive and non competetive inhibition.

Books Recommended

1. David L. Nelson and Michael Cox (2017) Lehninger Principles of Biochemistry, 7th ed, WH Freeman
2. Jeremy M. Berg, Lubert Stryer, John Tymoczko , Gregory Gatto (2019) Biochemistry, 9th Ed., WH Freeman
3. Ferrier (2017) Lippincott's Illustrated Reviews Biochemistry, 7th Ed, Wolters Kluwer India Pvt. Ltd.
4. J L Jain , Sunjay Jain , Nitin Jain (2016) Fundamentals of Biochemistry, 7th Ed, S Chand Satyanarayana (2020) Biochemistry, 5th Ed, Elsevier

Course Outcomes:

Upon completion of the course the students will be capable to understand and perform following in the laboratory.

1. Hydrolysis of glycosidic linkage in polysaccharides.
2. pH dependent phosphate esters hydrolysis by the action of phosphomonoesterase enzyme.
3. Determination of the temperature as well as pH optima of enzymatic reactions.
4. Significance of substrate concentration in estimating the velocity of the enzyme catalysed reactions.
5. Demonstration of major types of the enzyme inhibitions

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTL154

General Microbiology-II

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. To correlate the knowledge of fundamental Science's to explore modelling of microbial growth.
2: To make the pupils aware of the viral, fungal, bacterial and general disease.
3: The students made to learn all the techniques of diagnostics of disease casing microbes, prophylactic and preventive microbiology and remedy available for treatment of these diseases.
4: The theoretical knowledge along with the practical work further strengthened by use and application of ultra-modern instrumentation in world class labs to give first hand practical knowledge of Microbiology.
5: The students will be given knowledge about industrial, medical, environmental microbiology, so that they may become clear about their future job prospects.

Course content

SECTION-A

Factors affecting Microbial Growth: Temperature, pH, provision of gases. Introduction to concept of microbial growth in batch and continuous system.Bacterial generation, doubling time and specific growth rate.Monoauxic, diauxic and synchronised growth curve. Sporulation and regeneration of bacteria.

SECTION-B

Viruses-Introduction, Plant and animal viruses-structure and composition, Classification based on differences in their transcription process. Cultivation of plant and animal viruses. Life cycle Tobacco Mosaic Virus, Herpes simplex and Bacteriophages (Lysogenic and Lytic cycle)

SECTION-C

Pathogenic microorganisms- Factors contributing towards microbial pathogenicity (Adhesion, Invasiveness and toxigenicity), Natural resistance and Non specific defense mechanism against microorganisms. Introduction, mechanism of action, diagnosis and treatment for viral diseases- Influenza, AIDS and Hepatitis.Bacterial diseases-Diphtheria, Tuberculosis, Typhoid.Fungal diseases-Aspergillosis and Candidiasis.

SECTION-D

Introduction to Industrial Microbiology. Microbes involved in Food (Pickles, Saurkraut, Sausage), Single cell protein (Yeast, Bacteria), Antibiotics (Penicillin, Tetracyclin) and Municipal solid waste transformations.

Books Recommended:

1. Davis, B.D., Dulbecco. R., Eisen, H.N. and Ginsberg, H.S. (1990). Microbiology: 4thEdition, Harper & Row, Publishers, Singapore.
2. Tortora, G.J., Funke, B.R. and Case, C.L. (1994). Microbiology: An introduction: 5thEdition, The Benjamin / Cummings Publishing Company, Inc.
3. Stanier, R.Y. (1995). General microbiology, MacMillan Press, Londan.
4. Pelczar, M.T. (1995). Microbiology, Tata McGraw Hill Publication, New Delhi.
5. Schlegel. H. G., (1995). General Microbiology 7th Edition, Cambridge Univ. Press.
6. Prescott and Dunn (1999). Industrial Microbiology 4th Edition, By S.K. Jain for CBSPublishers & Distributors.
7. Chander, M. And Puri, P. (2008).A Concise Course in Microbiology.Krishna Brothers Publishers, Old Railway Road, Jalandhar.
8. Postgate. J. (2000). Microbes & Man 4th Edition, Cambridge Univ. Press.
9. Tortora. G.J., Funke. B.R., 2001. Microbiology: An Introduction, Benjamin Cummings.

Course Outcome

CO-1. The objective of this course is to bring forth the concepts of industrial, medical, environmental microbiology, for their future job prospects.

CO-2. The students aware of etiology of disease can know live a healthy and disease-free life.

CO-3. Students will be able to learn the higher and complex principle of all fields of microbiology.

CO-4. Students will gain knowledge on role of microbes in food industry.

CO-5. The students become fully acquainted to microbes as part of our daily life and now knew about fruits and fines coming from microbes.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTP174

General Microbiology-II Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Note. The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. To correlate the knowledge of the theoratical fields of Microbiology with practical.
2. To make the pupils aware of the role of Microbiology in daily life.
3. The students made to learn all the general features and identification of various microbes such as fungi, bacteria, virus etc.
4. To teach them microbiology practical applicable in dairy, diagnostics and other industries.
5. The students will be given opportunity to perform each and every experiment, get results and infer upon their findings.

Couse Content:

1. Enumeration of microorganism. Total vs viable counts.
2. Personal hygiene-Microbes from hands, tooth-scum and other body parts.
3. Growth curve of micro-organisms.
4. Identification of fungus by and lactophenol staining.
5. Identification of formation of germ tube by Candida albicans.

Books Recommended:

1. Cappuccino, J.G. and Sherman, N. (1999). Microbiology: A Laboratory Manual 4th Ed: Harlow, Addition-Wesley.
2. Sambrook, J., Russel, D.W. (2001). Molecular Cloning.A laboratory manual 3rd Ed., Cold Spring Harbor Laboratory Press, New York.
3. Dubey R.C. and Maheshwari (2012) Practical Microbiology 5th edition: S. Chand and company ltd.New Delhi.

Course Outcome

CO-1. The students become aware of procedures to evaluate various types of microbes and quantify them according to various standards.
CO-2. The have firsthand knowledge of quality control testing and analytical micro biology as is applicable to various industries.
CO-3. Students will have hand-on training on sterilization techniques, media preparation, and isolation of micro-organisms, bacterial/fungus staining and mounting methods.
CO-4. The students become more compatible to apply their knowledge to get suitable job after completion of their degree course.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTL155

Biomathematics and Biostatistics

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course objectives

1. To enable the students to solve Statistical problems using various measure of central tendency.
2. To help the students to collect the data and present it diagrammatically.
3. To establish linear association between two variables by using Correlation.
4. The content of this course is designed to make the students understand various sampling techniques.
5. To enable the students to apply the various techniques of testing of hypothesis.

Course content

Section A

Scientific notation, Significant digits, Rounding off, Scientific notations, Sampling, Problem identification, Concept of population and samples, Random sampling, Data collection, Log, Indices, Design of experiments, differentiation and integration.

Section B

Measurement of central tendency, mean, geometric mean, harmonic mean, Median, Mode, Quartile mean, decile, percentile, Dispersion, Mean deviation, Standard deviation, Geometrical standard deviation, Standard error, Coefficient of variation , Variation, Variance, Coefficient of determinant, moments, skewness and kurtosis.

Section C

Graphical representation of data, scattered diagram, Straight line, Least square test, Correlation coefficient, Regression coefficient, Correction of experimental data and model development.

Section D

Testing of hypothesis, null and alternate hypothesis, type-I, TYPE II errors, level of significance, Normal distribution, Poisson distribution, Binomial distribution, Student ‘t’-test, ‘F’-test, chi-square test, Wilcoxon test, analysis of variance (one way anova)

Books Recommended

1. Kothari, C.R. (2004) Research Methodology Methods and Techniques, New Age International Publications, New Delhi
2. Arora, P.N. &Malhan, P.K. : Biostatistics (Himalaya Publication House)
3. Robert R. Sokal and F. James Rohlf Introduction to Biostatistics

Course Outcomes

CO-1.Student will learn to solve Statistical problems using various measure of central tendency.

CO-2.It will enable the students to collect the data and present it diagrammatically.

CO-3 .Students will learn to establish linear association between two variables by using Correlation.

CO-4.The content of this course is designed to make the students understand various sampling techniques.

CO-5. It will enable the students to apply the various techniques of testing of hypothesis.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTL156

COMMUNICATION SKILLS IN ENGLISH-II

Credit Hours (Per Week): 4
Total Hours: 60
Time: 3 Hours **Max. Marks: 50**
Theory Marks: 37
Internal Assessment: 13

Suggested Pattern of Question Paper:
The question paper will consist of Seven skill–oriented questions from Listening and Speaking Skills. The first 6 Questions carry 5 marks each. The 7th Question carries 7 marks. The questions shall be framed in a manner that students know clearly what is expected of them. There will be internal choice wherever possible.

i) Making summary/ précis or paraphrasing of an idea of a given passage.
ii) Writing a paragraph of expository or argumentative nature of a given topic.
iii) Interpretation of a given data, chart, diagram etc and making a brief report.
iv) Transcoding (given dialogue to a prose or given prose to dialogue).
v) Draft an Advertisement for a given Product and E-mail Writing.
vi) Do as directed Change of voice Units 42-46 (6×5= 30 Marks)
vii) Translation from Vernacular (Punjabi/ Hindi) to English (Isolated Sentences (1×7 = 7 Marks)

Course Objectives:

I: To develop competence in oral and visual communication.

II: To inculcate innovative and critical thinking among the students.

III: To enable them to grasp the application of communication theories.

IV: To acquire the knowledge of latest technology related with communication skills.

V: To provide knowledge of multifarious opportunities in the field of this programme

Course Contents:

1. **Listening Skills:** Barriers to listening; effective listening skills; feedback skills, attending telephone calls; note taking.
   Activities:
   a) Listening exercises – Listening to conversation, speech/ lecture and taking notes.
2. **Speaking and Conversational Skills**: Components of a meaningful and easy conversation; understanding the cue and making appropriate responses; forms of polite speech; asking and providing information on general topics, situation based Conversation in English; essentials of Spoken English
   Activities:
   a) Conversation; dialogue and speech
   b) Oral description or explanation of a common object, situation or concept.
   c) Interviews and group discussion

Prescribed Book:
Murphy's English Grammar (by Raymond Murphy) CUP

Recommended Books:

1. *Oxford Guide to Effective Writing and Speaking* by John Seely.
2. *The Written Word* by Vandana R Singh, Oxford University Press

Course Outcomes:

The completion of this course enables students to:

1. Identify common errors in language and rectify them.
2. Develop and expand writing skills through controlled and guided activities.
3. Develop coherence, cohesion and competence in oral discourse through intelligible pronunciation.
4. Develop the ability to handle the interview process confidently and learn the subtle nuances of an effective group discourse.
5. Communicate contextually in specific and professional situations with courtesy.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTL157

ਲਾਜ਼ਮੀ ਪੰਜਾਬੀ

ਸਮਾਂ : 3 ਘੰਟੇ ਕ੍ਰੈਡਿਟ ਪ੍ਰਤੀ ਹਫਤਾ : 04

ਕੁੱਲ ਘੰਟੇ : 60 ਥਿਊਰੀ ਅੰਕ : 37, ਇੰਟਰਨਲ ਅਸੈੱਸਮੈਂਟ : 13, ਕੁੱਲ ਅੰਕ : 50

ਅੰਕ-ਵੰਡ ਅਤੇ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

- ਸਿਲੇਬਸ ਦੇ ਚਾਰ ਭਾਗ ਹਨ ਪਰ ਪ੍ਰਸ਼ਨ-ਪੱਤਰ ਦੇ ਪੰਜ ਭਾਗ ਹੋਣਗੇ। ਪਹਿਲੇ ਚਾਰ ਭਾਗਾਂ ਵਿਚ 02-02 ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ। ਹਰੇਕ ਭਾਗ ਵਿਚੋਂ 01-01 ਪ੍ਰਸ਼ਨ ਕਰਨਾ ਲਾਜ਼ਮੀ ਹੋਵੇਗਾ। ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ (08) ਅੰਕ ਹੋਣਗੇ। ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਪੰਜਵੇਂ ਭਾਗ ਵਿਚ ਸਾਰੇ ਸਿਲੇਬਸ ਵਿਚੋਂ 01-01 ਅੰਕ ਦੇ ਛੇ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ, ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ 05 ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ ਦੇਣਾ ਲਾਜ਼ਮੀ ਹੋਵੇਗਾ। ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

ਨੋਟ: ਇੰਟਰਨਲ ਅਸੈੱਸਮੈਂਟ 13 ਅੰਕਾਂ ਦੀ ਹੈ, ਜੋ ਕਾਲਜ ਵੱਲੋਂ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਥਿਊਰੀ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ। ਇਸ ਪੇਪਰ ਦੇ ਕੁੱਲ ਅੰਕ 37+13 = 50 ਹਨ।

ਕੋਰਸ ਦਾ ਉਦੇਸ਼ Course Objective

- ਵਿਦਿਆਰਥੀਆਂ ਵਿਚ ਸਾਹਿਤਕ ਰੁਚੀਆਂ ਪੈਦਾ ਕਰਨਾ।
- ਆਲੋਚਨਾਤਮਕ ਰੁਚੀਆਂ ਨੂੰ ਵਿਕਸਤ ਕਰਨਾ।
- ਭਾਸ਼ਾਈ ਗਿਆਨ ਵਿਚ ਵਾਧਾ ਕਰਨਾ।

ਪਾਠ-ਕ੍ਰਮ

ਭਾਗ-ਪਹਿਲਾ

ਸਾਹਿਤ ਦੇ ਰੰਗ, ਡਾ. ਮਹਿਲ ਸਿੰਘ (ਸੰਪਾ.), ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।

ਭਾਗ ਦੂਜਾ - ਵਾਰਤਕ ਅਤੇ ਰੇਖਾ-ਚਿੱਤਰ, ਡਾ. ਪਰਮਿੰਦਰ ਸਿੰਘ, ਡਾ. ਭੁਪਿੰਦਰ ਸਿੰਘ ਅਤੇ ਡਾ. ਕੁਲਦੀਪ ਸਿੰਘ ਢਿੱਲੋਂ (ਸਹਿ ਸੰਪਾ.)

(ਵਾਰਤਕ ਭਾਗ ਵਿਚੋਂ ਸਾਰ/ਵਿਸ਼ਾ-ਵਸਤੂ। ਰੇਖਾ-ਚਿੱਤਰ ਭਾਗ ਵਿਚੋਂ ਸਾਰ/ਨਾਇਕ ਬਿੰਬ)

ਭਾਗ-ਦੂਜਾ

ਇਤਿਹਾਸਿਕ ਯਾਦਾਂ

ਸ. ਸ. ਅਮੋਲ (ਸੰਪਾ.), ਪੰਜਾਬੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।

(ਨਿਬੰਧ 7 ਤੋਂ 12 ਤਕ ਸਾਰ/ ਵਿਸ਼ਾ-ਵਸਤੂ/ਸ਼ੈਲੀ)

ਭਾਗ-ਤੀਜਾ

(ੳ) ਦਫ਼ਤਰੀ ਚਿੱਠੀ ਪੱਤਰ

(ਅ) ਮੁਹਾਵਰੇ ਅਤੇ ਅਖਾਣ

ਭਾਗ-ਚੌਥਾ

(ੳ) ਸ਼ਬਦ-ਬਣਤਰ ਅਤੇ ਸ਼ਬਦ-ਰਚਨਾ - ਪਰਿਭਾਸ਼ਾ ਅਤੇ ਮੁੱਢਲੇ ਸੰਕਲਪ

(ਅ) ਸ਼ਬਦ-ਸ਼੍ਰੇਣੀਆਂ

ਪਾਠ-ਕ੍ਰਮ ਨਤੀਜੇ Course Outcomes (COs)

- ਵਿਦਿਆਰਥੀ ਦੀ ਸੋਚ-ਸਮਝ ਵਿਕਸਤ ਹੋਵੇਗੀ।
- ਉਸ ਅੰਦਰ ਸਾਹਿਤਕ ਰੁਚੀਆਂ ਪ੍ਰਫਲਿੱਤ ਹੋਣਗੀਆਂ।
- ਉਸ ਅੰਦਰ ਸਾਹਿਤ ਸਿਰਜਣਾ ਦੀ ਸੰਭਾਵਨਾ ਵਧੇਗੀ।
- ਉਹ ਸੰਬੰਧਿਤ ਵਿਸ਼ੇ ਦਾ ਗਹਿਨ ਅਧਿਐਨ ਕਰਨ ਦੇ ਸੁਯੋਗ ਹੋਵੇਗਾ।
- ਉਹ ਭਾਸ਼ਾਈ ਬਣਤਰ ਤੋਂ ਜਾਣੂ ਹੋਵੇਗਾ।

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTL157

ਮੁਢਲੀ ਪੰਜਾਬੀ

(In Lieu of Compulsory Punjabi)

ਸਮਾਂ : 3 ਘੰਟੇ ਕ੍ਰੈਡਿਟ ਪ੍ਰਤੀ ਹਫਤਾ : 04

ਕੁੱਲ ਘੰਟੇ : 60 ਥਿਊਰੀ ਅੰਕ : 37, ਇੰਟਰਨਲ ਅਸੈੱਸਮੈਂਟ : 13, ਕੁੱਲ ਅੰਕ : 50

ਅੰਕ-ਵੰਡ ਅਤੇ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

ਭਾਗ ਪਹਿਲਾ ਵਿਚੋਂ ਚਾਰ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਤਿੰਨ ਪ੍ਰਸ਼ਨਾਂ ਦਾ ਉੱਤਰ ਦੇਣਾ ਲਾਜ਼ਮੀ ਹੈ। ਹਰ ਪ੍ਰਸ਼ਨ ਦੇ ਚਾਰ-ਚਾਰ ਅੰਕ ਹਨ। ਭਾਗ ਦੂਸਰਾ ਵਿਚੋਂ ਦੋ-ਦੋ ਅੰਕ ਦੇ ਪੰਜ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ। ਸਾਰੇ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹਨ।ਭਾਗ ਤੀਸਰਾ ਵਿਚੋਂ ਚਾਰ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਹੱਲ ਕਰਨੇ ਲਾਜ਼ਮੀ ਹਨ। ਭਾਗ ਚੌਥਾ ਵਿਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਹੱਲ ਕਰਨਾ ਹੋਵੇਗਾ।

ਨੋਟ: ਇੰਟਰਨਲ ਅਸੈੱਸਮੈਂਟ 13 ਅੰਕਾਂ ਦੀ ਹੈ, ਜੋ ਕਾਲਜ ਵੱਲੋਂ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਥਿਊਰੀ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ। ਇਸ ਪੇਪਰ ਦੇ ਕੁਲ ਅੰਕ 37+13 = 50 ਹਨ।

ਕੋਰਸ ਦਾ ਉਦੇਸ਼ Course Objective

- ਵਿਦਿਆਰਥੀ ਅੰਦਰ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦੀ ਸਮਝ ਵਿਕਸਤ ਕਰਨਾ।
- ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦੇ ਵਿਆਕਰਨਕ ਪ੍ਰਬੰਧ ਸੰਬੰਧੀ ਗਿਆਨ ਕਰਾਉਣਾ।
- ਸਿਖਲਾਈ ਤੇ ਅਭਿਆਸ ਦੁਆਰਾ ਪੰਜਾਬੀ ਭਾਸ਼ਾ 'ਤੇ ਪਕੜ ਵਧਾਉਣਾ।

ਪਾਠ-ਕ੍ਰਮ

ਭਾਗ-ਪਹਿਲਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ :

ਧਾਤੂ, ਵਧੇਤਰ (ਅਗੇਤਰ, ਮਧੇਤਰ, ਪਿਛੇਤਰ), ਪੰਜਾਬੀ ਕੋਸ਼ਗਤ ਸ਼ਬਦ ਅਤੇ ਵਿਆਕਰਨਕ ਸ਼ਬਦ

ਭਾਗ-ਦੂਜਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਪ੍ਰਕਾਰ :

(ੳ) ਸੰਯੁਕਤ ਸ਼ਬਦ, ਸਮਾਸੀ ਸ਼ਬਦ, ਦੋਜਾਤੀ ਸ਼ਬਦ, ਦੋਹਰੇ/ਦੁਹਰੁਕਤੀ ਸ਼ਬਦ ਅਤੇ ਮਿਸ਼ਰਤ ਸ਼ਬਦ

(ਅ) ਸਿਖਲਾਈ ਤੇ ਅਭਿਆਸ

ਭਾਗ-ਤੀਜਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਰਚਨਾ :

ਇਕ-ਵਚਨ/ਬਹੁ-ਵਚਨ, ਲਿੰਗ-ਪੁਲਿੰਗ, ਬਹੁਅਰਥਕ ਸ਼ਬਦ, ਸਮਾਨਅਰਥਕ ਸ਼ਬਦ, ਬਹੁਤੇ ਸ਼ਬਦਾਂ ਲਈ ਇਕ ਸ਼ਬਦ, ਸ਼ਬਦ ਜੁੱਟ, ਵਿਰੋਧਅਰਥਕ ਸ਼ਬਦ, ਸਮਨਾਮੀ ਸ਼ਬਦ

ਭਾਗ-ਚੌਥਾ

ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ

ਖਾਣ-ਪੀਣ, ਸਾਕਾਦਾਰੀ, ਰੁੱਤਾਂ, ਮਹੀਨਿਆਂ, ਗਿਣਤੀ, ਮੌਸਮ, ਬਾਜ਼ਾਰ, ਵਪਾਰ, ਧੰਦਿਆਂ ਨਾਲ ਸੰਬੰਧਿਤ

ਪਾਠ-ਕ੍ਰਮ ਨਤੀਜੇ Course Outcomes (COs)

- ਵਿਦਿਆਰਥੀਆਂ ਦੀ ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ ਬਾਰੇ ਸਮਝ ਹੋਰ ਵਿਕਸਿਤ ਹੋਵੇਗੀ।
- ਉਹ ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ ਦੀ ਜਾਣਕਾਰੀ ਹਾਸਿਲ ਕਰਕੇ ਭਾਸ਼ਾਈ ਗਿਆਨ ਨੂੰ ਵਿਕਸਿਤ ਕਰਨਗੇ।
- ਪੰਜਾਬੀ ਸ਼ਬਦ-ਰਚਨਾ ਸੰਬੰਧੀ ਜਾਣਕਾਰੀ ਉਨ੍ਹਾਂ ਦੇ ਗਿਆਨ ਵਿਚ ਵਾਧਾ ਕਰੇਗੀ।

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTL157

PUNJAB HISTORY & CULTURE (C 321 TO 1000 A.D.)

(Special Paper in lieu of Punjabi compulsory)

(For those students who are not domicile of Punjab)

Credit Hours (per week): 04
Total Hours: 60
Time: 3 Hours **Total. Marks: 50**
Theory: 37
Internal Assessment: 13

Instructions for the Paper Setters:

The question paper consists of five units: I, II, III, IV and V. Units I, II, III and IV will have two questions each. Each question carries 8 marks. The students are to attempt one question from each unit approximately in 800 words. Unit-V consists of 7 short answer type questions to be set from the entire syllabus. Students are to attempt any 5 questions in about 20 words each. Each question carries 1 mark.

Note: **The examiner is to set the question paper in two languages: English & Hindi.**

Course Objectives: The main objective of this course is to educate the students who are not domicile of the Punjab about the history and culture of the Ancient Punjab. It is to provide them knowledge about the social, economic, religious, cultural and political life of the people of the Punjab during the rule of various dynasties such as The Mauryans, The Khushans, The Guptas, The Vardhanas and other ancient ruling dynasties of the period under study.

Unit-I

1. The Punjab under Chandragupta Maurya and Ashoka.
2. The Kushans and their Contribution to the Punjab.

Unit-II

3. The Punjab under the Gupta Emperors.
4. The Punjab under the Vardhana Emperors

Unit-III

5. Political Developments 7th Century to 1000 A.D.
6. Socio-cultural History of Punjab from 7th Century to 1000 A.D.

Unit-IV

7. Development of languages and Literature.
8. Development of art & Architecture.

Suggested Readings:-

1.L. Joshi (ed*), History and Culture of the Punjab*, Part-I, Patiala, 1989 (3rd edition)
2.L.M. Joshi and Fauja Singh (ed),*History of Punjab,* Vol.I, Patiala 1977.
3.BudhaParkash,*Glimpses of Ancient Punjab,* Patiala, 1983.
4.B.N. Sharma, *Life in Northern India,* Delhi. 1966.

Course Outcomes:

After completion of the course, the students will be able to learn:

CO-1 The history and culture of the Punjab in Ancient Period.

CO-2 Social, economic, religious, cultural and political life of Ancient Indian dynasties.

CO-3 Political developments from 7^{th} century to1000AD.

CO-4 Socio-cultural history of the Punjab from 7^{th} century to1000AD.

CO-5 Language, literature, art and architecture of Ancient Punjab.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BTL158

Drug Abuse: Problem, Management and Prevention
(Compulsory Paper)
Drug Abuse: Management and Prevention

Credit Hours (per week): 1.5 hrs.
Total Hours: 22.5 hrs.
Time: 3 Hours **Max. Marks: 50**

Instructions for the Paper Setters:
Section–A (15 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying 05 marks. Answer to any of the questions should not exceed two pages.
Section–B (20 Marks): It will consist of four essay type questions. Candidates will be required
to attempt two questions, each question carrying 10 marks. Answer to any of the questions should not exceed four pages.
Section–C: (15 Marks): It will consist of two questions. Candidate will be required to attempt one question only. Answer to the question should not exceed 5 pages.

Course Objectives:
The course aim is to

CO-1.	Describe the role of family in the prevention of drug abuse.
CO-2.	Describe the role of school and teachers in the prevention of drug abuse.
CO-3.	Emphasize the role of media and educational and awareness program.
CO-4.	Provide knowhow about various legislation and Acts against drug abuse.

Course content

Unit -I

Prevention of Drug abuse:
Role of family: Parent child relationship, Family support, Supervision, Shaping values, Active Scrutiny.

Unit -II

School: Counselling, Teacher as role-model. Parent-teacher-Health Professional Coordination, Random testing on students.

Unit -III

Controlling Drug Abuse:
Media: Restraint on advertisements of drugs, advertisements on bad effects of drugs, Publicity and media, Campaigns against drug abuse, Educational and awareness program

Unit - IV

Legislation: NDPS Act, Statutory warnings, Policing of Borders, Checking Supply/Smuggling of Drugs, Strict enforcement of laws, Time bound trials.

References:

1. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
2. Gandotra, R. and Randhawa, J.K. 2018. ਡਰੱਗਜ਼ ਦੁਰਵਰਤੋਂ (ਨਸ਼ਾਖੋਰੀ) ਪ੍ਰਬੰਧਨ ਅਤ ਰੋਕਥਾਮ। Kasturi Lal & Sons, Educational Publishers, Amritsar- Jalandhar.
3. Inciardi, J.A. 1981. The Drug Crime Connection. Beverly Hills: Sage Publications.
4. Modi, Ishwar and Modi, Shalini (1997) Drugs: Addiction and Prevention, Jaipur: Rawat Publication.
5. Randhawa, J.K. and Randhawa, Samreet 2018. Drug Abuse-Management and Prevention. Kasturi Lal & Sons, Educational Publishers, Amritsar- Jalandhar.
6. Sain, Bhim 1991, Drug Addiction Alcoholism, Smoking obscenity New Delhi: Mittal Publications.
7. Sandhu, Ranvinder Singh, 2009, Drug Addiction in Punjab: A Sociological Study. Amritsar: Guru Nanak Dev University.
8. Singh, Chandra Paul 2000. Alcohol and Dependence among Industrial Workers: Delhi: Shipra.
9. World Drug Report 2011, United Nations office of Drug and Crime.
10. World Drug Report 2010, United Nations office of Drug and Crime

Course Outcomes:

The students will be able to:

CO-1.	Understand the importance of family and its role in drug abuse prevention.
CO-2.	Understand the role of support system especially in schools and inter-relationships between students, parents and teachers.
CO-3.	Understand impact of media on substance abuse prevention.
CO-4.	Understand the role of awareness drives, campaigns etc. in drug abuse management.
CO-5	Learn about the Legislations and Acts governing drug trafficking and Abuse in India.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-III)

BTL201 Fundamentals of Biotechnology

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. Students will learn Emergence, basics of biotechnology and scope of Biotechnology as a career.
2. Applications of Biotechnology in health care, agriculture, bioremediation and forensics.
3. The students will learn to use the different biotechnological tools to develop new drugs for the welfare of society.
4. The students will becomes familiar with entrepreneurship opportunities in Biotechnology and importance of IPRs in Biotechnology.
5. At the end students will learn role of Biotechnology in the Society and future of Biotechnology.

Course content

Section – A

Emergence, scope and basics of biotechnology

Historical perspective, Appraise the interplay of science & technology in the development of biotechnology, Definition, areas and overview of the Fundamentals of Biotechnology, Biotechnology Research in India. Biotechnology Institutions in India (Public and Private Sector), Biotech Success Stories, Biotech Policy Initiatives. careers and employment opportunities in biotechnology

Section B

Applications of Biotechnology: An Overview

Applying Biotechnology to Modern life styles: Healthcare – Biopharma : Recombinant human insulin; molecular diagnostics : PCR for infectious disease (viral / bacterial), blood screening and genetic testing, Gene therapy, genetic counseling); Agriculture & food production (Genetically engineered food, Seed banks, aquaculture); Green biotechnology (Bioremediation, Biofuels, Conservation); Forensics & biodefense.

Section C

Bio business and IPRs in Biotechnology

Commercialization of Biotechnology: Concerns and Consequences, Biotechnology Industry Practices & Government regulations, Concept and market potential of Bio business, Requirements and Objectives of Patent, Patentable and non-patentable inventions, process of writing and filing a patent, patenting genes/ gene fragments /SNPs/ proteins / stem cells

Patents related to bacteria, viruses, fungi and medicinal plants. IPR: Introduction, types (Trade secret, Copyright, trademark)

Section D
Biotechnology & Society

Ethical Issues & Regulating the use of Biotechnology: Human cloning, GM foods and GMOs, stem cell; The future of Biotechnology.

Books Prescibed:

1. David P Clark & Nanette J. Pazdernik (2017) Biotechnology – Applying the Genetic Revolution, Elsevier Academic Press.
2. Bernard R Glick, Jack J Pasternak and Cheryl L Patten (2010) Molecular Biotechnology: Principles and applications of Recombinant DNA, ASM Press.
3. Singh, B.D. (2018). Biotechnology expanding horizons, Kalyani Publishers, New Delhi.
4. Singh, I. and Kaur, B (2010) Patent law and Entrepreneurship, 3rd Edition, Kalyani Publishers.

Course Outcomes

CO-1. The students will be able to learn about the use of biotechnological applications in healthcare and society welfare.
CO-2. The students will explore new biotechnological tools and their use in improvement of society by discovering new drugs and techniques to increase livelihood.
CO-3. The students will learn the application of bioinformatic tool- BLAST and its applications in determining the structure and function of different biomolecules.
CO-4. The students will be able to examine the recent discoveries related to structure and functioning of biomolecules through use of different bioinformatics tools.
CO-5. The students will be learn about fundamentals of bioinformatics and will use this knowledge to explore recent discoveries in the field of biotechnology.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP221 Fundamentals of Biotechnology Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours
Course Objectives

1. Students will learn about basic laboratory practices to be followed in biotechnology.
2. The students will gain knowledge about the working of different instruments like water bath, spectrophotometer, centrifuge, UV- transilluminator and Hot air oven.
3. The working of laminar air flow along with the use of BOD instrument will be given to students in order to perform experiments in the controlled environment.
4. The students will become aware about the handling and disposal of hazardous reagents such as acids, carcinogenic chemicals like acrylamide, ethidium bromide etc.
5. The students will learn about the basic procedure to patent the different biotechnological products.

Course content

1. Good laboratory practices followed in biotechnology laboratory.
2. Introduction, use and maintenance of basic equipments in a biotechnology laboratory (Auto-pipettes, weighing balance, pH meter, Water bath, dry bath, Spectrophotometer, centrifuges, light microscope, electrophoretic apparatus, vortex mixer, magnetic stirrer, rocker, laminar hoods, autoclave, sonicator, UV transilluminator, hot air oven, BOD incubator).
3. Handling and disposal of hazardous reagents (acids, carcinogenic chemicals like acrylamide, ethidium bromide) and concept of chemical hoods.
4. Different steps for patent with the help of example.

Course Outcomes

CO-1. The students will gain information about the different steps in order to clean and maintain the biotechnological laboratory.
CO-2. The students will be able to get hand on training about the working of different instruments and by this they will gain knowledge to conduct biochemical testing of bio-molecules.
CO-3. The information about the procedure to dispose the harmful and toxic biomedical waste will be helpful for students in order to avoid the spread of infectious diseases.

CO-4. The information regarding the protocol to patent the biotechnological products will boost students to develop useful products and safeguard them from illegal practices.

CO-5. This course will be very useful in laying the foundation for biotechnology students to explore different areas of biotechnology in useful manner.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-III)

BTL202 Immunology-I

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. To comprehend the basic principles of immunology, types of immunity and the molecular mechanisms of innate and adaptive immunity
2. Understanding lymphoid cells, as well as the immune system's primary and secondary organs
3. To provide an adequate knowledge of antigen, immunoglobulins and antibody diversity, and the complement system
4. Detailed description of antigen presentation, MHC molecules, humoral and cell-mediated responses

Course content

Section-A

Types of immunity-innate and adaptive; Features of immune response-memory; Specificity and recognition of self and non-self; Terminology used in the study of immune system.

Section-B

Lymphoid cells, heterogeneity of lymphoid cells; T-cells, B-cells, Null cells; Monocytes, Polymorphs, primary and secondary lymphoid organs-thymus, Bursa of fabricius, spleen, lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT), Lymphocyte traffic.

Section-C

Antigen, Epitope (B cell & T Cell epitioe), Immunogen, Factors influencing immunogenicity, Immunoglobulins, classes and structure; affinity and avidity; Complement fixing antibodies and complement cascade.

Section-D

MHC class I and class II molecules, structure T & B Cells and function of class I and class II MHC molecules, structure of T-cell antigen receptors.

Books Recommended:

1. Roitt, I.M. Brostoff, J. and Male, D.K. (2012), Immunology, 8th Edition, Elsevier , New York
2. Judy Owen, Jenni Punt, Sharon Stranford, Patricia Jone. (2018), Immunology, 7th Edition. W.H. Freeman and Company, New York
3. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai (2011) Cellular and Molecular Immunology; 7th Edition, Saunders
4. Doan (2012) Lippincott's Illustrated Reviews Immunology ; 2nd Edition, Wolters Kluwer India Pvt

Course Outcomes

Upon completion of this course, students will be able to:

CO-1. Understand and demonstrate basic knowledge of immunological processes at the cellular and molecular levels.

CO-2. Distinguish between innate and adaptive immunity, humoral and cell mediated responses.

CO-3. Explainthe cell types and organs involved in the immune response.

CO-4. Acquire knowledge about the antigens, different types of Immunoglobulins, and the complement system

CO-5. Describe the immune system's roles in identification, presentation and processingof the antigens.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP222 Immunology-I Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours
Note. The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. To acquire the ability of using laboratory techniques aimed to define the proportion of the different leukocyte populations in a healthy individual.
2. To learn the techniques used in the separation of plasma from blood.
3. Gaining knowledge about the different methods of blood collection.
4. Understanding different agglutination reactions such as hemagglutination.

Course content

1. Differential leucocytes count
2. Total Leucocytes count
3. Total RBC count
4. Separation of Plasma from blood
5. Collection of blood sample by different method.
6. Haemagglutination assay
7. Haemagglutination inhibition assay

Books Recommended

1. Stevans, C.D. (1996). Clinical Immunology and Serology : A Laboratory Perspective F.A. Davis Company, Philadelphia
2. Celis, K.E. (1998). Cell Biology: A laboratory handbook. Vol-I Academic Press, U.K. 3. Hay, F.C. Westwood O.M.R. (2002). Practical Immunology, 4th Ed., Blackwell Science, U.K.

Course Outcomes

Upon completion of this course, students will be able to:

CO-1. Learn about the diagnostic methods like TLC, DLC.
CO-2. Differentiate between different types of white blood cells.
CO-3. Understand the difference between blood plasma and serum and also about their role in clinical field.
CO-4. Perform different immunological techniques such as hemagglutination, etc.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTL203 Chemistry-II (Organic)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course objectives

1. Students will learn about aromatic compounds, alkanes, alkenes.
2. Stereochemistry (3D arrangement of molecules), the reactivity of carbonyl compounds with both hard and soft nucleophiles (carboxylic acids, aldehydes and ketones.

Course content

Section–A

Reactive intermediates

Carbocations, carbanions, free radicals, carbenes, arenes and nitrenes(with examples). Assigning formal charges on intermediates and other ionic species

Bonding

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Van der Waals interactions, resonance, hyperconjugation, hydrogen bonding and Inductive and electrometric effects.

Section–B

Aromaticity

Aromatic electrophilic substitution–general pattern of the mechanism, role of σ and π complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Methods of formation and chemical reactions of alkylbenzenes

Section-C

Stereochemistry: Molecular chirality, enantiomers/symmetry in achiaral structures, chiral centres in chiral molecules, properties of chiral molecules-optical activity, absolute and relative configuration, the Cahn-Ingold Prelog R-S notional system physical properties of enantiomers. Stereochemistry of chemical reactions that produce chiral centres, chemical reactions that produce stereoisomers, Resolution of enantionmers, chiral centres other than carbon, prochirality.

Section-D

Functional group transformation by nucleophilic substitution, the biomolecular (SN^2), mechanism of nucleophilic substitution , stereochemistry of SN^2 reactions, how SN^2 reactions occur, steric effect in SN2reactions, nucleophiles and nucleophilicity, the unimolecular (SN^1) mechanism of nucleophilies substitution, carbocation stability and the rate of substitution, by

the SN^1 mechanism sterochemistry of SN1reactions, carbocation real arrangements in SN^1 reactions, solvent effects, subtitution and elimination as competing reactions.

Books Recommended:

1. R.T. Morison and R.N. Boyd, Organic chemistry
2. I. L. Finar, Organic Chemistry, Vol.I, IV ed. J. March, Advanced Organic Chemistry, Reactions Mechanisms and Structure.
3. Schaum's Outlines Series, Theory and Problems of Organic chemistry.
4. I.L. Finar, Problems and their solution in Organic chemistry.
5. J. D. Robert and M. C. Caserio, Modern Organic Chemistry.
6. D. J. Cram and G. S. Hammond, Organic chemistry.
7. J. E. Banks, Naming Organic Compounds - Programmed Introduction to Organic Chemistry
8. E.L. Eliel, Stereochemistry of carbon compounds.
9. W. Camp, Organic Spectroscopy.
10. F. A. Carey, Organic chemistry

Course outcomes:

S. No.	On completing the course, Students will be having
CO1	Basic knowledge on the nomenclature, structure, stability and method of preparation of various reaction intermediates.
CO2	Knowledge of various field effects line Inductive, Electromeric, Resonance and Hyperconjugation along with some interactive forces.
CO3	Practice on the electrophilic substitution on the aromatic systems and information on the directive influence of various groups on these reactions.
CO4	Knowledge on some aspects of stereochemistry,Chirality, Prochirality, R-S and related topics.
CO5	Detailed knowledge of the Nucleophilic Substitution reactions SN1 and SN2 and the factors effecting these reactions.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP223 Chemistry-II (Organic) Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours

Course objectives

Students will gain practical knowledge of handling chemicals.
Students will learn identification of functional groups: Aldehydes, ketones, acids, Phenols, Amines and carbohydrates

Course content

Note: The question paper will be set by the examiner based on the syllabus.

Organic qualitative analysis:

Complete identification including derivation of following organic compounds:

- Amides
- Amines
- Carboxylic acids and phenols.

Organic qualitative analysis:

Complete identification including derivation of following organic compounds:

- Aromatic hydrocarbons
- Aldehydes
- Ketones
- Carbohydrates

Course outcomes

S. No.	On completing the course,
CO1	To perform various functional group tests in identification of organic compounds Such as phenols, carboxylic acids, carbonyl compounds, carbohydrates etc.
CO2	Systematic qualitative analysis of organic compounds for the detection of elements
CO3	Identification of the compounds and preparation of derivative and determination of its melting point.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTL204 Botany-II

Credit Hours (Per Week): 3 Hours
Total Hours : 45 Hours
Thoery : 30 Marks
Internal Assessment : 10 Marks

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objective

CO-1	To study the physiological processes in plants
CO-2	To study the mode of transmission & control measures of plant diseases and host-pathogen interactions.
CO-3	To study the concept of biodiversity, population growth, population growth curves and biogeographical zones of India.

Course content

Section-A

Nutrition, Transport and Stress responses in plants: Macronutrients and micronutrients and their deficiency symptoms; Water relations, osmosis, transpiration, water potential & its components, ascent of sap and transport of organic solutes. Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Section-B

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO_2 fixation-C3, C4 and CAM pathways.

Section-C

Plant Pathology & epidemiology: Definitions, classification, mode of transmission & control measures of plant diseases; host-pathogen interaction, Disease resistance, phytoalexins, PR proteins. A brief account of the following plant diseases with respect to casual agents, symptoms, epidemiology and their control measures : Black stem rust of wheat, Loose smut of wheat, Late and early blight of potato, Red rot of sugarcane, TMV of potato, Yellow vein mosaic of bhindi.

Section-D

Biodiversity: Physical environment; biotic environment; biotic and abiotic interactions. Concept of habitat and niche; Characteristics of a population; population growth curves; population regulation; Major terrestrial biomes; biogeographical zones of India.

Books Recommended:

1. Sharma, P.D. *Plant Pathology*. India: Rastogi Publication, 2011. Print.
2. Sharma, P.D. *Ecology and Environment*. 8th ed. India: Rastogi Publications, 2010. Print.
3. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A. *Plant Physiology and Development*. 6th ed. USA: Sinauer Associates Inc., 2015. Print.

4. Hopkins, W.G. and Huner, A. *Introduction to Plant Physiology*. 4th ed. USA: John Wiley and Sons, 2008. Print.
5. Shibu, J., Singh, H.P., Batish, D.R. and Kohli, R.K. *Invasive Plant Ecology*.New York, USA: CRC Press, Taylor and Francis Group, Boca Raton, 2013. Print.

Course Outcomes:

Upon completion of the course the student will be able:

CO-1	To understand the role of water and water related processes in plants
CO-2	To deeply learn the process of plant adaptation under stressed environment (cold, heat, drought and salt)
CO-3	To gain knowledge about role of stress induced proteins and osmolytes in plants under the influence of abiotic stressors
CO-4	To learn the concept of plant pathology, occurrence of plant diseases and their transmission
CO-5	To understand the disease cycle of the pathogens causing diseases in plants, the symptoms it causes and the epidemiology of the disease
CO-6	To learn the importance of biodiversity and population growth and its characteristics.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP224 Botany-II Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours

Note. The question paper will be set by the examiner based on the syllabus.

Course objectives

CO-1 To study water content, osmotic potential and transpriation in plants
CO-2 To study serperation of pigments and process of photosynthesis.
CO-3 To study different plant pathogens.

Course content

1. Estimation of relative water content of leaf.
2. Measurement of osmotic potential of different tissues by Chardokov method.
3. Demonstrate the transpiration pull by mercury method.
4. Demonstration that 0_2 is evolved during photosynthesis.
5. Separation of pigments by paper chromatography/TLC method
6. Study of Plant pathogens (a) Symptoms of the diseases (b) Morbid anatomy of the plants infected with following diseases. Black stem rust of wheat, Loose smut of wheat, Late and early blight of potato, Red rot of sugarcane, TMV of potato, Yellow vein mosaic of bhindi.

Course outcomes

CO-1 Students will learn about water content, osmotic potential and transpriation in plants
CO-2 Students will learn about seperation of pigments and process of photosynthesis.
CO-3 Students will study different plant pathogens.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTL205 Biochemistry-III (Metabolism of Carbohydrates and Lipids)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. Students will acquire knowledge about the various metabolic pathways in human body.
2. Students will learn in detail about carbohydrate metabolism and its regulatory pathways.
3. Students will learn in detail about Lipid metabolism and its regulatory pathways.

SECTION-A

Carbohydrate metabolism: - Biosynthesis and degradation of carbohydrates, Glycolysis, gluconeogenesis, feeders pathways for glycolysis, regulation of carbohydrates metabolism.

SECTION-B

Kreb's cycle: - Amphibolic nature of kreb's cycle, regulation and enzymes of kreb's cycle, glyoxylate pathway. Electron transport chain: - Mitochondrial electron chain, oxidative phosphorylation, chemiosmotic hypothesis, ATP synthase and regulation of ATP sy

SECTION-C

Lipid Catabolism: Oxidation of fatty acids, degradation of triacylglycerol, phosphoglycerides, sphingolipids, regulation of lipid metabolism.

SECTION-D

Lipid Anabolism: Synthesis of fatty acids, triacylglycerol, phosphoglycerides , sphingolipids, cholesterol.

Books Recommended

1. David L. Nelson and Michael Cox (2017) Lehninger Principles of Biochemistry, 7th ed, WH Freeman

2. Jeremy M. Berg, Lubert Stryer, John Tymoczko , Gregory Gatto (2019) Biochemistry, 9th Ed., WH Freeman
3. Ferrier (2017) Lippincott's Illustrated Reviews Biochemistry, 7th Ed, Wolters Kluwer India Pvt. Ltd.
4. J L Jain , Sunjay Jain , Nitin Jain (2016) Fundamentals of Biochemistry, 7th Ed, S Chand
5. Satyanarayana (2020) Biochemistry, 5th Ed, Elsevier

Course Outcome

At the end of the course

CO-1. Students will have learnt about the carbohydrates and lipids anabolic and catabolic processes.

CO-2. Students will have learnt about the carbohydrate and lipid metabolism regulatory processes and pathways at molecular level

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP225 Biochemistry-III (Metabolism of Carbohydrates and lipids) Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours

Note: The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. To give students hands on experience in preparation of reagents, buffers and media preparation.
2. To make students understand the concept of reducing sugars and determine it in give sample.
3. Students will perform paper chromatography of plant pigments & spectral analysis of various plant pigments, and perform thin layer chromatography.
4. Students will learn and perform the extraction of lipids from wheat grains

Course content

1. Determination of reducing sugar using 3,5 dinitrosalicylic acid.

2. Spectral analysis of various plant pigments

3. Separation of lipids from wheat grains.

4. Separation of macromolecules using thin layer chromatography

5 To perform Hb1Ac

6. Oral glucose tolerance test

Course Outcome

At the end of this course

CO-1. Students will have learnt about the basic concept of molarity, normality & prepare reagents and buffers.
CO-2. Students will be aware of the clinical significance of oral glucose tolerance test and HbA1c
CO-3. Students will be able to handle microscopes, spectrophotometer and other lab equipments.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTL206

Molecular Biology

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objetives

1. The course will provide a brief overview of Nucleic acid background comprising of salient features and models of DNA and RNA
2. The course will mainly focus on the study of principal molecular events of cell incorporating DNA Replication, Transcription and Translation in prokaryotic as well as eukaryotic organisms.
3. The course will also emphasize Post Transcriptional Modifications and Processing of Eukaryotic RNA covering the concepts of Split genes, Introns, Exons, Splicing Mechanisms and RNA Editing.
4. The course will also impart detailed explanation of Prokaryotic and Eukaryotic Transcriptional Regulation along with mechanism of Gene Silencing.
5. To enhance the significance & Practical applications of Mutation .

Course content

Section-A

Molecular basis of life. Structure of DNA & RNA. DNA replication in both prokaryotes and eukaryotes.

Section-B

RNA synthesis and processing RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, genetic code

Section-C

Protein synthesis and processing Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code,

aminoacylation of tRNA, aminoacyl tRNA synthetase and translational proof-reading, translational inhibitors, Post- translational modification of proteins.

Section-D

DNA recombination molecular mechanisms : prokaryotic and eukaryotic. Mutation: Spontaneous versus induced mutations, types of mutations, mutations rate and frequency, Mutagens: Physical and Chemical, the molecular basis of mutations. Significance & Practical applications of Mutation Insertion elements and transposons with appropriate examples.

Books Recommended

1. George M Malacinski (2015) Freifelders Essentials Of Molecular Biology, 4Th/Ed, Jones & Bartlett
2. David P. Clark, Nanette J. Pazdernik, Michelle R. McGehee (2018), 3rd edition, Molecular Biology, Academic Cell
3. Pk Gupta(2018) MOLECULAR BIOLOGY , 2nd Edition, Rastogi Publications
4. James D. Watson, A. Baker Tania, P. Bell Stephen , Gann Alexander, Levine Michael, Losick Richard (2017)Molecular Biology of the Gene, 7th Ed, Pearson Education

Course Outcome

CO-1. This gives them a strong foundation on the basics structure and functions of nucleic along with replication of genetic material in prokaryotes and eukaryotes.
CO-2. Molecular Events of Transcription and processing of transcripts, RNA editing.
CO-3. Molecular Events of Translation leading to protein synthesis and Post translational modification.
CO-4. Students will get insight into the process of recombination and mutations.
CO-5. Understand and apply the principles and techniques of molecular biology which prepares students for further education, basic and applied research, and/or as health professionals.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP226

Molecular Biology Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours

Note. The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. Cognize basic concepts and terminology of the main techniques of molecular biology.
2. To prepare various Preparation of stock solutions
3. To perform the extraction of nucleic acids (DNA) in order to cover different levels of a research in molecular biology and genetics.
4. To perform Gel casting and Setting up of gel apparatus 4. Preparation of Agarose gel for agarose gel electrophoresis.
5. To quantify DNA by spectrophotometric and fluorometric (Ethidium bormide) analysis.
6. To collect and correlate the information obtained and knowing how to present in the form of a scientific report.

Course content

1. Preparation of stock solutions.
2. Isolation of genomic DNA from plants.
3. Gel casting and Setting up of gel apparatus
4. Preparation of Agarose gel for agarose gel electrophoresis
5. Spectrophotometric determination of purity.
6. Quantification of DNA by spectrophotometric and fluorometric (Ethidium bormide) analysis.

Books Recommended:

1. S.B. Primrose and R.M. Twyman; Principles of Gene Manipulation. 2006.
2. J. Sambrook and Michael R. Green; Molecular Cloning: A Laboratory Manual, (Fourth Edition), CSHL, 2012.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006

Course Outcome

CO-1. This gives them and terminology of the main techniques of molecular biology.
CO-2. To understand the Isolation of genomic DNA from plants and Gel casting and Setting up of gel apparatus.
CO-3. To learn about the preparation of Agarose gel for agarose gel electrophoresis.
CO-4. To gain thorough knowledge about Quantification of DNA by spectrophotometric and fluorometric (Ethidium bormide) analysis.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

Course code: ESL–221:
Course Title: ENVIRONMENTAL STUDIES–I (COMPULSORY)

Credit Hours (Per Week): 2
Total Hours : 30
Maximum Marks : 50 Marks

Time 3 hrs

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections. Each unit of the syllabus should be given equal weightage of marks.Paper to be set in English, Punjabi and Hindi

Section–A: (16 Marks): It will consist of five short answer type questions. Candidates will be required to attempt four questions, each question carrying four marks. Answer to any of the questions should not exceed two pages.

Section–B: (24 Marks): It will consist of five questions. Candidates will be required to attempt four questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

Section–C: (10 Marks): It will consist of two questions. Candidate will be required to attempt one question (carrying ten marks) only. Answer to the question should not exceed 5 pages.

Course Objectives

CO-1	The main goal of Environmental studies is to create the environmental awareness to create a safe, green and sustainable environment.
CO-2	To make students aware about the importance of ecosystem, types of ecosystem, energy flow in an ecosystem, ecological succession, food chain and food web.
CO-3	To make students aware of water conservation, global warming, consumerism and waste products. and, also about the environmental protection acts.
CO-4	Role of National Service Scheme (NSS). Health and hygiene.

Course content

Unit-I

The Multidisciplinary Nature of Environmental Studies:

- Definition, scope & its importance.
- Need for public awareness.

Natural Resources:

- Natural resources and associated problems:

a) Forest Resources: Use of over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

b) Water Resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food Resources: World food problems, change caused by agriculture and overgrazing, effects or modern agriculture, fertilizer-pesticide problem, salinity, case studies.

e) Energy Resources: Growing of energy needs, renewable and non-renewable energy resources, use of alternate energy sources, case studies.

f) Land Recourses: Land as a resource, land degradation, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit-II

Ecosystem:

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystems:
a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit-III

Social Issues and Environment:
From unsustainable to sustainable development.
Urban problems related to energy.
Water conservation, rain water harvesting, watershed management.
Resettlement and rehabilitation of people; its problems and concerns. Case studies.
Environmental ethics: Issues and possible solutions.
Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocause. Case studies.
Wasteland reclamation.
Consumerism and waste products.
Environmental Protection Act:

- Air (prevention and Control of Pollution) Act.
- Water (prevention and Control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.

Issues involved in enforcement of environmental legislation.
Public awareness.

Unit-IV

National Service Scheme

- **Introduction and Basic Concepts of NSS:** History, philosophy, aims & objectives of NSS; Emblem, flag, motto, song, badge etc.; Organizational structure, roles and responsibilities of various NSS functionaries.
- **Health, Hygiene & Sanitation:** Definition, needs and scope of health education; Food and Nutrition; Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan); National Health Programme; Reproductive health.

References/Books:

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Down to Earth, Centre for Science and Environment, New Delhi.
4. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.

5. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
6. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
7. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
8. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
9. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar
10. Kanta, S., 2012. Essentials of Environmental Studies, ABS Publications, Jalandhar.

Course Outcomes

CO-1	To learn about the sustainable environment.
CO-2	To gain the knowledge ecosystem and its functioning.
CO-3	To know about the water conservation programs like rain water harvesting and water shedding. and, to gain knowledge of environmental (air, water and pollution) protections acts.
CO-4	To know about the role and importance of NSS– a volunteer organization, in making up a better environment and to maintain better health and hygiene.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BTL251

Industrial Biotechnology-I

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. To comprehend the basic principles of Industrial biotechnology.
2. To describe the principles of fermentation process.
3. Understanding the different methods of microbial isolation, identification and preservation.
4. To learn about the methods used for strain improvement of industrially important microbes.
5. Theoretical knowledge about the production of dairy products, primary and secondary metabolites, and the role of enzymes in industries.

Course content

Section-A

History of general and industrial Microbiology, Basic concept of Industrial fermentation and its significance in industry. Differences between microbial industrial processes and chemical industrial processes.

Section-B

General study and characterization of industrial important microbes. Methods of isolation, screening, selection and Identification of industrial microbes. Maintenance and preservation of industrially important microbial cultures.

Section-C

Strain improvement of industrial important microbes: by using mutational programme and recombination systems (par sexual cycle, protoplast fusion and recombinant DNA techniques), Isolation of mutants (induced, auxotrophic, resistant and revert ant mutants), Inoculums Development, media formulation and process optimization of Industrial and agro industrial microbes.

Section-D

Introduction to primary and secondary metabolites production. Dairy products like curd, yoghurt, Cheese, bread, proteases in leather processing industries.

Books Recommended:

1. Davis, B.D., Dulbecco. R., Eisen, H.N. and Ginsberg, H.S. (1990). Microbiology: 4th Edition, Harper & Row, Publishers, Singapore.
2. Tortora, G.J., Funke, B.R. and Case, C.L. (1994). Microbiology: An introduction: 5th Edition, The Benjamin / Cummings Publishing Company, Inc.

3. Stanier, R.Y. (1995). General microbiology, MacMillan Press, Londan.
4. Pelczar, M.T. (1995). Microbiology, Tata McGraw Hill Publication, New Delhi.
5. Schlegel. H. G., (1995). General Microbiology 7th Edition, Cambridge Univ. Press.
6. Prescott and Dunn (1999). Industrial Microbiology 4th Edition, By S.K. Jain for CBS Publishers & Distributors.
7. Purohit, S.S. (2000). Microbiology: Fundamentals and Applications (6th Edition), Agrobios (India).
8. Postgate. J. (2000). Microbes & Man 4th Edition, Cambridge Univ. Press.
9. Tortora. G.J., Funke. B.R., 2001. Microbiology: An Introduction, Benjamin Cummings.
10. Stanbury, P.F., Whitaker, A. and Hall, S.J. (2001), Principles of Fermentation Technology 2nd ed., Pergamon Press, Oxford.
11. Frazier, W.C. and Westhoff, D.C. (2003) Food Microbiology. 18th Edition, Tata McGraw Hill, Inc., New York.
12. Industrial Biotechnology: Approach to Clean Technology · Jogdand, S.N. Himalaya Publishing House 2006. ISBN: ISBN number: 9788183184250.

Course Outcome

Upon completion of this course, students will be able to:

CO-1. Apply biotechnology to industrial processes. Students will also gain knowledge about the basic fermentation process.

CO-2. Identify the suitable methods of isolation, identification and preservation of microbes. Students will also get to know about the inoculum development and media formulation process.

CO-3. Understand how bacteria and other microbes can be manipulated by recombinant DNA technology or selective isolation for use in industrial processes to generate products of interest.

CO-4. Learn the basic steps involved in production of curd, yoghurt, cheese, bread, primary and secondary metabolites. Students will also get familiarized with the role of proteases in leather processing industries.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTP271

Industrial Biotechnology-I Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours
Note. The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. To learn about the basic methods of microbial isolation.
2. Measurement of bacterial cell size.
3. Identification of an organism in the coliform group.
4. To know the importance of starter culture in fermentation process.
5. To perform nitrate reduction test.

Course content

1. Isolation of microbial cells by serial dilution-spread plate method, pour plate.
2. Measurement of bacterial size.
3. Metabolic Characterization by IMVIC test
4. Alcoholic and Mixed–Acid Fermentation.
5. Starter culture preparation, evaluation and application.
6. Determination of nitrate reduction by bacteria.

Books Recommended:

1. Cappuccino J.G., Sherman N. (2007). Microbiology: A laboratory (Pearson Benjamin Cummings).
2. Plummer D.T. (2004). An introduction to practical biochemistry (Tata McGraw Hill Publishers Co. Ltd., New Delhi).
3. Bansal, D.D., K Hardori, R., Gupta, M.M. (1985). Practical biochemistry (Standard Publication Chandigarh).
4. Dubey R.C. and Maheshwari (2012) Practical Microbiology 5th edition: S. Chand and company ltd. New Delhi.

Course Outcome

Upon completion of this course, students will be able to:

CO-1. Perform the serial dilution, spread plate and pour plate method of bacterial isolation.

CO-2. Measure the dimensions of microorganisms under microscope by a technique known as micrometry.

CO-3. Differentiate between coliforms, i.e., bacteria of the genera Escherichia and Enterobacter, into species and varieties.

CO-4. Prepare starter cultures for the fermentation processes.

CO-5. Determine whether the microorganism can reduce nitrate or not.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTL252

Immunology-II

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. Theoretical knowledge about the production of monoclonal antibodies and also, the role of various types of T-cells.
2. To learn about the basic techniques for identifying antigen-antibody interactions.
3. Elucidation of various mechanisms that regulate immune responses against the pathogens and maintain tolerance
4. To provide an adequate knowledge about different types of vaccines.

Course content

Section-A

T-cell subsets and surface markers, T-dependent and T-independent antigens, recognition of antigens by T-cells. Monoclonal antibodies: its production and uses.

Section-B

Various types of immunodiffusion and immunoelectrophoretic procedures. ELISA, RIA, Agglutination of pathogenic bacteria, Haemagglutination and haemagglutination inhibition.

Section-C

Immunity to viruses, intracellular and extracellular bacteria, immunopathological consequences of parastitic infections, immune invasion, mechanism used by parasites, regulation of immune invasion, mechanism used by parasites.

Section-D

Active and passive immunization, Adjuvants, whole organism vaccine, purified macromolecules as vaccine, recombinant antigen vaccine, recombinant vector vaccine, synthetic peptide vaccine, multivalent subunit vaccine, DNA Vaccine

Books Recommended:

1. Roitt, I.M. Brostoff, J. and Male, D.K. (2012), Immunology, 8th Edition, Elsevier , New York
2. Judy Owen, Jenni Punt, Sharon Stranford, Patricia Jone. (2018), Immunology, 7th Edition. W.H. Freeman and Company, New York

3. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai (2011) Cellular and Molecular Immunology; 7th Edition, Saunders
4. Doan (2012) Lippincott's Illustrated Reviews Immunology ; 2nd Edition, Wolters Kluwer India Pvt
5. Goldsby, R.A., Kindt, T.J., Osborne, B.A. (2006). Kuby Immunology, 4th ed., W.H. Freeman and Company, New York

Course Outcome

Upon completion of this course, students will be able to:

CO-1. Learn aboutT-cell subsets and surface markers and Hybridoma Technology

CO-2. Identify antigen-antibody interactions using techniques such as precipitation, immune-electrophoresis, agglutination, ELISA, and RIA

CO-3. Investigate the mechanisms underlying the immune response to various infectious agents such as bacteria, viruses, and parasites.

CO-4. Elucidate the reasons for immunisation and be aware of the various vaccinations.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTP272

Immunology-II Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours

Note. The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. Understanding the significance of various vaccines used for children.
2. Demonstration ofantigen-antibody interaction by using immunodiffusion techniques
3. To perform the agglutinations reactions: hemagglutination and hemagglutination inhibition assay.
4. Comparison of direct and indirect ELISA.

Course content

1. Preparation of vaccine chart of child, highlighting optional vaccines
2. Haemagglutination assay
3. Haemagglutination inhibition assay
4. Double immunodiffusion test using specific antibody and antigen Line of identity, partial identity and non identity
5. Single immunodiffusion test using specific antibody and antigen
7. Direct and indirect ELISA

Books Recommended

1. Stevans, C.D. (1996). Clinical Immunology and Serology : A Laboratory Perspective F.A. Davis Company, Philadelphia
2. Celis, K.E. (1998). Cell Biology : A laboratory handbook. Vol-I Academic Press, U.K.
3. Hay, F.C. Westwood O.M.R. (2002). Practical Immunology, 4th Ed., Blackwell Science, U.K.

Course Outcome

Upon completion of this course, students will be able to:

CO-1. Understand the importance of vaccination.
CO-2. Performsingle and double immunodiffusion technique for the detection, identification and quantification of antibodies and antigens.
CO-3. Determinewhether a patient has ever had any infection, for e.g., *Salmonella typhi* infection by using agglutination reactions.
CO-4. Apply immunological techniques such as direct and indirect ELISA as a diagnostic tool.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTL253

Biochemistry-IV (Metabolism of Proteins and Nucleic acid)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. To understand the basic concept of Proteins and Nucleic acid biosynthesis.
2. To acquire the knowledge of advanced pathways leading to the biosynthesis of building blocks of proteins and nucleic acids.
3. To learn how energy is obtained through the catabolism of proteins and nucleic acids.
4. To make students aware of the metabolic defects in these pathways leading to severe disorders.

Course content

Section-A

Amino Acid Metabolism: Transamination reactions of amino acids, urea cycle, catabolism of essential amino acids, Inborn errors of Metabolism and amino acid degradation.

Section-B

Amino Acid Metabolism: Biosynthesis of essential amino acids, Regulation of amino acid biosynthesis by feed back inhibtion

Section-C

Nucleic Acid Metabolism: Biosynthesis of purines and pyrimidines nucleotides, regulation of nucleotide biosynthesis.

Section-D

Nucleic Acid Metabolism: Degradation of purines and pyrimidines , nucleotides, salvage pathway.

Books Recommended:

1. David L. Nelson and Michael Cox (2017) Lehninger Principles of Biochemistry, 7th ed, WH Freeman

2. Jeremy M. Berg, Lubert Stryer, John Tymoczko , Gregory Gatto (2019) Biochemistry, 9th Ed., WH Freeman
3. Ferrier (2017) Lippincott's Illustrated Reviews Biochemistry, 7th Ed, Wolters Kluwer India Pvt. Ltd.
4. J L Jain , Sunjay Jain , Nitin Jain (2016) Fundamentals of Biochemistry, 7th Ed, S Chand
5. Satyanarayana (2020) Biochemistry, 5th Ed, Elsevier

Course Outcome

CO-1. Students will study complete catabolism of essential Amino Acids and Nucleotides.

CO-2. Students will be acquainted with the knowledge Biosynthesis of essential Amino Acids and Nucleotides.

CO-3. The course will help the students to understand the abnormalities in the metabolism of Amino Acids and Nucleotides and their relationship to various diseases.

CO-4. Biological processes are keenly regulated; in this course students will also acquire the information about regulation of these pathways.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTP273

Biochemistry-IV lab (Metabolism of Proteins and Nucleic Acid)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Note. The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. To apply the biochemical principals in the estimation of basic biomolecules like amino acids and cholesterol.
2. To learn the process of fat estimation from milk.
3. Students learn the precipitation of proteins using isoelectric point and salt precipitation methods as it's the first step in studying any protein.

Course content

1. Isolation of Casein from milk
2. Determination of fat content in milk.
3. Estimation of cholesterol in a given sample.
4. Purification of protein using salt precipitation.
5. Quantitative estimation of amino acids using the ninhydrin reaction.

Course Outcome

CO-1. Good experimental and quantitative skills encompassing preparation of laboratory reagents, conducting experiments, satisfactory analyses of data and interpretation of results.
CO-2. Awareness of resources, and their conservation.
CO-3. Students will develop a conceptual and practical understanding of protein isolation using protein isoelectric point and Salt precipitation .
CO-4. Estimation of biomolecules lies at the heart of biochemistry, students will learn estimation of Amino Acids ,cholesterol and fat content of a sample.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTL254

Skill Development in Biotechnology

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. The aim of this course is to make students aware about the use of biofertlizers in agricultural processes.
2. Students will learn about the different types of microorganisms that are used in the production of biofertlizers.
3. Students will learn about the different types of processes for nitrogen fixation and various types of medicinal plants and their applications.
4. Students will be able to understand the extraction of essential oils from plants such as Eucalyptus, Levender, Rosa grass and Tulsi.
5. Students will be able to understand different types of clinical and molecular diagnostic tests performed by using blood sample to understand the physiology and biochemistry of blood in humans.

Course content

Section A: Biofertilizers

Biofertilizers: Introduction and types and importance of biofertilizers, Microorganisms used in biofertilizers production, Biological Nitrogen fixation VIZ: Rhizobium: Process of nodule formation ,Role of Nif and Nod gene in, Enzyme nitrogenase and its component, Different methods of application of biofertilizers, Strategies of Mass production and packing, Registration of biofertilizers.

Section B: Herbal Biotechnology

Introduction to medicinal plants and their medicinal value, Phytochemicals, Essential oil: definition, extraction and applications in domestic life, industry and other purposes (Eucalyptus, Levender, Rosa grass, Tulsi)

Section C: Clinical and molecular diagnostics

Collection of blood samples, preparation and use of different anticoagulants, estimation of CBC, TLC, DLC, bleeding count, clotting time, ESR, PCB, principles of X-ray, MRI, ultrasonography, CT scan, ECG, ECHO, Overview of vector borne diseases: Dengue, Chickengunia, PCR based diagnosis of Bacterial, viral & fungal diseases (covid-19, Swine flu, Tuberculosis, Candidiasis)

Section D: Bioentrepreneurship

Overview of bioindustries, public/private funding opportunities; Innovation-focused thinking. Preparation of a business plan: socio-economic cost benefit analysis; Statutory and legal aspects. Business and market strategy: pricing, financing, market linkages, branding

Books Recommended

1. Fundamentals of Foods, Nutrition and Diet Therapy, (English, Mudambi Sumati R.), New Age International publication,
2. Clinical Dietetics and Nutrition, by Antia F P (Author), Oxoford publication.
3. Alpers.D.H. , Stenson W.F.and Bier.D.M., (2002). Manual of Nutritional Therapeutics, 4th edition, Lippincott Williams & Wilkins, Philadelphia, USA.
4. Research pare and e notes.
5. F. Bakkali, S. Averbeck , D. Averbeck, M. Idaomar. (2008). Biological effects of essential oils – A review. Food and Chemical Toxicology 46: 446–475.
6. R. Amorati,M. C. Foti, L. Valgimigli. (2013). Antioxidant Activity of Essential Oils. Journal of Agriculture and Food Chemistry. 61:10835−10847.
7. A Sharma, D.S. Cannoo. (2016). Comparative evaluation of extraction solvents/techniques for antioxidant potential and phytochemical composition from roots of Nepeta leucophylla and quantification of polyphenolic constituents by RP-HPLC-DAD. Food Measure. doi 10.1007/s11694-016-9349-5
8. Sharma and D. S. Cannoo. (2013). Phytochemical composition of essential oils isolated from different species of genus NEPETAof Labiatae family: a review. Pharmacophore, 4 (6): 181-211.
9. Sarikurkcu, B. Tepe, D. Daferera, M. Polissiou, Mansur Harmandar. (2008). Studies on the antioxidant activity of the essential oil and methanol extract of Marrubium globosum subsp. globosum (lamiaceae) by three different chemical assays. Bioresource Technology, 99: 4239–4246.

Course Outcome

CO-1. The students will be able to learn about the strategies of mass production, packing and registration of biofertlizers.

CO-2. The students will learn different methods to collect blood samples from different body parts of humans in order to perform clinical diagnostic tests.

CO-3. The students will learn to estimate CBC, TLC, DLC, bleeding count, clotting time, ESR, X-ray, MRI, CT scan, ECG, ECHO, ultrasonography and PCB.

CO-4. The students are able to understand the life cycles of various bacterial, viral and fungal diseases like Dengue, Chickengunia, Covid-19, Swine flu, Tuberculosis and Candidiasis.

CO-5. Students will be learn about bioentrepreneurship in order to perform business and learn market strategy of healthcare products.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTP274

Skill Development in Biotechnology Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours

Note: The question paper will be set by the examiner based on the syllabus.

Course objectives

1. The aim of this course is to make students aware about the use of biofertlizers in agricultural processes.
2. Students will learn about the different types of microorganisms that are used in the production of biofertlizers.
3. Students will learn about the different types of processes for nitrogen fixation and various types of medicinal plants and their applications.
4. Students will be able to understand the extraction of essential oils from plants such as Eucalyptus, Levender, Rosa grass and Tulsi.
5. Students will be able to understand different types of clinical and molecular diagnostic tests performed by using blood sample to understand the physiology and biochemistry blood in humans.

Course content

1. Isolation of Rhizobium from root nodules
2. Production of commercial biofertilizers using *Rhizobium*.
3. Extraction of essential oils through oil distillation apparatus.
4. To measure total polyphenolic content of the essential oil.
5. Total flavanoid content of the essential oil.
6. Investigating the antioxidant potential of the oils by DPPH assay.
7. Antimicrobial activity of essential oils.
8. Estimation of CBC/DLC/TLC/Bleeding count/Clotting time/ESR/PCB
9. Estimation of BMR
10. Estimation of lipid profile
11. Estimation of blood glucose

Course Outcome

CO-1. The students will be able to learn about the strategies of mass production, packing and registration of biofertlizers.

CO-2. The students will learn different methods to collect blood samples from different body parts of humans in order to perform clinical diagnostic tests.

CO-3. The students will learn to estimate CBC, TLC, DLC, bleeding count, clotting time, ESR, X-ray, MRI, CT scan, ECG, ECHO, ultrasonography and PCB.

CO-4. The students are able to understand the life cycles of various bacterial, viral and fungal diseases like Dengue, Chickengunia, Covid-19, Swine flu, Tuberculosis and Candidiasis.

CO-5. The students will be learn about bioentrepreneurship in order to perform business and learn market strategy of healthcare products.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTL255

Fundamental of Bioinformatics

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. The aim of this course is to make students learn about Genome sequencing Projects, Various primary and secondary databases.
2. Students will have hands on practice for sequence alignment, Multiple sequence alignment, Multiple sequence alignment alignment, Phyllogenetic tree construction and analysis.
3. Students will learn about the fundamentals of computers and functioning of data storage devices such as primary and secondary storage devices.
4. Students will be able to understand the scoring matrices like PAM and BLOSUM and their uses in multiple sequence alignment.
5. Students will learn about various online platform of bioinformatics such as NCBI, EBI, DDBJ, Expasy, PUBMED, PDB, UNIPROT, Pfam and Prosite.

Course content

Section-A

Computers: General introduction to computers, organization of computers, Computer hardware and software. Data Storage Devices: Primary and secondary Storage devices. Input/Output Device: Key-tape/diskette devices, light pen mouse and joystick. Printed Output: Serial, line, page, printers; plotters, visual output; voice response units.

Section-B

Introduction to bioinformatics: History, Milestones and Applications, Local and Global alignments, Gap Penalities, Pairwise sequence alignments (Needleman-Wunsch, Smith-Watermann Algorithms), Significance of Sequence Alignment.

Section-C

Scoring Matrices: PAM, BLOSUM,
Multiple Sequence Alignment: Progressive Alignment, Iterative Alignment Methods,
Database Searching: BLAST and its types

Section-D

Primary and Secondary databases, Online resources of Bioinformatics: Introduction about: NCBI, EBI, DDBJ, Expasy, PUBMED, PDB, UNIPROT, Pfam, Prosite.

Books Recommended:

1. Norton's P. (2001). Introduction to Computing Fundamental. McGraw Hill Education, New Delhi.
2. Sinha P.K. (2001). Fundamental of Computers. BPB Publication, New Delhi.
3. Jin Xiong.(2006) Essential Bioinformatics. Cambridge University Press.

4. Baxevais B.F. and Quellette F. (2004). Bioinformatics a Practical Guide to the Analysis of Genes and Proteins. Wiley-Interscience

Course Outcome

CO-1. The students will be able to learn about the general introduction to computers and the organization of different parts of computers.

CO-2. The students will about the history, milestones and applications of bioinformatics.

CO-3. The students will learn the application of bioinformatic tool- BLAST and its applications in determining the structure and function of different biomolecules.

CO-4. The students will be able to examine the recent discoveries related to structure and functioning of biomolecules through use of different bioinformatics tools.

CO-5. The students will be learn about fundamentals of bioinformatics and will use this knowledge to explore recent discoveries in the field of biotechnology.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTP275

Fundamental of Bioinformatics Lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours

Note: The question paper will be set by the examiner based on the syllabus. Practical related to theory shall be carried out for this course.

Course Objectives

Students will learn Emergence, basics of biotechnology and scope of Biotechnology as a career.

1. Applications of Biotechnology in health care, agriculture, bioremediation and forensics.
2. The students will learn to use the different biotechnological tools to develop new drugs for the welfare of society.
3. The students will becomes familiar with entrepreneurship opportunities in Biotechnology and importance of IPRs in Biotechnology.
4. At the end students will learn role of Biotechnology in the Society and future of Biotechnology.

Course content

1. Ms-Office: word, Excel, Power-point
2. Introduction about Various Databases: NCBI, EMBL, UNIPROT, PUBMED
3. GenBank Format, FASTA format etc
4. Basic Local Alignment Search tools (BLAST)
5. Multiple Sequence Alignment using Clustal Omega
6. Prediction of Protein functional domain using PFAM/PROSITE

Course Outcome

CO-1. The students will be able to learn about the use of biotechnological
CO-2. The students will about the learn the
CO-3. The students will learn the application of bioinformatic tool- BLAST and its applications in determining the structure and function of different biomolecules.
CO-4. The students will be able to examine the recent discoveries related to structure and functioning of biomolecules through use of different bioinformatics tools.
CO-5. The students will be learn about fundamentals of bioinformatics and will use this knowledge to explore recent discoveries in the field of biotechnology.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTL256

Zoology-II

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives: The paper aims to

1.	Describe the theory of natural selection.
2.	Understand how species evolve.
3.	Describe origin of species on earth.
4.	Understand various pathogenic microbes and diseases caused by them, their occurrence and eradication programmes.
5.	Understand the life history, mode of infection and pathogenicity of pathogenic protozoans and helminthes.
6.	Study the life cycle and control measures of arthropod vectors of human disease.

Course content

Section–A

Origin of Life on Earth: Origin of earth and primitive earth conditions, Theories of origin of life (Theory of Extraterrestrial contact- Import of life through meteorites, Special creation theory, Oparin Haldane Theory, Abiogenesis , Evidences against theory of spontaneous generation of life, Biogenesis, Theory of chemical evolution, Miller & Urey Experiment).
Evolution of Prokaryotes and Eukaryotes (unicellularity to multicellularity).

Section–B

Evolution: Definition, Scope and History, Theories of Evolution (Lamarckism, Darwinism, Hugo de Vries and Modern theory of Evolution).
Geological time scale.

Section–C

Introduction to Parasitology (pertaining to various terminologies in use). Brief account of Life history, mode of infection and pathogenicity of the following pathogens with reference to man, prophylaxis and treatment.

Pathogenic Protozoans: Entamoeba, Trypanosoma, Giardia and Plasmodium.
Pathogenic Helminths: Tape Worm, Ascaris and Ancylostoma.

Section-D

Arthropod vectors of human diseases: Malaria, Yellow fever, Dengue haemorragic fever, Filariasis, Plague and Epidemic typhus. Distribution and control of the above mentioned vectors.

Books Recommended:

1. Garcia, L.S. (2001), Diagnostic Medical Parasitology, (4th ed), ASM Press Washington.
2. Panikar, C. K. and Ghosh Sougata. (2018). Textbook of Medical Parasitology (8th Edition), Jaypee Brothers Medical Publishers (Pl Ltd.), New Delhi.
3. Harrison A. (2000). Principles of Medicine.
4. Loker, Eric S. and Bruce V. Hofkin (2015). Parasitology: A Conceptual Approach, Garland Science, Taylor & Francis Group, New York and London.
5. Zimmer, C. 2000. Parasite Rex: Inside the Bizarre World of Nature's Most Dangerous Creatures, The Free Press, New York.

Course Outcomes

CO-1.	To develop an understanding of concept evolution & different proposed theories of evolution
CO-2.	To develop understanding of origin of life and concept of species and speciation
CO-3.	Study of Pathogenic protozoans, helminthes, their pathogenicity, prophylaxis & treatment.
CO-4.	Have insight into physiology, biochemistry, reproduction and control measures of insect vectors.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTP276

Zoology-II lab

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours

Note. The question paper will be set by the examiner based on the syllabus.

Course Objectives: The paper aims to

1.	Understand evolutionary phenomena: homology and analogy.
2.	Understand the skeleton of human.
3.	Study histology of man.
4.	Study permanent slides of parasitic protozoans, helminthes and arthropods.

Course content

1. Study of Evolutionary phenomenon with the help of charts / models /videos: Homology, Analogy and Mimicry.
2. Study of the skeleton of human.
3. Study of the following prepared slides: histology of man (compound tissues).
4. Study of following prepared slides/specimen :

   Pathogenic Protozoans: Entamoeba, Trypanosoma, Giardia and Plasmodium.

   Pathogenic Helminths: Tape Worm, Ascaris and Ancylostoma.

   Arthropod vectors of human diseases: Anopheles, Culex, Aedes Mosquitoes, Rat flea.

Books Recommended

1. Sobti, R.C. & Nigam, S.K. (2002). Structural & function biology of chordates, Vishal Publishers, Jalandhar.
2. Sobti, R.C. & Sharma, V.L. (2005). Basics of Biotechnology: Introduction of Life Sciences. Vishal Publishers, Jalandhar.
3. Sobti, R.C. (2005). Introduction to Biotechnology, Part-2, Concepts Tools and Application, Vishal Publishers.

Course Outcomes

CO-1.	Students will be able to understand various evolutionary phenomenon.
CO-2.	Students will be able to study the skeleton of man.
CO-3.	Students will be able to study the histology of man through permanent stained slides.
CO-4.	Students will be able to study the protozoans, parasitic helminthes , arthropods vectors of various diseases through permanent slides

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTP277
Industrial/Institutional Visit

Max. Marks: 20

Educational Tour & Written illustrated reports. Viva should be conducted by a panel of three internal examiners.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

ESL–222
ENVIRONMENTAL STUDIES–II (COMPULSORY)

Credit Hours (Per Week): 2
Total Hours : 30
Maximum Marks : 50 Marks

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections. Each unit of the syllabus should be given equal weightage of marks. Paper to be set in English, Punjabi and Hindi
Section–A: (16 Marks): It will consist of five short answer type questions. Candidates will be required to attempt four questions, each question carrying four marks. Answer to any of the questions should not exceed two pages.
Section–B: (24 Marks): It will consist of five questions. Candidates will be required to attempt four questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.
Section–C: (10 Marks): It will consist of two questions. Candidate will be required to attempt one question (carrying ten marks) only. Answer to the question should not exceed 5 pages.

Course Objectives

CO-1	To study the concept of Biodiversity – role, importance, values and its conservation. Hot spots and threats to biodiversity.
CO-2	To create awareness regarding environmental pollution, its causes and effects and preventive measure to control the different types of pollution.
CO-3	To make students aware of growing human population – causes and concern. Family welfare programs. Road safety (Traffic) rules.
CO-4	To know about entrepreneurship development and civil/self defense.

Course content

Unit-I

Biodiversity and its Conservation:

- Definition: Genetic, species and ecosystem diversity.
- Biogeographical classification of India.
- Value of Biodiversity: Consumptive use; productive use, social, ethical, aesthetic and option values.
- Biodiversity of global, National and local levels.
- India as mega-diversity nation.
- Hot-spots of biodiversity.
- Threats to Biodiversity: Habitat loss, poaching of wild life, man wildlife conflicts.
- Endangered and endemic species of India.
- Conservation of Biodiversity: In situ and Ex-situ conservation of biodiversity.

Unit-II

Environmental Pollution:

- Definition, causes, effects and control measures of:

a) Air Pollution
b) Water Pollution
c) Soil Pollution
d) Marine Pollution
e) Noise Pollution
f) Thermal Pollution
g) Nuclear Hazards
h) Electronic Waste

- Solid Waste Management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster Management: Floods, Earthquake, Cyclone and Landslides.

Unit-III

Human Population and the Environment

- Population growth, variation among nations.
- Population explosion-Family welfare programme.
- Environment and human health.
- Human rights.
- Value education.
- HIV/AIDS.
- Women and child welfare.
- Role of information technology in environment and human health.
- Case studies.
- Road Safety Rules & Regulations**:** Use of Safety Devices while Driving, Do's and Don'ts while Driving, Role of Citizens or Public Participation, Responsibilities of Public under Motor Vehicle Act, 1988, General Traffic Signs.
- Accident & First Aid**:** First Aid to Road Accident Victims, Calling Patrolling Police & Ambulance.

Unit-IV

National Service Scheme:

- **Entrepreneurship Development:** Definition & Meaning; Qualities of good entrepreneur; Steps/ ways in opening an enterprise; Role of financial and support service Institutions.
- **Civil/Self Defense:** Civil defense services, aims and objectives of civil defense; Needs for self-defense training.

Field Visits:

- Visit to a local area to document environmental assets–river/forest/grassland/hill/ mountain.
- Visit to a local polluted site–Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems–pond, river, hill slopes etc.
- Contribution of the student to NSS/any other social cause for service of society.

Note: In this section the students will be required to visit and write on the environment of an area / ecosystem/vi1lage industry/disaster/mine/dam/agriculture field/waste management/

hospital etc. with its salient features, limitations, their implications and suggestion for improvement.

Books Recommended

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Down to Earth, Centre for Science and Environment, New Delhi.
4. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.
5. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
6. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
7. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
8. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
9. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar
10. Kanta, S., 2012. Essentials of Environmental Studies, ABS Publications, Jalandhar.

Course Outcomes

CO-1	To know about the meaning of Biodiversity and its role in environment.
CO-2	To know about the causes of different forms of pollution and their control measures.
CO-3	To know about the causes and challenges of growing human population. Women and child welfare programs.
CO-4	To know the development of entrepreneurship and techniques of civil/self defense.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-501

rDNA Technology A

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objectives

1. To understand basic concept of recombinant DNA technology.
2. To acquire knowledge of basic tools and experiments performed in this subject.
3. To acquaint with the important vectors used in the cloning experiments.
4. Understand the probes and their synthesis.
5. To study basic blotting techniques and know their applications in rDNA Technology.

Course content

UNIT I

DNA Modifying enzymes: Ligases for blunt & sticky end ligation, DNA Polymerases, Klenow fragment, Alkaline phosphatase, Antarctic phosphatase, Polynucleotide kinase, Terminal deoxynucleotidyl transferase, Restriction enzymes, reverse transcriptase. RNase-H, DNase-I, Nuclease S-I

UNIT II

Cloning Vectors for E.coli: features of plasmids and development of plasmids as vector (α-complementation), lytic & lysogenic cycle in Lambda: bacteriophages as vector, Genetic selection (Hfl, Spi) and histochemical selection, genome composition of M13, Cosmids, Phagemids, fosmids.

UNIT III

Southern & Northern blotting, Hybridization, Merits and demerits of nitrocellulose and nylon membranes (N & N+). Methods of Transformation: $CaCl_2$, electroporation, transfection, micro

projectile.

UNIT IV

Labelling of DNA and RNA- Radioactive labeling (Nick Translation, Random Priming, End Labelling), Non-Radioactive labelling (Direct & Indirect non isotopic labeling), Detection systems of labeled probes

Course Outcomes

CO-1. The students will be competent to perform genetic manipulation experiments by learning basic and advanced techniques.

CO-2. The recombinant DNA technology course give emphasize to make students familiar with molecular biology in the context of the application of recombinant DNA technology in basic and applied research.

CO-3. The most fundamental outline of genetic engineering is to impart deep knowledge among students regarding mechanism of action and the use of restriction enzymes, different probes for specific genes of interest.

CO-4. Through this course, the students will have a wide scope of learning the key concepts in recombinant technology both from academic and industrial point of view.

CO-5. Students will learn about DNA-modifying enzymes, vectors, blotting methodologies and labelling of probes.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

rDNA Technology (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours
Note: The question paper will be set by the examiner based on the syllabus.
Course Objectives

1. To learn the prepration of reagents and buffers used in rDNA Technology.
2. To acquire the knowledge of basic chemicals involved, their applications and steps involved in the isolation of DNA.
3. To perform quantification and separation of isolated DNA.
4. To understand the concept of Restriction Digestion by performing it.

Course content

1. Growing of E.coli bacterial culture.

2. Isolation of genomic DNA from bacteria.

3. Spectrophotometric quantification of DNA and determination of purity.

4. Agarose Gel Electrophoresis.

5. Restriction enzyme digestion of the isolated DNA with 6, 5 and 4 cutters.

6. Agarose Gel Electrophoresis of the digested fragments.

Books Recommended

1. S.B. Primrose and R.M. Twyman; Principles of Gene Manipulation. 2006.
2. J. Sambrook and Michael R. Green; Molecular Cloning: A Laboratory Manual, (Fourth Edition), CSHL, 2012.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006

Course Outcomes

CO-1. To perform basic practicals in rDNA Technology and learn working at molecular level.
CO-2. Students get hands-on experience in growing E.coli and isolating its DNA.
CO-3. Students will get acquainted to the techniques used to estimate DNA qualitatively and quantitatively.
CO-4. Students will learn the concept of restriction enzymes by performing restriction enzyme digestion.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-502

Concepts of Plant Tissue Culture

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objectives

1. This course provides brief overview of plant nutrients, macronutrients, micronutrients and their deficiency symptoms.
2. Students will be able to know about plant tissue culture media components and their role in growth and development of plants.
3. Students will be able to gain fundamental knowledge about de-differentiation, re-differentiation and factors influencing plant tissue culture.
4. This course provides information about physiological functions and biosynthesis of major plant growth regulators.

Course content

Unit-I

Plant nutrition, macronutrients and micronutrients and their deficiency symptoms; Plant tissue culture media: types, components and their role.

Unit-II

Physiological functions and biosynthesis of major plant growth regulators such as auxins, cytokinins, gibberllins and abscisic acid.

Unit-III

Totipotency, factors affecting cellular totipotency **,** Cell differentiation, Dedifferentiation and redifferentiation of cells; tissue competency, plant-explant-plant concept. Factors influencing plant tissue culture: Genotypic, physiological, biochemical and other extrinsic factors.

Unit IV

Introduction to Methods of gene transfer - Direct (Biolistics) and indirect (agrobacterium mediated gene transfer)

Books:

1. Taiz, L. and Zeiger, E. (2002) Plant Physiology, 3rd Edition, Publisher: Sinauer Associates; 3rd edition (Aug. 30, 2002)
2. Razdan, M.K. (2003) Introduction to Plant tissue culture, Science Publishers
3. Bhojwani, S.S. and Razdan, M.K. (1996). Plant Tissue Culture. Theory and Practice, Elsevier.
4. Smith, R.H. (2000) Plant tissue culture: techniques and experiments, Gulf professional publishing

Course Outcomes

CO-1 The students will learn about nutrients required in culture media and various factors influencing the growth of explant inplant tissue culture.
CO-2 The students will learn about sterilization techniques in plant tissue culture laboratory.
CO-3 The students will learn about physiological functions and biosynthesis of major growth regulators in plants.
CO-4 The students will learn the concept of totipotency, cell differentiation, dedifferentiation and redifferentiation.
CO-5 This course will enable the students to learn the procedure for preparation of plant tissue culture media.
CO-6 The students will gain knowledge about different methods of gene transfer - Direct (Biolistics) and Indirect (agrobacterium mediated) gene transfer methods.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-502

Concepts of Plant Tissue Culture (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours
Note: The question paper will be set by the examiner based on the syllabus.

Course Objective

The objective of this practical course is to make

1. Students aware of the basic instrumentation of plant tissue culture laboratory (pH meter, autoclave, laminar air-flow, incubators, oven, distillation unit etc).
2. Make studnets aware of plant tissue laboratory design set up, cleaning of glassware, plasticware and contaminated cultures.Preparation of cotton plugs, learn different sterilization process
3. Students will learn the preparation of stock solutions of Murashige & Skoog (1962) medium and also learn to select, prepare, sterilize and inoculate explants

Course content

1. To study functions and operations of various instruments required for plant tissue culture (pH meter, autoclave, laminar air-flow, incubators, oven, distillation unit etc).
2. Laboratory design set up for a PTC Laboratory.
3. Cleaning of glassware, plasticware and contaminated cultures.
4. Different types of enclosure used in plant tissue culture. Preparation of cotton plugs.
5. Preparation of stock solutions of Murashige & Skoog (1962) medium.
6. Preparation of Murashige & Skoog's medium from stock solutions.
7. Different sterilization process (Instruments, glassware and thermolabile and thermostable components)
8. Selection, preparation, sterilization and inoculation of explants.

Course Outcomes

CO-1: The students willknow thefunctions and operations of various instruments in plant tissue culture laboratory.
CO-2: The students willbe able to know the design set up for a plant tissue culturelaboratory.
CO-3: The students willlearncleaning of glassware, plastic ware and contaminated cultures.
CO-4: The students willlearnabout different types of enclosure used in plant tissue cultures.

CO-5: The students willlearndifferent sterilization processes for instruments, glassware, thermolabile and thermostable components.

CO-6: The students will learn about preparation of stock solutions and media for plant tissue culture.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-503

Animal Tissue Culture

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objectives

1. To understand fundamentals of Animal Tissue culture and its need.
2. To acquire knowledge of establishing a primary cell culture and maintain cell lines.
3. To learn different medium used for the cell culture.
4. To be aware of problems encountered on Animal Tissue Culture and their troubleshot.

Course content

Unit-I

Historical background , Advantages & Disadvantages of animal tissue culture, Design and layout of ATC Lab, Equipments used in ATC Lab, Aseptic Techniques in ATC- Sterilization of culture media, glassware & tissue culture laboratory. Growth and viability of cells in culture, cryopreservation and retrieval of cells from frozen storage, transportation of cells. Characteristics of normal and transformed cells.

Unit- II

Contamination- sources, Types, monitoring and eradication of contamination, Cross Contamination. Safety considerations in ATC laboratory, Clean Environment – P1, P2, P3 facility and their applications.

Unit-III

Culture Media and Reagents-Types of cell culture media, physiochemical properties, balanced salt solution, constituents of serum, serum free media (SFM), design of SFM, Advantages and

disadvantages of serum supplemented and serum free media, conditioned media

Unit-IV

Primary culture and Established cell line Culture (Finite & continuous cell lines), Isolation of cells-Enzyme digestion, perfusion and mechanical disaggregation. Culture of attached cells and cells in suspension, phases of cell growth and determination of cell growth data (calculation of *in vitro* age, multiplication rate, population doubling time, cell counting, phases of cell cycle)

Books Recommended

1. Gareth, E.J. (1996), Human Cell Culture Protocols, Humara Press.
2. Butler, M. (1996), The Animal Cell Culture and Technology, IRL Oxford Univ. Press.
3. Julio, E., Celis (1998), Cell Biology-A laboratory hand book, Vol. I-IV, 2nd ed., Academic Press, New York.
4. Freshney, R, T. (2006), Culture of Animal Cells 5th ed., John Wiley and Sons, New York

Course Outcomes

CO-1. Develop basic aseptic skills for mammalian cell culture and their applications.
CO-2. Understand types of contamination and its effects
CO-3. Understand media constituents and media formulation strategies for mammalian cell culture.
CO-4. Develop proficiency in establishment of primary cell culture.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

Animal Tissue Culture (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours
Note: The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. To gain important skills like prepration of basic buffers and medium.
2. To learn the process of sterilization of Animal Tissue Culture medium.
3. To prepare cells for culturing.
4. To acquire knowledge of counting and estimating cell number in the culture.

Course content

1. Sterilization techniques: Theory and Practical

-Glass ware sterilization

-Media sterilization

-Laboratory Sterilization

2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium.
5. Isolation of lymphocytes for culturing and perform cell viability test.
6. Isolation of macrophages from blood for culturing

Book Recommended :

1. Freshney, R.T. (2006), Culture of Animal Cells. 5th ed., John Wiley and Sons, New Delhi.

Course Outcomes

CO-1. The course will focus on practical aspects of cell culture, like design and layout of the laboratory, aseptic technique, contamination, methods for measuring viability.
CO-2.Students will get the knowledge and hands on training on design and how to use the cell culture facilities.
CO-3. Students will get practical hands on how to determine viability count of cultured cells.
CO-4. Students will study and isolate lymphocytes for cell culture

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-504

PATENT LAWS IN BIOTECHNOLOGY

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objectives:

1. This course will look at the importance of patents in the world of biotechnology - and what you actually can patent.
2. It will introduce the students how to find existing patents is a crucial and necessary element to being able to assess whether your research should be protected or not.
3. It will cover biotech invention: Nature and Scope
4. Help in understanding the filing procedure, Claims and concept of Freedom to Operate in Biotech area.
5. It will introduce the students to the legal and ethical issues related to biotech patents and various national & international policies and management committees.

Course content

Unit-I

Introduction to Patent law. First Indian Patent Law and Amendments, History of Indian Patent System, Patentable and Non Patentable Inventions in India, Requirements and objectives of Patent, Patentable subject matter. Procedure for obtaining patent and patenting agencies in India.

Unit-II

Writing a patent, Formats of application and background information, Provisional and Complete Specifications, Types of patent applications, Life of a Patent, Rights of Patentee, Post Grant Opposition, Infringement of Patent, Patent Cooperation Treaty, Patent Offices in India, Sources of

Patent Information, Patent literature search.

Unit - III

Patenting in Biotechnology, economic and depository considerations, TRIPs articles relevant to Biotechnology Sector, Patenting Genes, Gene fragments, SNPs, Proteins and Stem cells, Patents related to Bacteria, Virus, Fungi and medicinal plants.

Unit IV

Ethical issues in Biotechnology, Types of risk associated with release of genetically modified microorganisms, Ecological impact, Biosafety, environmental and agricultural concerns, Ethics of Human cloning, reproduction and stem cell research, Legal aspects of patenting

Books:

1. Singh, I. and Kaur, B (2010) Patent law and Entrepreneurship, 3rd Edition, Kalyani Publishers

2. Singh, B.D. (2004). Biotechnology expanding horizons, Kalyani Publishers, New Delhi.

Course Outcomes

CO-1 This course presents the importance of intellectual property rights, patents laws and regulations, patent writing and ethical issues.

CO-2 Students will be familiarized with the principles, objectives and agreements of international organizations; WTO, WIPO

CO-3 Students will understand the significance of international policies and relations

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-505

BIOPROCESS ENGINEERING – A

Credit Hours: 3
Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objectives

1**.** Exploration of the fundamental principles of chemical and biochemical engineering.
2**.** In-depth studyof microbial growth kinetics, oxygen demand and supply for industrial bioreactors.
3**.** To know the effect of temperature, pH, inducer on product synthesis.
4. Understandingthe basic sterilization techniques anddesign of batch and continuous sterilization processes.

Course content

Unit-1

Introduction: Fundamental principles of Chemical Engineering and biochemical engineering. Fourier's Laws of heat transfer, Moleular diffusion, Diffusion theory, role of diffusion in bioprocessing**,** Oxygen transfer methodology in bioreactors and factors affecting oxygen transfer, Types of microbial culture: Batch, Fed batch and continuous culture.

Unit-II

Microbial Growth Kinetics : Simple kinetics of microbial growth, yield coefficient, doubling time, specific growth rate, substrate inhibition kinetics, product inhibition kinetics, metabolic and biomass productivities.

Unit-III

Internal & external feed back systems, effector molecules and its kinetics, Effect of temperature, pH and inducer on product synthesis.

Unit-IV

Sterilization: Introduction, air and media sterilizations, design of batch sterilization process, Del factor, sterilization cycle, continuous sterilization process, sterilization of fermenters.

Books Recommended

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (2001), Principles of Fermentation Technology 2nd ed., Pergamon Press, Oxford.
2. Young, M.Y. (2000), Comprehensive Biotechnology (Vol. 1-4), Pergamon Press, Oxford.
3. Young, M.Y. (1996), Environmental Biotechnology, Principles & Applications, Kluwer Academic Publications, New Delhi.
4. Bailary, J.E. and Ollis, D.F.,(1986), Biochemical Engineering Fundamentals, McGraw Hills, N.Y.
5. S.J. Pirt (1985), Principles of microbes and cell cultivations. Blackwell Scientific Publication, London.

Course Outcomes

Upon completion of this course, students will be able to:

CO-1. Apply engineering principles in determining and solving contemporary and complex problems related to bioprocessing.
CO-2. Apply mass and energy balances to calculate the concentration of different gases in the fermenter off-gas, amount of reactant used, amount of oxygen etc.
CO-3. Understandthe mathematical modelling/kinetics of microbial growth, product synthesis, oxygen transfer.
CO-4. Learn about the sterilizationcyclesfor batch and continuous processes.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BIOPROCESS ENGINEERING – A (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours
Note: The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. Determination of growth curve, specific growth rate, and generation time of microorganism
2. To learn about the sterilization methods of fermenter
3. To investigate the effect of different environmental parameters such as temperature, pH on the bacterial growth
4. Understanding the production process of enzymes in a bioreactor.

Course content

1. To study the growth curve of microorganism.
2. To determine the specific growth rate and generation time of a bacterium during submerged fermentation.
3. Demonstration of sterilization of fermenter and other accessories.
4. To study the effect of temperature, pH and aeration on growth of microbes.
5. Production of an enzyme in a Bioreactor/shaking flask.

Books Recommended

1. Cappuccino J.G., Sherman N. (2007). Microbiology: A laboratory (Pearson Benjamin Cummings).
2. Plummer D.T. (2004). An introduction to practical biochemistry (Tata McGraw Hill Publishers Co. Ltd., New Delhi).
3. Bansal, D.D., K Hardori, R., Gupta, M.M. (1985). Practical biochemistry (Standard Publication Chandigarh).

Course Outcomes

Upon completion of this course, students will be able to:

CO-1. Study the bacterial growth curve, specific growth rate and doubling time of bacteria
CO-2. Gain knowledge aboutthe ex–situ and in–situ methods of sterilization.
CO-3. Analyze various parameters such as temperature and pH for optimum growth of bacterial cultures.

CO-4. Learn about the production processof enzymes at industrial scale including the type of substrate, pH, temperature, dissolved oxygen concentration, required for the enzyme production.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-506 Biophysical and Biochemical Techniques-A

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objectives

The objectives of this course is to make students

1. To make students understand the basic concept of centrifugation, its types and applications, differnts rotors and their usage.
2. Elaborate the concept behind Chromatography, its types and applications.
3. To make students understand the principles of spectroscopy and working of NMR and ESR

Course content

Unit-I

Centrifugation: Basic principles of sedimentation, theory and applications of preparative and analytical centrifugation, Differential and density gradient centrifugation, Types of centrifugation machines and rotors, Sedimentation co-efficient, Factors affecting sedimentation coefficient, care of rotors.

Unit - II

Chromatography: Partition Coefficient, Theory and Principle of Paper and column chromatography, Two dimensional chromatography, gel exclusion chromatography, Principle and applications of paper, thin layer, ion-exchange and affinity chromatography.

Unit III

Gas Liquid Chromatography, High Performance Liquid chromatography, Fast Protein Liquid chromatography.

Unit IV

Spectroscopy: Basic Principle, Lambert Beer's law, Absorption spectrum, theory & principles of single and double beam UV/Visible spectroscopy, Basic Principle and instrumentation of NMR and ESR

Books:

1) Upadhyay, A., Upadhyay, K. and Nath N. (2005) Biophysical chemistry: Principles and Techniques. Himalaya Publishing House, India.
2) Wilson K. and Walker J. (Eds.) (1995). Practical Biochemistry: Principles and Techniques, Cambridge University Press, U.K.
3) Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd. , Chichester, England.
4) Freifelder, D. (1982). Physical Biochemistry. Applications to Biochemistry & Molecular Biology, W.H. Freeman & Co.

Course Outcomes

CO-1. Students will be able to identify and diffentiate working principle, instrumentation and applications of different bio- analytical instruments.
CO-2. The students will be able to understand the principle and working of different centrifugation techniques and will be able to apply this process in various analytical examinations related to biotechnology and healthcare.
CO-3. The students will understand the basic concepts of spectroscopy and its applications in healthcare and drug discovery.
CO-4. Students will be able to observe the biological behavior and physical properties of single protein or DNA molecules within a living cell and determine how the behavior of the single molecule influences the biological function of the organism.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

Biophysical and Biochemical Techniques (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours

Note: The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. To make students aware of the sedimentation patterns using swing out and angle rotor
2. Students will understand the principle behind biomolecule separation using paper chromatography
3. Understand the principle behind biomolecule separation using thin-layer chromatography
4. Students will learn and perform protein separation using ion-exchange and affinity chromatography

Course content

1. To study **s**edimentation using Swing Out Rotor and Angle Rotor.
2. To study separation of bio-molecules by paper chromatography.
3. To study separation of bio-molecules by thin layer chromatography.
4. Separation of proteins by ion-exchange column chromatography
5. Separation of proteins by affinity column chromatography.

Course Outcomes

CO-1. The students will get good knowledge about the different types of rotars and also learn about how and when to use particular types of rotars during centrifugation process.

CO-2. The separation of bio-molecules through paper chromatography will gives a good knowledge to students about the presence of various molecules in given sample.

CO-3. Through ion- exchange chromatography, students will be able to separate mixture of proteins in very less time.

CO-4. The use of affinity column chromatography will helps students to separate protein from given sample mixture and also to learn about affinity properties of particular

CO-5. These techniques will helps students to understand the biophysical and biochemical properties of different types of bio-molecules.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-507

Physical, Organic & Inorganic Aspects of Spectroscopy-A

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximumlength of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course objectives

This course leads to clearing the basics of spectroscopic techniques: UV and IR and spectral analysis.

Course content

UNIT – I

1. Energy and Electromagnetic Spectrum

Introduction, electromagnetic spectrum and Units, regions of the spectrum, basic features of different spectrometers, statement of Born-Oppenheimer approximation, degree of freedom, Frank Condon Principle, Fluorescence and Phosphorescence.

UNIT – II

II. Ultraviolet and Visible Spectroscopy

The energy of electronic excitation, measurement techniques, Beer-Lambert Law, Molar extinction coefficient. Different types of transition noticed in UV spectrum of organic functional groups and their relative energies. Chromophore, auxochromes, Absorption and intensity shifts, Transition probability. Factors affecting λ_{max} Effect of steric hindrance to coplanarity, Solvent Effects.

UNIT – III

III. Infrared Spectroscopy

Vibrational Energy Levels, Selection Rules, Force Constant, Fundamental Vibration Frequencies, Factors influencing Vibrational Frequencies (Vibrational Coupling, Hydrogen Bonding, Electronic effect, Bond Angles, Field Effect) of different functional groups. Sampling Techniques.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

UNIT – IV

IV. Applications of UV and IR Spectroscopy

Applications of UV spectroscopy, Woodward Fieser rules for calculating λ_{max} of conjugated polyenes and α,ß -unsaturated carbonyl compounds. Applications o f IR spectroscopy, Absorption of Common functional Groups, Interpretation of simple IR spectra, Finger print Regions. Simple numerical problems based on UV and IR spectroscopy.

Books Recommended:

1. Organic Spectroscopy By W. Kemp; Publisher- Palgrave, New York
2. D.H. Williams and I. Fleming. Spectroscopic Methods in Organic Chemistry.
3. Spectrometric Identification of Organic Compounds - R.M. Silverstein & F. X. Webster; Publisher: John Willey and Sons,Inc.
4. Introductory Problems in Spectroscopy- By R.C. Banks, E.R. Matjeha and G. Mercer; Publisher : The Benzamine / Cummings Publishing Company Inc.
5. Introduction to Spectroscopy – D. L. Pavia, G. M .Lampman, and G. S. Kriz Publisher: Brooks / Cole, a part of cengage learning

Course outcomes

1. The students would be able to analyze and interpret spectroscopic data collected by the methods discussed in the course.
2. This course would help students to solve problems related to the structure, purity and concentration of chemicals and to study molecular interactions by choosing suitable spectroscopic methods.
3. This is a key tool course for the students who want to pursue further research in synthetic chemistry.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

Physical, Organic & Inorganic Aspects of Spectroscopy-A

(Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note. The question paper will be set by the examiner based on the syllabus.

Course objectives

Focused on skill enhancement in the core chemistry with practical expert hands which will make students employable in academia and industries.

Course content

1. Record of IR spectra of diethyl ether, ethyl acetate and butanone and make its comparisons.

2. Synthesis and electronic spectral studies of d-d bands of $[Ni(NH)_3]Cl_2$ and $[Ni(en)_3]Cl_2$ complexes. A comparison of their electronic spectra with that of $[Ni(H2O)_6]Cl_2$ for the calculation of 10Dq values.

3. Covert cyclohexanone to cyclohexanol and hydrazine of cyclohexanone. Compare the UV-Vis and IR spectra of te products with that of the starting material.

4. Preparation of $[Fe(py)_4(NCS)_2]$ and its IR characterization.

5. Take a commercial sample of methyl orange and record its UV-Vis and florescence spectra under neutral, acidic and basic medium and make comparisions.

6. To verify Beer-Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of given $KMnO_4/K_2Cr_2O_7$

Course outcomes

1. This course would help students to solve problems related to the structure, purity and concentration of chemicals and to study molecular interactions by choosing suitable spectroscopic methods.
2. This is a key tool course for the students who want to pursue further research in synthetic chemistry.
3. The students would be able to analyze and interpret spectroscopic data collected by the methods discussed in the course.

BSC. (BIO-TECHNOLOGY) SEMESTER-V

BT-508
Term Paper **Max. Marks: 20**

(i) On recent advances in Life Sciences using Internet and library based resources. To be presented as hard Copy/CD/Floppy. Viva/ seminar should be conducted by a panel of three internal examiners.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-601

rDNA Technology-B

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objective

1. The course imparts knowledge of advanced vectors used in rDNA Technology.
2. Students learn the important technique of PCR and Microarray.
3. DNA sequencing lies at the heart of rDNA Technology , this subject will deliver knowledge of different sequencing experiments.

Course content

UNIT I

Cloning vectors for Eukaryotes (TAC, YAC, BAC, Ti & Ri plasmids), Expression Vectors pET280 , pGEX , role of promoter, cassettes and gene fusion, important components of shuttle vectors.

UNIT II

Overview of cloning, genomic cloning in (lambda) vector, cDNA cloning: Linker, Adapters, Different strategies for cDNA cloning- self priming and adaptor linker methods.

UNIT III

Principles & applications of PCR, Fundamental concepts & applications of microarray.

UNIT IV

DNA Sequencing: Sanger-Coulson method (chain terminating nucleotides), Maxam-

Gilbert method (chemical degradation of DNA), Changing genes: site directed mutagenesis, cassette mutagenes, single primer method, PCR methods of site directed mutagenesis, Phage & plasmid display: selection of mutant peptides.

Course Outcomes

CO-1. In this course students will acquire knowledge about Eukaryotic Cloning, expression vectors and construction of genomic and cDNA libraries.
CO-2. Students will get explored to techniques like PCR and microarray in relation to their application in medical and other fields.
CO-3. Detail study of DNA sequencing technique, phage and plasmid display
CO-4. This is courses that build up student's deep knowledge towards the modern approaches used in genetic engineering.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

rDNA Technology-B (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours
Note: The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. To learn problems encountered and their troubleshot during isolation of plasmid DNA.
2. To cut plasmid with enzymes so as to incorporate foreign DNA in the vector.
3. To carry out DNA transformation in the bacteria.

Course content

1. Isolation of plasmid DNA
2. Digestion of plasmid with three different restriction enzymes.
3. Preparation of competent cells
4. Transformation of competent cells by $CaCl_2$ method.
5. Confirmation of the transformants for the presence of plasmid.
6. Southern Blotting.

Books Recommended

1. S.B. Primrose and R.M. Twyman; Principles of Gene Manipulation. 2006.
2. J. Sambrook and Michael R. Green; Molecular Cloning: A Laboratory Manual, (Fourth Edition), CSHL, 2012.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006

Course Outcomes

CO-1. Students practically learn technique Plasmid isolation and agarose gel electrophoresis
CO-2. Students practice technique in recombinant DNA technology like restriction digestion.
CO-3. Students gets idea about transformation in bacterial cells and screening of transformants.
CO-4.Students will get hand-on training in performing Southern Blotting.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-602

Applications of Plant Tissue Culture

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objectives

1. The main objective of this course is to introduce the practices of plant tissue culture, genetic engineering and transgenic production of plants.
2. This course presents the applications of micro-propagation and somatic embryogenesis for the large scale propagation of plants.
3. Students will learn about somatic hybridization, cybridizationand production of secondary metabolites from plants.

Course content

Unit I

Micropropagation methods (axillary bud, shoot-tip and meristem culture), Stages of micropropagation, Factors affecting micropropagation and technical problems, Applications of micropropagation, Acclimatization of tissue culture raised plants. Modes of regeneration, Somatic embryogenesis and organogenesis, Types of somatic embryogenesis, Applications of somatic embryogenesis.

Unit II

Haploid and triploid plant production through tissue culture; ovary and ovule culture; embryo culture and rescuing hybrid embryos; somaclonal variations, selection of variant cell lines and its applications.

Unit-III

Protoplast isolation and culture, viability of protoplasts, protoplast fusion, selection of somatic hybrids and cybrids, applications of somatic cell hybridization.

Unit-IV

Cell suspension culture, production of secondary metabolites by plant tissue culture, immobilized plant cell culture, use of bioreactors in secondary metabolite production, transgenic approaches in secondary metabolite production.

Books Recommended

1. Bhajwani, S.S, & Razdan, M.K. (1996). Plant Tissue Culture. Theory and Practice, Elsevier.

2. Razdan, M.K. (2003) Introduction to Plant tissue culture, Science Publishers

3. Singh, B.D. (2004). Biotechnology expanding horizons, Kalyani Publishers, New Delhi.

Course Outcome

CO-1 The students will learn different modes of regeneration in plant tissue culture.
CO-2 The students will learn different procedures for micropropagation of plants.
CO-3 The students will gain knowledge about production of haploid and triploid plants using tissue culture techniques.
CO-4 The students will learn the technique of protoplast isolation, culture, fusion, selection of somatic hybrids and cybrids,
CO-5 The students will learn about cell suspension culture and production of secondary metabolites using tissue culture.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

Applications of Plant Tissue Culture (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours
Note: The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. Students will learn and perform micropropagation in lab
2. Students will learn the importance of growth hormones in plant culture medium and will induce callus formation from different explants in the lab.
3. Students will raise cell suspension cultures in lab and learn various explant culture techniques.

Course content

1. Micropropagation and its different steps.
2. Significance of growth hormones in culture medium.
3. Induction of callus from different explants.
4. To study regeneration of shoots/embryos.
5. Raising of cell suspension cultures.
6. Anther culture, ovary culture and embryo rescue.

Course Outcome

CO-1 The students will able to select, prepare, sterilize and inoculate the explants on culture medium.
CO-2 The students will able to micro-propagate plants from different explants.
CO-3 The students will be able to knowthe significance and role of growth hormones in plant tissue culture medium.
CO-4 The students will be able to induce callus from different explants.
CO-5 The students will be able to culture anther, ovary and embryos in laboratory.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-603

Animal Biotechnology

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objectives

1. To apply biotechnology in Animal Tissue culture.
2. To study various cell lines and their applications.
3. To understand the techniques involved in the transformation of Animal cells.
4. To know different application of Animal cell culture.

Course content

Unit- I

Commonly used animal cell line, their origin and characteristics (WI-38, MRC-5, IMR-90, TIG 1, HEK-293, 3T3, BHK21-C13, C7, CHO-K1, A-2790, A9, B16, HeLa, A 549), Differentiation of cells, organ culture

Unit- II

Transfection methods (calcium phosphate precipitation, DEAE-Dextran- mediated transfection, Lipofection, electroporation,Retroviral infection, Microinjection), Promoters, Expression vectors and detection of transgenics, need to express proteins in animal cells.

Unit- III

Applications: Cell fusion and production of monoclonal antibodies; scale up methods for propagation of anchorage dependent and suspension cell culture; Bioreactors for large scale culture of cells; micro carrier cultures; Stem cells-characterization of embryonic stem cells & their applications.

Unit-IV

Genetic Engineering in Animal Cells: Genetic engineering in production of regulatory proteins, blood products, vaccines and hormones; Transgenic animals (Mice, rabbit, Cattle, goat, sheep, pigs, Fish), Animal cloning- IVF & embryo transfer

Books Recommended

1. Butler, M. (1991), Mammalian Cell Biotechnology – A Practical Appproach, IRL, Oxford University Press.
2. Wolff, J.E.D. (1993): Gene Therapeutics Birkhuser
3. Rasko, I., and Downes, C.S. (1995). Genes in Medicine, Champan & Hall
4. Maulik, S. and Patel, S.D. (1997). Molecular Biotechnology Therapeutic Application and Strategies, John Wiley & Sons.

Course Outcome

CO-1. The course prepares students for the advance animal tissue culture and its applications.

CO-2.Students will get the knowledge of commonly employed cell lines.

CO-3. Variety of transfection methods including important vectors are thought.

CO-4. Students will study genetic engineering of Animal Cells and techniques of animal cloning.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

Animal Biotechnology (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours

Note: The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. To learn the principle behind isolation of DNA and RNA.
2. To quantify the isolated DNA.
3. To establish and maintain cell lines.

Course content

1. DNA isolation from blood
2. Spectrophotometric quantification of isolated DNA and calculating the yield.
3. Elution of DNA from Agarose Gel electrophoresis.
4. Isolation of RNA from blood.
5. Separation and purification of IgG antibodies from Serum using protein A column.
6. Maintenance of a cell line and check doubling time.

Book Recommended

1. Butler, M.C. (1991) Mammalian Cell Biotechnology. A practical approach. IRL, Oxford University Press.

Course Outcome

CO-1. Student will get hands-on experience in isolation of DNA and RNA from animal cells.
CO-2. Quantification of the DNA using spectrophotometer will be studied.
CO-3. Student will study the concept of affinity chromatograph through purification of IgG using protein A column.
CO-4. Student will learn estabilishment, subculturing and checking doubling time of a cell line.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-604 Intellectual Property Rights and Enterepreneurship

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objectives:

1. Introduction to different types of IPR.
2. It will help in the introduction of history of IPR in India, Benefits, Problems and Management of IPR.
3. To deal with Principles, objectives, structure and functions of various international organizations like WTO, WIPO, GATT, USPTO, TRIPS, TRIMS, MFN.
4. It will help in learning the bio-entrepreneurship Patentability of Biotech inventions

Course content

Unit I

Intellectual Property, Introduction to Intellectual Property Rights (IPR), History of IPR in India, Benefits, Problems and Management of IPR, Different forms of protection under IPR: Trade secret, Patents, Plant Breeder Rights and Copyright, Trademark and Geographical indications.

Unit II

Intellectual property and its legal protection in research, design and development, World Trade Organization and its related intellectual property provisions, General Agreement on Tariffs and Trade (GATT), Principles and objectives of GATT, Principles, objectives, structure and functions of WTO

Unit III

Trade related Investment Measures (TRIMs), Trade related aspects of IPR (TRIPS), TRIPS agreement, objectives and principles, Most Favored Nation (MFN) Principle, Berne convention, Budapest Treaty, International depository authorities, World Intellectual Property Organisation (WIPO)

Unit IV

Entrepreneurship, Characteristics of entrepreneur, Selection of a product line, design and development processes, Plant layout and design, Demand for a given product, Financing of Enterprise, Capital structure, Project inspection

Books:

1. Singh, I. and Kaur, B (2010) Patent law and Entrepreneurship, 3rd Edition, Kalyani publishers

2. Ahuja, V.K (2007) Law Relating to Intellectual Property Rights, 1st Edition

Course Outcomes

CO-1. Describe the different types of IPR.

CO-2. Explain the conditions of patentability for an invention.

CO-3. Describe the various stages involved in a patent application

CO-4. Deal with the bio-entrepreneurship Patentability of Biotech inventions.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-605 BIOPROCESS ENGINEERING – B

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objectives

1. To make students aware of the principles associated with production and processing at large scale in industrial setup
2. To impart students the knowledge about the design of fermenter, various batch cultures, bioreactors along with its kinetics
3. To bring in detail insights about the downstream processing at insustrsial level setup

Course content

Unit-1

Design of a Fermenter:

Introduction, fermenter for microbial, animal & plant cell culture, Aseptic operation of fermenter, impeller and spargers, batch, fed batch, C.S.T.B.R, plug flow and air loop bioreactors and its kinetics.

Unit-II

Control and measurement equipments of fermenter, pH & D.O. probes, Operation and agitation and its kinetics.

Unit-III

Down Stream Processing: Introduction, removal of microbial cells and other solid matters. Foam separation, filtration, industrial filters and its principles, centrifugation and industrial centrifuges, cell disruption, aqueous two phase extraction system, super critical fluid extraction, whole broth processing.

Unit-IV

Effluent treatment, aerobic and anaerobic slug treatment process, fermentation economics.

Course Outcomes

CO-1 Students will have gained knowledge about the design of different fermenters used for microbial, animal and plant cell cultures. They will have learnt about the fermenter operation, agitation and its kinetics
CO-2 Students will have learned about bioreactors and its kinetics
CO-3 Students will have learned about downstream processing in detail including microbial cell removal, foam separation, indutral filters and centrifugations, extraction systems , super critical fluid extraction,
CO-4 Students will have knowledge about slug treatment processes and economical importance of fermentation

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BIOPROCESS ENGINEERING – B (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20

Time: 3 Hours

Note: The question paper will be set by the examiner based on the syllabus.

Students will go for two week training in fermentation technology in industry/institute and the students will be required to submit written report of their training which will be evaluated by the teacher who has taught theory course.

Books Recommended

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (2001), Principles of Fermentation Technology 2nd ed., Pergamon Press, Oxford.
2. Young, M.Y. (2000), Comprehensive Biotechnology (Vol. 1-4), Pergamon Press, Oxford.
3. Young, M.Y. (1996), Environmental Biotechnology, Principles & Applications, Kluwer Academic Publications, New Delhi.
4. Bailary, J.E. and Ollis, D.F.,(1986), Biochemical Engineering Fundamentals, McGraw Hills, N.Y.
5. S.J. Pirt (1985), Principles of microbes and cell cultivations. Blackwell Scientific Publication, London.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-606

Biophysical and Biochemical Techniques- B

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course Objectives

1. To introduce the students to the concepts of Mass spectroscopy in detail and its practical applications.Also students will learn about fluorescence spectroscopy.
2. To clarify the fundamentals of agarose, SDS, capillary and 2D gel electrophoresis and their applications.
3. Students will gain knowledge on the concept of Geiger Muller tube, scintillation counters, primary and secondary flours and safety measures associated with radioactive studies.

Course content

UNIT-I

Mass spectroscopy: Ionization methods and Analyzers, MALDI TOF and MALDI Q, Applications of mass spectroscopy in biology for qualitative and quantitative determination of bio-molecules, Introduction to fluorescence spectroscopy

UNIT-II

Electrophoresis: Factors affecting electrophoretic mobility, Types of electrophoresis, Basic principle, theory and application of native, SDS-PAGE and Agarose Gel electrophoresis, Use of solubilizers in electrophoresis.

UNIT III

Introduction to IEF (Iso-electric focusing), Two dimensional gel electrophoresis and capillary electrophoresis, Applications of electrophoresis in biology for isolation of biomolecules based on charge and molecular weight.

UNIT-IV

Radioisotopic Techniques: Basic concepts of radioisotopy, theory and applications of Geiger-Muller tube, solid and liquid scintillation counters, primary and secondary flours. Safety rules for radioisotopic studies.

Course Outcomes

At the end of this course. Students will be:

CO-1. Able to run different electrophoretic gels such as native, SDS- PAGE, agaose gel and two dimensional gel electrophoresis.

CO-2. Able to understand the importance of solubilizers in electrophoretic processes.

CO-3. Able to apply the practical applications of electrophoresis at industrial set up.

CO-4. Able to understand the various safety rules for radioisotopic studies.

CO-5. Able to recall and relate the various concepts of radioactivity and their applications

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-606

Biophysical and Biochemical Techniques -B (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours
Note: The question paper will be set by the examiner based on the syllabus.

Course Objectives

1. Students will perform qualitative and quantitative estimation of DNA samples.
2. Students will learn the preparation of standard curve of DNA and protein sample.
3. Students will perform agarose and SDS gel electrophoresis and learn the basis of biomolecular separation.

Course content

1. Qualitative and quantitative analysis of DNA sample
2. Preparation of standard curve of protein
3. Preparation of standard curve of DNA.
4. Casting of vertical and horizontal gels for electrophoresis.
5. Separation of bio-molecules by vertical and horizontal gel electrophoresis

Books Recommended

1) Upadhyay, A., Upadhyay, K. and Nath N. (2005) Biophysical chemistry: Principles and Techniques. Himalaya Publishing House, India.
2) Wilson K. and Walker J. (Eds.) (1995). Practical Biochemistry : Principles and Techniques, Cambridge University Press, U.K.
3) Riley, T. and Tomilson, C. (1987). Principles of Electroanalytical Methods. John Wiley and Sons Ltd. , Chichester, England.
4) Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd. , Chichester, England.
5) Freifelder, D. (1982). Physical Biochemistry. Applications to Biochemistry & Molecular Biology, W.H. Freeman & Co.
6) Slater, R.J.(1990). Radioisotopes in Biology- A Practical Approach, Oxford University Press, NY.
7) Wilson, K and Goulding, K.H. (1991). Biologist's Guide to Principles and Techniques of Practical Biochemistry. 3rd., Edward Arnold, London.
8) Sawhney, S.K. and Singh, R. (2001). Introductory Practical Biochemistry, Narosa Publishing House, New Delhi.
9) Tinoco Kenneth Saur and J.C. Wang. Physical Chemistry: Principles and Applications in Biological Sciences, 3rd edition.

Course Outcomes

CO-1. Students will be able to quantify DNA using gel electrophoresis.

CO-2. Students will be able to perform protein estimation through Lowry's method and Bradford's method.

CO-3. Students will understand the various safety rules for radioisotopic studies.

CO-4. Students will be able to recall and relate the various concepts of radioactivity and their applications.

CO-5. Through use of these techniques, the students will have good knowledge about the properties of various types of bio-molecules and their uses in different areas of biotechnology.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-607: Physical, Organic & Inorganic Aspects of Spectroscopy-B

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Course objectives

This course leads to clearing the basics of NMR ans Mass spectrometry techniques, their applications and spectral analysis.

Course content

UNIT-I

I. Proton Magnetic Resonance spectroscopy (1H NMR)

The Nuclear spin, Larmor frequency, the NMR isotopes, population of nuclear spin level, spin and spin lattice relaxation. Measurement techniques (CW & FT method), solvent used.

Chemical shift, reference compounds, shielding constant, range of typical chemical Shifts simple application of chemical shifts, Anisotropic effect. Spin spin splitting, Coupling constant.

UNIT-II

II. Applications of NMR spectroscopy

NMR spectra with various examples such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene, o-, m-, p- anisidine, o-, m-, p- nitrophenols, acetophenone. Simple numerical of structure elucidation of NMR spectroscopic data.

UNIT- III

III. Mass Spectrometery

Basic Principles Elementary theory. Molecular ions, isotope ions, fragment ions of odd and even electron types, Nitrogen rule, Factors affecting cleavage patterns, simple cleavage, cleavages at a hetero atom, multicentre fragmentations, rearrangements, diels – alder fragmentation, Mc Lafferty rearrangement.

UNIT- IV

IV. Applications of Mass Spectroscopy

Cleavage associated with common functional groups , Aldehydes, ketones cyclic and acyclic esters, alcohols, olefins, aromatic compounds amines, Interpretation of the spectrum of unknown simple molecules.

Books Recommended:

1. Organic Spectroscopy By W. Kemp; Publisher- Palgrave, New York
2. D.H. Williams and I. Fleming. Spectroscopic Methods in Organic Chemistry.
3. Spectrometric Identification of Organic Compounds - R.M. Silverstein & F. X. Webster; Publisher: John Willey and Sons,Inc.
4. Introductory Problems in Spectroscopy- By R.C. Banks, E.R. Matjeha and G. Mercer; Publisher : The Benzamine / Cummings Publishing Company Inc.
5. Introduction to Spectroscopy – D. L. Pavia, G. M .Lampman, and G. S. Kriz Publisher: Brooks / Cole, a part of cengage learning

Course outcomes

1. Students will learn basic concepts of NMR spectroscopy.
2. They will be able to solve the problems related to 1H-NMR spectroscopy and interpret the 1H-NMR spectrum.
3. They will thoroughly learn basic concepts of Mass spectrometry

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

Physical, Organic & Inorganic Aspects of Spectroscopy-B Practical

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

Time: 3 Hours

Note. The question paper will be set by the examiner based on the syllabus.

Course objectives

This practical will enable them to learn about the practical skills for performing the chemical reactions and to monitor reaction with the help of thin layer chromatography. This will enable them to identify the compounds with the help of NMR and IR spectrometry.

Course content

1. Record the ^{1}H NMR spectra of ethyl acetate and ethyl acetoacetate (in $CDCl_3$ or CCl_4) and show the presence of the tautomeric structures.

2. Preparation of benzillic acid from benzaldehyde.(Green Chemistry Experiment)

3. Separation of components of spinach using column chromatography.

4. Prepare *p*-nitroacetanilde and make comparison of ^{1}H NMR spectral data of aniline, acetanlide(starting material) and *p*-nitroacetanide product.

5. Compare IR and ^{1}H NMR spectra of aspirin and salicyclic acid

Course outcomes

1. Students will thoroughly learn basic concepts of column chromatography

2. Students will learn basic concepts of spectroscopy techniques.

3. They will be able to solve the problems related to 1H-NMR spectroscopy and interpret the 1H-NMR spectrum.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-608

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20

Educational Tour & Written illustrated reports. Viva should be conducted by a panel of three internal examiners.

SYLLABUS

FOR

M. Sc.

BIOTECHNOLOGY

(Two years/Four semesters)

2020-21

Eligibility for M.Sc. Biotechnology:

Pass with 50% aggregate marks in Bachelor's degree (Medical and allied Medical Sciences / Bio Sciences) or equivalent or relevant higher qualification.

Semester-wise marks distribution/course hours:

S.No.	Semester	Marks	Course Hours
1.	**I**	**600**	**27**
2.	**II**	**625**	**30**
3.	**III**	**550**	**39**
4.	**IV**	**425**	**27**
	Grand Total	**2200**	**123**

M. Sc. Biotechnology – Semester-I

S. No.	Code	Title of Course	Marks		Total Marks	Periods/week		Total Periods /week	Course Hours
			Theory (75 + 25*)	Practical (19+6*)		Theory	Practical		
1	MBT101	Introductory Biomathematics and Biostatistics	100	-	100	6	-	6	4
2	MBT102	Cell Biology	100	25	125	6	4	10	6
3	MBT103	Molecular Biology	100	25	125	6	4	10	6
4	MBT104	Biochemistry	100	25	125	6	4	10	6
5	MBT105	General Microbiology, Microbial Physiology & Biotechnology	100	25	125	6	4	10	6
				Total Marks	**600**	**Total Periods**		**46**	**-**
						Course Hours		**-**	**28**

M. Sc. Biotechnology – Semester-II

S. No.	Code	Title of Course	Marks		Total Marks	Periods/week		Total Periods /week	Course Hours
			Theory (75 + 25*)	Practical (19+6*)		Theory	Practical		
1	MBT201	Environmental Biotechnology	100	25	125	6	4	10	6
2	MBT202	Enzymology and Enzyme Technology	100	25	125	6	4	10	6
3	MBT203	Biophysical and Biochemical Techniques	100	25	125	6	4	10	6
4	MBT204	Genetic Engineering	100	25	125	6	4	10	6
5	MBT205	Computer Applications & Data Analysis	100	25	125	6	4	10	6
				Total Marks	**625**	**Total Periods**		**50**	**-**
						Course Hours		**-**	**30**

***** denotes Internal Assessment

M. Sc. Biotechnology – Semester-III

S. No.	Code	Title of Course	Marks		Total Marks	Periods/week		Total Periods /week	Course Hours
			Theory (75 + 25*)	Practical (19 +6*)		Theory	Practical		
1	MBT301	Animal Tissue Culture & Animal Biotechnology	100	25	125	6	4	10	6
2	MBT302	Plant Tissue Culture & Plant Biotechnology	100	25	125	6	4	10	6
3	MBT303	Immunology	100	25	125	6	4	10	6
4	MBT304	Bioprocess Engineering and Technology	100	25	125	6	4	10	6
5	MBT305	Seminar	50**	-	50	2 Credit hours/Teacher			
				Total Marks	**550**	**Total Periods**		**40*** **	**-**
						Course Hours		**-**	**24*** **

*** Denotes internal assessment (MBT-301 to MBT-304)**
**** Denotes no internal assessment in the subject (MBT-305)**
*****Denotes additional 2 Credit hours/Teacher for MBT-305**

M. Sc. Biotechnology – Semester-IV

S. No.	Code	Title of Course	Marks		Total Marks	Periods/week		Total Periods /week	Course Hours
			Theory (75 + 25*)	Practical (19 +6*)		Theory	Practical		
1	MBT401A MBT401B	Genomics and Proteomics Or Introduction to Bioinformatics	100	-	100	6	-	6	4
2	MBT402A MBT402B MBT402C	Medical Biotechnology Or Advances in Plant Biotechnology Or Microbial Biotechnology	100	-	100	6	-	6	4
3	MBT403	Intellectual Property Rights, Bioethics and Biosafety	100	-	100	6	-	6	4
4	MBT404	Research Project	Thesis: Presentation/Viva:		75**	6 Credit hours/Teacher			
5	MBT405	Educational Tour/Industrial Visit	50	-	50**	-	-	-	-
				Total Marks	**425**	**Total Periods**		**18*** **	**-**
						Course Hours		**-**	**12*** **

*** Denotes internal assessment (MBT-401 to MBT-402)**
**** Denotes no internal assessment in the subject (MBT-404 to MBT-405)**
*****Denotes additional 6 Credit hours/Teacher for MBT-405**

M.Sc. Biotechnology (Semester – I)
MBT-101
Introductory Biomathematics and Biostatistics

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates
The question paper will consist of five sections A, B, C, D and E. Section-A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section-E will consist of 10 short answer type questions which cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E**.**

Course Objectives
1. To help the Students to solve Statistical problems using various measure of central tendency.
2. To enable the students to collect the data and present it diagrammatically.
3. To establish linear association between two variables by using Correlation.
4. To help the students to use regression to predict the behavior of dependent variable.
5. To use t, chi square, F and z tests to solve problems related to different types of data.

Course content

Unit – A

Binomial Theorem, Pascal rule and Pascal triangle. Scientific notation, significant digits, rounding off. Scientific notation, Sampling, problem identification, designing of experiment, factorial designs: full factorial design, fractional factorial design, concept of population and sample, random sampling, Data collection.

Unit-B

Measures of central tendency, mean, arithmetic mean, geometric mean & harmonic mean, medium, mode, quartile, deciles, percentile, dispersion, mean deviation, standard deviation, geometric standard deviation, standard error, coefficient of variation, variance, coefficient of determinant and coefficient of non-determinant, moments, distribution of data, skewness and kurtosis.

Unit-C

Pearson's correlation coefficient, linear correlation and regression, Effect of change of origin and scale on correlation -coefficient, Angle between regression lines, exponential curve. Power function, log-function, Partial correlation.

Unit-D

Probability, Addition and Multiplication law of Probability, Conditional Probability, Probability distribution function, Poisson distribution function, binomial distribution, , standard normal distribution, Testing of hypothesis, Null and alternative hypothesis, Type-I and Type-II errors, level of significance, two tailed and one tailed tests, Z-score, chi-square

(χ^2) test, student 't' test, 'F' test, student 't' distribution, chi square (χ^2) distribution, Analysis of variance, ANOVA-one way ANOVA and two way ANOVA.

Books Recommended

1) Kothari, C.R. (2004) Research Methodology Methods and Techniques, New Age International Publications, New Delhi

2) P.S.S. Sundar Rao, P.H. Richard, An Introduction to Biostatistics, Prentice Hall of India (P.) Ltd. New Delhi 2003.

3) Jerrold H. Zar, Biostatistical Analysis, Tan Prints (I) Pvt. Ltd., New Delhi, 2003.

Course Outcomes

CO-1 Student will learn to solve Statistical problems using various measure of central tendency.
CO-2 It will enable the students to collect the data and present it diagrammatically.
CO-3 Students will learn to establish linear association between two variables by using Correlation.
CO-4 Students will use regression to predict the behavior of dependent variable.
CO-5 Students will learn to use t, chi square, F and z tests to solve problems related to different types of data.

M. Sc. Biotechnology (Semester-I)
MBT 102
Cell Biology (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates
The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. To recall the history of cytology, distinguish the structure of prokaryotic and eukaryotic cell, and to learn about principles and working of various kinds of microscopes.
2. To know the fundamentals of cell division, cell cycle and its regulation.
3. In-depth study of different pathways of cell signalling.
4. Understanding the communications of cells with other cells and to the environment.

Course content

SECTION -A

History of cell biology: Development of cell theory and First cell, Evolution of metabolism
Diversity of cell size and shape: General organization of prokaryotic and eukaryotic cells,
Origin of cells: Assembly of macromolecules (proteins and nucleic acid), mechanism of assembly, evolutionary steps in the origin of cells (Chemical evolution).
Cell biology techniques: Microscopy-light, phase-contrast, fluorescence, confocal, scanning electron microscopy. Use of radioisotopes, cell culture, fractionation of cells contents.

SECTION -B

Cell motility: Cilia, flagella of eukaryotes and prokaryotes, their molecular mechanism
Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.
Regulators of cell cycle progression: MPF, families of cyclins and cyclin dependent kinases, Growth factors, cell cycle inhibitors.

SECTION -C

Cell signaling: Mechanism of signal transduction, Modes of cell signaling, steroid hormone receptors, G-protein coupled receptors, second messengers, c- AMP pathway of signal transduction ; c GMP, phospholipids and calcium ions , Ras, Raf , MAP kinase pathway , JAK –STAT pathway, bacterial and plant two component systems, bacterial chemotaxis and quorum sensing,

SECTION -D

Cellular communication: Extracellular matrix; Matrix structural proteins, Matrix polysaccharides, Adhesion proteins, cell-matrix interactions. Adhesion junctions, Tight junctions, Gap junctions

Protein Sorting and Transport : Targeting proteins to endoplasmic reticulum, Protein export from ER; Protein sorting and export from Golgi Apparatus, Mechanism of vesicular transport

Books Recommended

1) Smith, C.A. and Wood, E.J. (1993). Cell Biology: Molecular and Cell Biochemistry. Chapman & Hall, London.
2) Karp, G. (1999). Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons Inc., New York.
3) Pollard, T.D. and Ernshaw, W.C. (2002). Cell Biology. Elsevier Science (USA)
4) Becker, W.M., Kleinsmith, L.J. and Hardin, J. (2000). The World of the Cell. The Benjamin/Cummings Publishing Company.
5) Cooper, G.M. (2000). The Cell – A Molecular Approach. ASM Press, Washington, D.C.
6) Rastogi, S.C. (2005) Cell Biology, New Age International, pp. 532
7) Alberts, B., Bray, D., Hopkin, K., Johnson, A.D., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P (2009) Essential Cell Biology, Garland Science, pp 860

Course outcomes

Upon completion of this course, students will be able to:

CO-1. Understand the structureand purpose of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles. The students will get familiarized with basic principles of working of Microscopy.

CO-2. Gain knowledge about the cellular components underlying mitotic and meiotic cell division.

CO-3. Learnabout the phases of cell cycle and its regulation.

CO-4. Acquire knowledge about the mechanism of signal transduction, modes of cell signalling and various pathways involved in cell signalling.

CO-5. Describe the mechanism of cellular communication, protein sorting and its transportation across organelles.

M. Sc. Biotechnology (Semester-I)
MBT 102
Cell Biology (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course Objectives

1. Slide preparation andexamination of different cell types under microscope.
2. To examine different stages of cell division.
3. Staining techniques employed for different cell organelles.
4. In-depth knowledge of centrifugation and chromatography.

Course content

1. Microscopic examination of bacteria, yeast and plant cell
2. Preparation of permanent slides of eukaryotic and prokaryotic cell.
3. Study of different stages of mitosis and meiosis.
4. Staining and visualization of different cell organelles.
5. Instrumental methods for cell biology-centrifugation, chromatography.
6. Histochemical techniques.

Course outcomes

Upon completion of this course, students will be able to:

CO-1. Differentiate between eukaryotic and prokaryotic cell structure.
CO-2. Understand the structure and function of various cell organelles.
CO-3. Get familiarized with different phases of mitosis and meiosis.
CO-4. Perform different types of staining techniques employed in cell biology.
CO-5. Learn about various instrumental methods used in cell biology such as centrifugation, chromatography and microscopy.

M. Sc. Biotechnology (Semester-I)
MBT103
Molecular Biology (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates
The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. To understand heredity of life and basic makeup of genetic material.
2. To know the complete process of duplicating cells genetic material.
3. To understand how genotype is expressed in phenotype by learning the process of mRNA transcription and protein translation.
4. To understand the genes and their expression.

Course content

Section-A

DNA: the vehicle of inheritance, DNA replication, Repair and Recombination: Replication initiation, elongation and termination in prokaryotes & eukaryotes, enzymes and accessory proteins involved in DNA replication, Fidelity; DNA repair- photoreactivation, nucleotide and base excision repair, mismatch repair, SOS response, gene amplification, mobile genetic elements, nucleic acid hybridization – cot curves.

Section-B

Prokaryotic transcription; transcription unit, promoters: constitutive and inducible, initiation, termination- rho dependent and independent. Eukaryotic transcription, promoters for RNA polymerase I, II and III, transcription factors, regulatory elements & mechanism of transcription regulation, post-transcriptional modifications: processing of hnRNA, rRNA & tRNA; 5'cap formation, 3'-end processing, polyadenylation and splicing.

Section-C

Genetic code, prokaryotic & eukaryotic translation, the translation machinery, isoaccepting tRNA, wobble hypothesis, mechanism of initiation, elongation & termination, ribosome recycling factor, tm RNA, regulation of translation, co & post translation modification of proteins and intracellular protein targeting import into nucleus, mitochondria and peroxiome, non-ribosomal polypeptide synthesis, prions.

Section-D

Regulation of gene expression in prokaryotes and eukaryotes; (operon concept; lac, trp and ara operons), RNA interference, Viral & cellular oncogenes, tumor suppressor genes from humans, structure, function & mechanism of action of p53 tumor suppressor proteins, Molecular mechanism of antisense molecules, ribozymes, applications of antisense & ribozyme technologies.

Books Recommended

1. Rawn, J. D. (1989). Biochemistry, 2nd edition, Neil Patterson Publications, U. S. A. , North Carolina,
2. Damal, J., Lodish, H., and Baltimore, D. (1990). Molecular Cell Biology, 2nd ed., Scientific American Books, Distributed by W. H. Freeman and Co., New York.
3. Adams, R. L. P., Knowler, J. T., and Leader, D. P. (1992). The Biochemistry of Nucleic acids, 11th ed., Champman and Hall, The New York/London/Tokyo/Melbourne/Madras.
4. Stryer, L. (1995). Biochemistry, 4th ed., W. H. Freeman and Co., New York.
5. Nelson, D. L. & Cox, M. M. (2005). Lehninger Principles of Biochemistry, 4th ed., Worth Publishers, New York.
6. Watson J., Baker T., Bell S., Gann A, Levine M and Loscik R. (2008). Molecular Biology of the Gene. 6th Ed. Pearson Education.
7. Krebs J.E., Goldstein E.S. and Kilpatrick ST (2009), Lewin's Genes, Jones and Bartlett Publishers, U.K.
8. Michael R. Green, Joseph Sambrook (2012) Molecular Cloning: A Laboratory Manual (Fourth Edition): Three-volume set Cold Spring Harbor Laboratory Press
9. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick (2013) Molecular Biology of the Gene (7th Edition) Benjamin Cummings, Publishers.

Course outcomes

Upon completion of the unit the student shall be able to understand:

CO-1 Structure of DNA, DNA as genetic material and complete process of replication, transposition and recombination in prokaryotes and eukaryotes.
CO-2 Molecular Events of Transcription and processing of transcripts, RNA editing.
CO-3 Understanding the regulation of gene expression in prokaryotes using operon concept and Eukaryotes.
CO-4 Molecular Events of Translation leading to protein synthesis and Post translational modification.

M. Sc. Biotechnology (Semester-I)
MBT103
Molecular Biology (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course Objectives

1. To learn the prepration of reagents and buffers used in rDNA Technology.
2. To acquire the knowledge of basic chemicals involved, their applications and steps involved in the isolation of DNA from prokaryotes and Eukaryotes.
3. To perform quantification and separation of isolated DNA.
4. To understand the concept of Restriction Digestion and DNA ligation by performing it.

Course content

1. Isolation of genomic DNA from plant tissues.
2. Isolation of genomic DNA from *E. coli* cells.
3. Spectrophotometric analysis of DNA.
4. Restriction digestion of DNA.
5. Separation of digested fragments by agarose gel electrophoresis.
6. Transfer of resolved DNA fragments from agarose gel to nylon/nitrocellulose membrane.
7. Hybridization of nylon/nitrocellulose blots.

Books Recommended

1. Practical handbook of biochemistry and molecular biology (1989) by Gerald D. Fasman (CRC Press, Taylor and Francis Group).
2. Molecular cloning: A laboratory manual (2000) by J. Sambrook, E.F. Fritish and T. Maniatis (Cold Spring Harbor Laboratory Press, New York).
3. Michael R. Green, Joseph Sambrook (2012) Molecular Cloning: A Laboratory Manual (Fourth Edition): Three-volume set Cold Spring Harbor Laboratory Press, New York.

Course outcomes

CO-1. Students practically learn technique DNA isolation (bacterial and plant sample) and agarose gel electrophoresis
CO-2. Students practices various technique in recombinant DNA technology like restriction digestion and quantification of DNA.
CO-3. Students get idea about transformation in bacterial cells and screening of transformants.
CO-4. Students will get hand-on training in performing Southern Blotting.

M. Sc. Biotechnology (Semester-I)
MBT104
Biochemistry (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates
The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. To analyse, appreciate, understand the basic concepts of chemical reactions that occur in living systems, which enable them to understand the various perspectives of applied sciences that benefit the mankind.
2. To understand the concept of Biochemistry regarding BiomoleculesCarbohydrates, proteins, lipids, Nucleic acids.
3. Have knowledge of intermediary metabolism of the above & regulation of individual metabolism.
4. To inculcate the .overview of metabolite pathways: Glycolysis, citric acid cycle, oxidative phosphorylation, pentose phosphate pathway and gluconeogenesis and their regulation; photosynthesis

Course content

SECTION –A

Carbohydrates: Classification, characteristics and functions of monosaccharides, disaccharides- polysaccharides. Epimers, isomers, anomers, chiral carbon atom, chair and boat form, glucopyranose and fructopyranose.

SECTION –B

Amino acids & peptides: Classification, chemical reactions and physical properties
Proteins: Classification of proteins. Primary, Secondary (Alpha helix and beta pleated structure), Tertiary and Quaternary structures of proteins. Disulphide bridges, Ramachandran plot.

SECTION –C

Lipids: Definition and classification of lipids. Fatty acids- General formula, nomenclature and chemical properties structure, function and properties of simple, complex, acylglycerols, phosphoglycerides, sphingolipids, waxes, terpenes, steroids and prostaglandins.
Beta oxidation - Pathway and regulation. Role of acyl carnitine in fatty acyl transport. Synthesis of fatty acid - Structure and composition of fatty acid synthetase complex, pathway and regulation. synthesis of triacyl glycerides. Ketone bodies - Formation and utilization.

SECTION –D

Nucleic Acids: Structure of nucleoside, nucleotide. De novo and salvage pathways of nucleotide synthesis. Experimental evidence for nucleic acids as genetic material. Secondary

structure of DNA, Watson and Crick model of DNA. A, B and Z forms of DNA, T_m and its relation to GC content.

Overview of metabolite pathways: Glycolysis, citric acid cycle, oxidative phosphorylation, pentose phosphate pathway and gluconeogenesis and their regulation; photosynthesis.

Books Recommended

1. Stryer, L. (2012). Biochemistry: 7th Edition, W.H. Freeman and Company, New York
2. Lehninger, A.L., Nelson, D.L. and Lox, M.M. (2012). Principles of Biochemistry 6th Ed., W.H. Freeman and Company, New York
3. Moran, Horton, Scrimgeour & Perry (2011)Principles of Biochemistry, Prentice Hall.
4. Zubay, G.L., Parson. W.W. and Vance, D.E. (1995). Principles of Biochemistry: Student Study Art Notebook, Wm. C. Brown Publishers.
5. Rawn, J.D. (1989). Biochemistry, Neil Patterson Publishers.
6. Bucke C., (1999)), Carbohydrate Biotechnology Protocols, Humara Press.

Course outcomes

CO-1. The students will have a detailed understanding on the bio-molecules of life, their structure and function

CO-2. Students will be acquainted with the knowledge of structures, function, and interactions of proteins, nucleic acids, carbohydrates and lipids

CO-3. Students will be aware of basic biosynthetic and catabolic pathways for Carbohydrate, Lipid, Amino Acids and Nucleotide metabolism.

M. Sc. Biotechnology (Semester-I)
MBT104
Biochemistry (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course Objectives

1. To learn the Theory & Application of Buffers & pH.
2. To prepare various buffers: Phosphate buffer and Tris buffer for conducting experiment.
3. To learn the protocol of quantitation of sugars: Anthrone method and Bradford method.
4. To learn protein estimation by Lowry‟s method.
5. To determine the saponification and acid value of fat, Iodine number of fat & Separation of amino acids by TLC.

Course content

1. Theory & Application of Buffers & pH
2. Preparation of buffers: Phosphate buffer and Tris buffer
3. Quantitation of sugars: Anthrone method and Bradford method
4. Protein estimation: Lowry's method
5. Determination of saponification and acid value of fat.
6. Determination of Iodine number of fat.
7. Separation of amino acids by TLC.

Books Recommended

1. Singh, S.P. (2006) Practical manual of Biochemistry. 6th Edition, CBS publication.
2. Sawhney, S.K. and Randhir Singh (2001). Introductory Practical Biochemistry. Narosa Publishing House, New Delhi.
3. Plummer D.T. (1998). An Introduction of Practical Biochemistry, 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
Bansal, D.D., Khardori, R. & Gupta, M.M. (1985). Practical Biochemistry. Standard Publication, Chandigarh.

Course outcomes

CO-1. Have knowledge regarding the preparation of various buffers: Phosphate buffer and Tris buffer for conducting experiment.
CO-2. Develop skills of performing quantitation of sugars: Anthrone method and Bradford method.
CO-3. Possess the knowledge protein estimation by Lowry‟s method.
CO-4. Understand the process of saponification and acid value of fat, Iodine number of fat & Separation of amino acids by TLC.

M. Sc. Biotechnology (Semester-I)
MBT 105
General Microbiology, Microbial Physiology & Biotechnology (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates
The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. To give students insights about the principles and application of microscopy.
2. To make students aware about the concepts of pure culture techniques, sterilization techniques.
3. Students will learn about the prokaryotic cells and eukaryotic cells in detail at structural and molecular level. They will also learn about their growth curve patterns.
4. To give students detailed concept about bacterial classification and genetics, mechanisms of drug-resistance.
5. Students will also study about viral biology details pertaining to their characteristics, classification and life cycle.

Course content

Section – A

Principles of Microbiology: Principles and applications of bright field, dark field, phase contrast, fluorescence and scanning tunnelling microscopy.

Methods in Microbiology; pure culture techniques, theory and practice of sterilization, principles of microbial nutrition, microbial culture media, enrichment culture techniques, culture collection, culture purification and preservation methods.

Section-B

Prokaryotic cells: Organelle of microbes and their structure and functions. Cell wall types of Gram-positive and Gram-negative bacteria, capsules, Pili, Fimbriae, flagella. Classification of microorganisms based on their nutritional requirements. Sporulation and regeneration in bacteria. Brief comparison of archaea and eubacteria.

Section – C

Microbial Growth: Definition of growth, mathematical expression of growth, growth curve, diauxic and synchronous growth, effect of temperature, pH (acidity, basicity), oxygen and water availability on growth.

Virology: General characteristics , classicfication, ultrastructure of virus, viroids. Methods of isolation and purification of virus (T4,Mu, X174, M13 only). Lytic and lysogenic life cycles of virus.

Section- D

Bacterial Genetics: Recombination in bacteria, transformation, transduction, conjugation, plasmids; drug resistance in bacteria, transposons.

Bacterial classification: Bacterial classification according to Bergey's manual, 16S rRNA, % GC ratio, DNA-DNA homology, fatty acid analysis methods of classification.

Books Recommended

1. Damal. J, Lodish, H. and Baltimore, D. (2007). Molecular Cell Biology, 6th edition, Scientific American Books, Distributed by W.H. Freeman and Co., New York.
2. Lewin, B. (2007). Gene IX, 9th edition, Jones and Bartlett Publishers.
3. Lehninger, Nelson, D. L. & Cox, M. M. (2005). Lehninger Principles of Biochemistry, 4th ed., Worth Publishers, New York.
4. Freifelder, D. (2000). Microbial Genetics, Narosa Publishing House.
5. Watson,J.D., Baker,T.A, Bell,S.P., Gann,A., Levine,M., Losick,R. (2004). Molecular biology of the gene (5^{th} Ed.). Pearson Education (Singapore) Pvt. Ltd.
6. Chander,M, Puri, P. (2008). A Concise course in Microbiology. Krishna Publishing House. Pvt. Ltd.
7. Presscott, L.M., Harley, J.P. and Klein,D.A. (2011). Microbiology (6th Edition). McGraw Hill Inc.
8. Ronald, A.M. (1995). Principles of Microbiology. Mosby Year Book Inc. Missouri.
9. Pelczar, M.J., Chan, E.C.S., Kreig, N.R. (2010). Microbiology: Concepts and Applications. McGraw Hill, NY.
10. Tortora, G.J., Funke, B.R., Case, C.L. (2012). Microbiology an Introduction (11^{th} edition), Benzamin Cummins.

Course outcomes

At the end of the course

CO-1 Students will have detailed insights about the principles, working and application of different microscopes in microbiology.

CO-2 Students will be able to distinguish prokaryotic and eukaryotic cells based on morphological features and other key differences.

CO-3 Students will have knowledge about bacterial classification and concepts about bacterial replication.

CO-4 Students will be understand Virus life cycle, prokaryotic cells and their growth curve patterns.

M. Sc. Biotechnology (Semester-I)
MBT105
General Microbiology, Microbial Physiology & Biotechnology (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course Objectives

1. Students will learn to handle lab equipments and microscopes.
2. To provide students hands-on training to perform serial dilutions of bacterial samples and calculate CFU.
3. Students will perform bacterial and fungal DNA isolation and perform spectro-photometric analysis.
4. Students will perform the MIC test for antibiotic sensitivity of a bacterial strain against a specific antibiotic
5. Students will learn to test microbiological quality of potable water by MPN/MTFT method.
6. Students will learn to perform bacterial staining methods.

Course content

1. To study the morphology and structural characteristics of different bacteria and fungi using light microscope.
2. To perform serial dilution of the soil sample to isolate bacterial and fungal CFU.
3. To perform the Gram staining of given bacterial samples isolated in above experiment.
4. To evaluate the microbiological quality of potable water by MPN/MTFT method.
5. To isolate bacterial or fungal DNA and purify it by gel electrophoresis.
6. To test for the antibiotic sensitivity of the bacterial sample.
7. To perform the MIC test for antibiotic sensitivity of a bacterial strain against a specific antibiotic.
8. Preservation/cryopreservation of a microbial strain.

Books Recommended

1. Claus, W.G. and Claus, G.W. (1991). Understanding microbes: Laboratory Text Book for Microbiology, W.H. Freeman Company.
2. Benson, H.J. (1994). Microbiological Applications, 6th ed., Win, C. Brown Publishers, England.
3. Cappucino, J.G. (1999). Microbiology-A laboratory manual, 4th ed., Harlow, Addition-Wesley.

Course outcome

At the end of the course

CO-1. Students will be able to handle microscopes and be able to work on microorganisms.

CO-2 By performing serial dilutions of bacterial samples, students will learn the techniques of obtaining pure cultures in lab and practice sterilization techniques.

CO-3 Students will accomplish the testing of microbiological quality of potable water.

CO-4 Students will be able to perform antibiotic sensitivity of a bacterial strain using antibiotic discs.

CO-5 Students will be able to distinguish *E.coli*. bacterial strains using staining techniques.

M. Sc. Biotechnology (Semester-II)
MBT201
Environmental Biotechnology

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. To correlate the knowledge of fundamental Science's to explore types,, sources and impact of various types of pollution.
2. To make the pupils aware of the viral, fungal, bacterial and general disease.
3. The students made to learn all the techniques of analysing waste and use/study various techniques availed for treatment of these diseases?
4. The theoretical knowledge along with the practical work further strengthened by use and application of ultra-modern instrumentation in world class labs to give first hand practical knowledge of Environmental Biotechnology / Microbiology.
5. The students will be given knowledge about industrial, medical, municipal environmental pollution and use of physical, chemical and microbiological tools to treat that waste.

Course content

SECTION –A

Environmental Pollution and management: Types of pollution including electronic pollution, methods for the measurement of pollution, Air pollution and its control through Biotechnology; sources of water pollution, waste water treatment: physical, chemical and biological treatment processes. Microbiology of waste water treatments, aerobic and anaerobic process. Thin film techniques for waste water treatment using aquatic plants. Role of nanotechnology in environmental pollution control.

SECTION –B

Solid waste management with vermicomposting: Organic waste processing, composting, anaerobic digestion, vermiculture and vermicomposting, essential precautionary steps in vermicomposting, vermiculturing, vermiwash, overall benefits, economics and marketing.

Biomass production and Biofuels: Introduction, plant biomass, sources of biomass, forest biomass, crop residues (cereals, leguminous crops, sugar cane etc.) aquatic biomass, wastes as a source of energy, composition of plant biomass (cellulose, hemicellulose and lignins), biomass conversion, biological and non- biological processes, useful products biomass (ethyl alcohol, methanol, methane), Application and future prospects, Recent trends in biofuel research.

SECTION –C

Biological nitrogen fixation and biofertilizer:The range of nitrogen fixing organisms, biochemistry of nitrogenase, genetics of nitrogen fixation, regulation of *nif* gene expression, symbiotic nitrogen fixation, genetic analysis of *Rhizobium* bacteria, regulation of nod gene expression, transfer of *nif* genes from *Klebsiella pneumoniae* to other organisms, application and future prospects. green manuring, the blue green algae, algalization,*Azolla*, present status and improvements.

SECTION –D

Bioremediation: Types of bioremediation, use of fungi, algae and bacteria in biosorption, ecological considerations, biodegradation of oil spills, surfactants, TNT wastes, dye stuff wastes, insecticides, herbicides, antibiotics. plastic menace, biodegradable plastics, volatile toxic gases and biofiltration.

Books Recommended

1. Manahan, S. E. (2000), Environmental Science and Technology, Lewis Publishers, New York.
2. Anderson, D. & Conning, D.M. (1984). Experimental Toxicology, Royal Society of Chemistry.
3. Abbasi, S.A., and Ramasami, E. (1999). Biotechnological Methods of Pollution Control. Universities Press, Hyderabad.
4. Alexander, M.(1999). Biodegradation and Bioremediation. Acadamic Press, San Diego.
5. David, T.G. (1984). Microbial Degradation of Organic Compounds, Marcel Dekkar Inc., New York.
6. Omenn, G.E. (1987). Environmental Biotechnology, Plenum Press, New York.
7. Rittmann, D.E., McCarty, P.L. (2001). Environmental Biotechnology: Principles and Applications. McGraw Hill, New York.

Course outcome

CO-1. Students will learn about management of waste water environmental pollution, solid waste with vermicomposting.

CO-2. Students will learn about applications of Biomass production, mechanisms of nitrogen fixation and applications of Biofuels, Bioremediation.

CO-3. Students will be able to determine the quality of portable water, perform BOD/COD, study techniques of vermicomposting, Bioremediation and enrichment culture technique.

CO-4. Students will be able to compare and use various types of bioremediation technologies to treat different types of pollutants.

M. Sc. Biotechnology (Semester-II)
MBT-201
Environmental Biotechnology (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course Objectives

1. To correlate the theoretical knowledge of Environmental Biotechnology to experiment various ideas and protocols for treatment of various types of pollution.
2. To make the pupils aware of diagnostic environmental engineering.
3. The students made to learn all the techniques of analysing waste and use/study various techniques availed for treatment of these wastes.
4. The practical work by applying experimentation like BOD, COD, Bioreactor studies, Vermicomposting in world class labs to give first hand practical knowledge of Environmental Biotechnology.
5. The students will be given knowledge about industrial, medical, municipal environmental pollution and use of physical, chemical and microbiological tools to treat that waste.

Course content

1. Determination of potable water quality in terms of coliforms, *Enterobacter*, *Shigella*, *Salmonella* qualitative assay.
2. Determination of BOD of given water/wastewater sample.
3. Determination of COD of given water/wastewater sample.
4. Isolation of *Rhizobium* from root nodule and mass cultivation.
5. Study the technique of vermicomposting.
6. Bioremediation of dyes using different fungi strains from soil.
7. Isolation of xenobiotic degrading microbes by enrichment culture technique.

Course Outcome

CO-1 Students will practically learn waste management and remediation.
CO-2. Students will learn about applications of Biomass production, mechanisms of nitrogen fixation and applications of Biofuels.
CO-3. Students will be able to determine the quality of portable water, perform BOD/COD, study techniques of vermicomposting,
CO-4. Students will be able to compare and use various types of bioremediation technologies to treat different types of pollutants.
CO–5. The students are perfectly ready for jobs of Environmental Biotechnologists in Pollution Control Boards, Effluent Treatment Plants, Municipal Solid Waste disposal Plants etc.
CO-6. The students may become an entrepreneur in field of Environmental Pollution Control Consultant, owning of Bio-compost manufacturing unit or vermi-compost production industry.

M. Sc. Biotechnology (Semester-II)
MBT 202
Enzymology and Enzyme Technology (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

Course contents are designed to enable students to learn:

1. Understand Classification, nomenclature of enzymes, coenzymes, energetics and theories of enzyme catalysis along with extraction from natural sources.
2. Learn the mathematical kinetics of enzymatic conversions, various inhibitory mechanisms
3. Brief account of Mechanisms of enzyme action, activity regulation, isoenzymes, ribozymes.
4. Knowledge about enzymes immobilization techniques, Allosteric, product inhibition, Lipid-protein interactions in membrane bound enzymes.

Course content

SECTION -A

Classification and nomenclature of enzymes, enzyme properties and denaturation; Energetics of enzyme catalyzed reactions, transition state; Mechanism of enzyme action; Regulation of enzyme activity; Isoenzymes, co-factors and co-enzyme, Concept of active centre, binding sites, stereospecificity and ES complex formation, activation energy and transition state theory. Effect of temperature, pH and substrate concentration on reaction rate. Extraction, and purification of enzymes.

SECTION -B

Basic aspects of Enzyme Kinetics: Pre-steady state kinetics. Michaelis-Menten, Line Weaver-Burke, Eadie-Hofstee and Hanes-Woolf equations and Km value.
Enzyme inhibitors: Types of inhibitors–Reversible and irreversible, their mode of action.
Enzyme activity, international units, specific activity, turnover number.

SECTION -C

Regulation of enzyme activity and concentration: Brief account of enzyme induction and repression, covalent modification, isoenzymes and allostery, ribozymes and abzyme.
Enzyme specificity, Enzyme substrate complex. Nueleophilic and electrophilic attack. Role of metal ions in enzyme catalysis. Mechanism of enzyme action : Lysozyme, Chymotrypsin, zymogens and enzyme activation.

SECTION -D

Allosteric interactions and product inhibition. Membrane bound Enzymes- Lipid-protein interaction and Effect of fluidity on enzyme activity. Immobilization of Enzymes: Techniques of immobilization, Properties and applications of immobilized enzymes.

Books Recommended

1) Principles of Biochemistry, AL. Lehninger, D.L. Nelson and M. M. Cox. 1993. Worth Publishers, New York.
2) Palmer, T. (2001). Enzymes. Horwood Publishing, Chichester
3) Methods in enzymology Vol.185 (1990) Gene Expression technology edited by D.V. Goeddel (Academic Press Inc. San Diego).
4) Enzymes: biochemistry, biotechnology and clinical chemistry (2001) by Trevor Palmer (Horwood).
5) Fundamentals of enzymology: The cell and molecular biology of catalytic proteins (2003) by Nicholas C. Price, Lewis Stevens, Lewis Stevens published (Oxford University Press, USA).
6) Principles and reactions of protein extraction, purification, and characterization (2004) edited by Hafiz Ahmed PhD (CRC, Taylor Francis Group).
7) Shultz, A.R. (1994). Enzyme Kinetics, Cambridge Press.
8) Trevor, P. (1995). Understanding Enzymes, 4th ed. Prentice Hall/Ellis Horwood, England.
9) Engel, P.C. (1996). Enzymology Labfax, Bios Scientific Publisher, Academic Press, U.K.
10) Price, N.C. and Strevens, L. (1999). Fundamentals of Enzymology, 3rd ed., Oxford University Press.
11) Bisswanger, H. (2013) Practical Enzymology, Willey BlackWell

Course Outcome:

Upon completion of this course, students will be able to:

1. Learn about international Classification and nomenclature along with concepts, mechanisms involved in catalysis and extraction, purification techniques of enzymes.
2. Learn different mathematical models involved in enzymatic reaction kinetics along with different types of inhibitors.
3. Deeply understand the regulatory mechanisms including induction, repression, covalent modification, along with different types of catalysis as well.
4. Acquire apprehension about Membrane bound Enzymes, immobilization techniques and industrial applications.

M. Sc. Biotechnology (Semester-II)
MBT 202
Enzymology and Enzyme Technology (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course objectives

Course contents are designed to enable students to

1. Understand the location of enzyme with in the cell and procedures for its removal.
2. Know inside out of parameters affecting enzymatic reactions.
3. Acquire skills in performing enzymatic investigations.
4. Learn how enzymes are fixed to solid supports for their repeated use in reaction mixture.

Course content

1. Extraction and purification of enzymes.
2. Effect of pH on enzyme activity.
3. Effect of temperature on enzyme activity.
4. The effect of enzyme concentration on the rate of enzyme catalyzed reaction.
5. Effect of substrate concentration on enzyme activity and demonstration of the Km and Vmax of the reaction.
6. Immobilization of enzymes.

Course outcome

CO-1. Students learn aboutthe extraction of enzyme from natural source along with its further purification in the laboratory by salt fractionation and dialysis techniques.

CO-2. Students learn about the effect of proton or hydroxyl concentrationon theenzymatic activityleading to determination pH optima of an enzyme.

CO-3. Laboratory outcome includes learning of effect of temperature on theenzymatic activityleading to determination temperature optima of a particular enzyme.

CO-2. Students learn about the effect of increasing enzyme concentrationon therate of enzyme catalysed reaction.

CO-4. Students learn about the dependence of reaction rates of enzyme catalysed reaction on thesubstrate concentrationand further estimation of Michalis constant Km and by estimating the maximum velocity of the reaction.

CO-5. Students learnthe technique to immobilise the enzyme for repeated use in reaction mixture.

M. Sc. Biotechnology (Semester-II)

MBT 203

Biophysical and Biochemical Techniques (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course objectives

1. To make students aware of principle, theory and applications of microscopic, chromatographic, spectroscopic, radio isotopic and electrophoretic techniques.
2. Students will learn about radio isotopes and radiolabeling techniques.
3. Studies will learn about qualitative and quantitative determination of biomolecules in different samples using different techniques

Course content

SECTION –A

Principles and application of light, phase contrast, fluorescence scanning and transmission electron microscopy, cytophotometry and flow cytometry, fixation and staining.
Centrifugation: Types of centrifuges and centrifugation, rotors and applications, ultracentrifuge-Analytical and preparative.

SECTION –B

Principles and techniques of nucleic acid: hybridisation and Cot curves; Sequencing of proteins and nucleic acids; Southern, Northern and South Western blotting techniques; Polymerase chain reaction. Principles and applications of gel filteration, ion-exchange and affinity chromatography, thin layer and gas chromatography, high pressure liquid (HPLC) chromatography

SECTION –C

Principles of biophysical methods used for analysis of biopolymeric structure, X-ray diffraction fluorescence UV/CD, visible NMR and ESR spectroscopy, hydrodynamic methods, Atomic absorption and plasma emission spectroscopy. Theory and application of Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis

SECTION –D

Radioactive & stable isotopes; Pattern and rate of radioactive decay; Units of radioactivity; Measurement of radioactivity; Geiger-Muller counter; Solid & Liquid scintillation counters (Basic principle, instrumentation & technique); Brief idea of radiation dosimetry; Cerenkov

radiation; Autoradiography; Measurement of stable isotopes; Falling drop method; Applications of isotopes in biochemistry; Radiotracer techniques

Books Recommended

1) Wilson K. and Walker J. (Eds.) (1995). Practical Biochemistry : Principles and Techniques, Cambridge University Press, U.K.
2) Riley, T. and Tomilson, C. (1987). Principles of Electroanalytical Methods. John Wiley and Sons Ltd. , Chichester, England.
3) Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd. , Chichester, England.
4) Cooper, T.G (1977). The Tools of Biochemistry, John Wiley & Sons, N.Y.
5) Freifelder, D. (1982). Physical Biochemistry. Applications to Biochemistry & Molecular Biology, W.H. Freeman & Co.
6) Sadasivam, S. and Manickam, A. (1992). Biochemical Methods for Agricultural Sciences, Wiley Eastern Limited, New Delhi.
7) Sawhney, S.K. and Singh, R. (2001). Introductory Practical Biochemistry. Narosa Pub.House, New Delhi.
8) Plummer, D.T. (1990). An Introduction to Practical Biochemistry 3rd ed. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
9) Rana, S.V.S (2008) Bio-Techniques, Rastogi publications

Course outcome

CO-1 The course will help students to learn the basic instrumentation, principle and procedure of various sophisticated instruments like electron microscope, fluorescence microscope, UV-VIS spectrophotometer, gas chromatography, NMR and ESR spectroscopy.

CO-2 The students will get theoretical knowledge of various instruments and their practical applications like Geiger-Muller counter, liquid scintillation counter, autoradiography and X-ray crystallography

CO-3 The students will learn about centrifugation, electrophoresis, polymerase chain reaction and blotting techniques.

CO-4 This course will enable the students to implement these techniques in biological research and in discovering new products/compounds.

M. Sc. Biotechnology (Semester-II)
MBT 203
Biophysical and Biochemical Techniques (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course Objectives

1. Students will learn about the principle and methodology for the isolation of DNA and protein from biological samples
2. Students will learn to estimate DNA and protein by gel electrophoresis and spectrophotometric methods
3. Students will learn the preparation of protein standard curve
4. Students will perform chromatographic techniques *viz* Ion exchange, affinity chromatography, thin layer chromatography and gel permeation chromatography.

Course content

1. Isolation of DNA and protein from biological samples.
2. Estimation of DNA and protein by Spectrophotometer
3. Preparation of standard curve of protein by Bradford method.
4. Electrophoresis of proteins-Native and denaturing PAGE.
5. Ion exchange chromatography of proteins.
6. Affinity chromatography of proteins
7. Thin layer chromatography of biomolecules.
8. Gel permeation chromatography

Course Outcome

CO-1 The students will be able to isolate and estimate DNA and proteinfrom biological samples.

CO-2 The students will be able to separate sample components using TLC, ion exchange, affinity and gel permeationchromatography.

CO-3 The students will be able to separate proteins usingelectrophoresis (Native and SDS-PAGE)

M. Sc. Biotechnology (Semester-II)
MBT204
Genetic Engineering (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E.Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all.Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. The aim of this core-course is to acquaint the students to versatile tools and techniques employed in genetic engineering.
2. This course provides theoretical bases to properties and applications of versatile DNA modifying enzymes, cloning strategies, vector types, host genotype specificities for selection and screening of recombinants and/or recombinant transformants.
3. Students will also be introduced to prominent nucleic acid labeling techniques. Introduction to various types of vectors viz. cloning, transformation, expression; and also vectors for genomic and cDNA library and whole genome sequencing will be provided.
4. A critical appraisal of methods for Polymerase Chain reaction and site-directed mutagenesis and sequencing of cloned genomic fragments will also be covered.

Course content

Section-A

Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotidekinase, Alkaline phosphatase; Cohesive and blunt end ligation; Labeling of DNA: Nicktranslation, Random priming, Radioactive and non-radioactive probes (digoxigenin andbiotin), Cloning vectors: Plasmids,M13, phagemids, insertion and replacement lambda vectors

Section-B

Cloning vectors: Cosmids, Artificial chromosome vectors (YACs; BACs); yeast vectors,Expression vectors: principle of recombinant protein expression as His- and GST-tags by cloningin pET and pGEX; Expression strategies for heterologous genes: codon optimization, Hosts:expression in bacteria and yeast, Inclusion bodies; Methodologies to reduce formation ofinclusion bodies,siRNA technology, Gene Editing (CRISPR-Cas)

Section-C

Linkers; Adaptors; Homopolymeric tailing, strategies for making cDNA libraries;Colony Hybridization, Transformation; Northern and Southern, hybridization, cloning differentially expressed genes(mRNA differential display and subtractive cloning). DNA-Protein Interactions (Electromobilityshift assay)

Section-D

PCR and Its Applications: Primer design; DNA polymerases (Taq & Pfu); Types of PCR – multiplex, nested, reversetranscriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCRproducts, Site specific mutagenesis by PCR, Splice Overlap Extension (SOE)- PCR

Books Recommended:

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition,S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL,2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.

Course outcome

CO-1. Students practically learn technique DNA isolation (bacterial and plant sample) and agarose gel electrophoresis

CO-2. Students practices various technique in recombinant DNA technology like restriction digestion and quantification of DNA.

CO-3. Students get idea about transformation in bacterial cells and screening of transformants.

CO-4.Students will get hand-on training in performing Southern Blotting.

M. Sc. Biotechnology (Semester-II)
MBT204
Genetic Engineering (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course Objectives

1. To learn problems encountered and their troubleshot during isolation of plasmid DNA.
2. To cut plasmid with enzymes so as to incorporate foreign DNA in the vector.
3. To carry out DNA transformation in the bacteria and identify the transormants.
4. To perform southern blotting to identify DNA fragment of interest.

Course content

1. Isolation of plasmid DNA from *E. coli* cells
2. Qualitative analysis of plasmid DNA
3. Quantitative analysis of plasmid DNA
4. Making competent cells of *E.coli*.
5. Transformation of competent *E.coli* cells.
6. Ligation of DNA with T4 DNA ligase
7. Isolation of total RNA.
8. Polymerase Chain Reaction

Books Recommended

1. Practical handbook of biochemistry and molecular biology (1989) byGerald D. Fasman (CRC Press, Taylor and Francis Group).
2. Molecular cloning: A laboratory manual (2000) by J. Sambrook, E.F.Fritish and T. Maniatis (Cold Spring Harbor Laboratory Press, NewYork).
3. Michael R. Green, Joseph Sambrook (2012) Molecular Cloning: A Laboratory Manual (Fourth Edition): Three-volume setCold Spring Harbor Laboratory Press, New York.

Course outcome

After completion of this course, students should be able

CO-1. To gain hands on experience in gene isolation, cloning and amplification.
CO-2. To get expertise in isolation of plasmids, cloning of gene, transformation into suitable bacteria for selection of recombinant clones and to learn gene cloning in an expression vector.
CO-3. To conduct gene amplification experiments by PCR analysis and to isolate RNA for cDNA synthesis.
CO-4. This practical experience would enable them to begin a career in biotech as well as pharmaceutical industry that engages in genetic engineering.

M. Sc. Biotechnology (Semester- II)
MBT205
Computer Applications & Data Analysis (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instruction for paper setters and candidates

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives

1. To introduce students with programming in C , learn various program operators, statements and its types , functions in C
2. Students will learn about arrays ,data sorting
3. Learn about SPSS processor, its working statistical data representation and hypothesis testing
4. Students will learn the regression analysis, T-test, ANOVA, parameteric and non-parametric test for data

Course content

Section-A

Introduction to programming in C, Overview , Character set, C Tokens, Keywords, Identifiers, Variables, Constant , Data Types, Comments, Structure of a C. Program Operators & Expression, Types of Operators , Precedence and Associativity, Expression , Statement and Types of statements Built-in functions: printf(), scanf(), getch(), getchar(), putchar(), header files, Pre-processor directives : #include, #define , Control Statements : If, If- else ,Nested If-else, switch ,while, do-while ,for ,Nested for loop ,break ,continue etc.

Section-B

Arrays, One Dimensional arrays, Two Dimensional Arrays, storing data into arrays, searching and sorting, function, calling a function, passing arguments, call by reference, call by value, storing and displaying strings, structure & union.

Section -C

Developing the familiarity with SPSS Processer: Entering and editing data in SPSS editor.Inserting and defining variables and cases. .Working with descriptive statistics - Frequency tables, Graphical representation of statistical data (histogram, Boxplot, line charts, scatter plot, P-P plots, Q-Q plots). Hypothesis Testing - Sample & Population, concept of confidence interval, Testing normality assumption in SPSS

Section-D

SPSS: Testing the differences between group means - t – test (one sample, independent – sample, paired sample), ANOVA-GLM 1 (one way). Regression Analysis: The method of Least Squares, Assessing the goodness of fit, Simple regression. Non-parametric tests - Categorical testing: Pearson's Chi-square test.

Books Recommended

1. Balaguruswamy: "Programming in ANSIC".

2. Scaum Outline Series: "Programming inC".
3. Dennis & Ritchie: "Programming inC".
4. Stephen G. Kochar: "CProgramming".
5. Statistical Methods for Research: A Step by Step Approach Using IBM SPSS.2010. By-K. Kalyanaraman;Hareesh N. Ramanathan;P.N. Harikumar. Atlantic Publishers.
6. Statistics Made Simple: Do it Yourself on PC. by Sarma K.V.S. Prentice-Hall of India Pvt.Ltd (2004) ISBN: 9788120317413.
7. SPSS 20.0: A Guide to Statistical Analysis for Reseachers Paperback – 2018. by Dr. Dinesh Gabhane , Dr. S.B. Kishor, Ms. MadhuriBankar. Himalaya Publishing House; First edition (2018). ISBN-13: 978-9352993062

Course outcome

After completing this course, the student must demonstrate the knowledge and ability to:

CO-1. Understand the basic concept associated with C- Language and program designing
CO-2. Use the various input and output functions, operators and data types.
CO-3. Identify solution to a problem and apply control structures and user-defined functions for solving the problem.
CO-4. Understand how to start SPSS.
CO-5. Define a variety of statistical variables.0
CO-6. Enter basic data into SPSS.
CO-7. Carry out a statistical analysis that can test hypotheses.

M. Sc. Biotechnology (Semester- II)
MBT205 – Computer Applications & Data Analysis (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course Objectives

1. To introduce students with conditional statements using c lanquage
2. Students will learn manipulateing matrices
3. Learn about SPSS processor, its working statistical data representation and hypothesis testing
4. Students will learn about charts and scatter plot of the data

Course content

1. Write programme to demonstrate conditional statements using c language.
2. Write programme to manipulate matrices.
3. To demonstrate array function.
5. Use of SPSS software: Entering and editing data.
6. Plotting histogram, Boxplot, line charts, scatter plot from the given data.

Course outcome

CO-1. Use the various input and output functions, operators and data types.
CO-2. Understand how to start SPSS.
CO-4. Understand the basic concept associated with C- Language and program designing
CO-5. Enter basic data into SPSS.
CO-6. Carry out a statistical analysis.

M. Sc. Biotechnology (Semester-III)
MBT301
Animal Tissue Culture & Animal Biotechnology (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. Learning basic layout of ATC lab. And understanding importance of aseptic techniques in ATC.
2. Studying relevance of important solutions and medium used in ATC.
3. To learn how to establish and maintain cell lines, detection of contaminations and long term storage of these cell lines.
4. To apply ATC at large scale.

Course content

Section-A

Concept of aseptic techniques in ATC; design and layout of ATC lab, Equipment for ATC lab. Laboratory safety and Biohazards, balanced salt solution and tissue culture media.

Section-B

Detection of contamination, preservation, storage and shipment of cells. Constituents of serum, Serum free medium, design of serum free medium, Advantages and disadvantages of serum supplemented and serum free medium.

Section-C

Dispersion and disruption of tissue, monolayer and suspension culture techniques, measurement of growth and viability of cells in culture, maintenance of cultured cell line, primary and established cell line cultures, cell separation.

Section-D

Cell culture characteristics, scale up methods for propagation of anchorage dependent and suspension cell culture, concept of Bioreactors for mass culture of mammalian cells, microcarrier culture. Three dimensional culture system. Cell synchronization, cell transformation, cell immobilization techniques

Books Recommended

1. Spier, R. R. and Griffiths, J. B. (1990). Animal Cell Biotechnology, Academic Press, London.
2. Gareth, E. J. (1996). Human Cell Culture Protocols, Humana Press.
3. Julio, E., Celis (1998). Cell Biology-A Laboratory Hand Book, Vol. I-IV, 2nd Ed., Academic Press, New York.

4. Butler, M. (2004). Animal Cell Technology, 2nd Ed., BIOS Scientific Publishers, U.K.
5. John M. Davis (2011) Animal Cell Culture: Essential Methods: Publishers Wiley
6. R. Ian Freshney (2012) : A Manual of Basic Technique and Specialized Applications, 6th Edition, John Wiley and Sons, New York.

Course outcome

Upon completion of the course students should be able to:

CO-1. Successfully maintain cultures of animal cells and established cell lines with good viability, minimal contamination and appropriate documentation.

CO-2. Perform supportive or episodic tasks relevant to cell culture, including preparation and evaluation of media, cryopreservation and recovery, and assessment of cell growth/health.

CO-3. Establishment and maintenance of cell lines.

CO-4. Applications of cultured cell for large scale production of metabolites, transformation and in-vitro cell immobilization.

M. Sc. Biotechnology (Semester-III)
MBT-301
Animal Biotechnology (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course Objectives

1. To gain important skills like prepration of basic buffers and medium.
2. To learn the process of preparation and sterilization of Animal Tissue Culture medium.
3. To prepare cells for culturing.
4. To acquire knowledge of counting and estimating cell number in the culture.
5. Long term preservation of Cell lines.

Course content

1. Introduction to cell culture laboratory and instruments (Inverted microscope, CO2 incubator, Refrigerated centrifuges, Bio-safety cabinets, cryo cans, Water Bath, Deep freezers etc) used in the lab
2. Preparation of tissue culture medium
3. Sterilization of medium by membrane filtration technique
4. Maintenance of a cell line
5. Trypsinization of monolayer and sub culturing of cells
6. Counting of viable cells by trypan blue dye with the help of haemocytometer
7. Cryopreservation and revival of cells.
8. Determination of cell doubling time of a given cell line.

Books Recommended

1. Culture of Animal Cells, (3rd Edition), R. Ian Freshney. Wiley-Liss.
2. Animal Cell Culture – Practical Approach, Ed. John R.W. Masters, OXFORD.
3. Cell Growth and division: A practical Approach. Ed. R. Basega, IRL Press.
4. Cell Culture Lab Fax. Eds. M Butler & M. Dawson, Bios Scientific Publications Ltd. Oxford.
5. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
6. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods. Ed. Jenni P Mather and David Barnes. Academic Press.
7. R. Ian Freshney (2012) : A Manual of Basic Technique and Specialized Applications, 6th Edition, John Wiley and Sons, New York.

Course outcome

CO-1. The course will focus on practical aspects of cell culture, like design and layout of the laboratory and introduction to the instruments used in Animal Biotechnology lab.
CO-2. Students will get the knowledge and hands on training on media preparation and sterilization.
CO-3. Crypreservation, revival of cells, maintenance and subculturing cell lines.
CO-4. Students will get practical hands on how to determine viability count of cultured cells and determine cell doubling time.

M. Sc. Biotechnology (Semester-III)
MBT 302
Plant Tissue Culture & Plant Biotechnology (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. The main objective of this course is to introduce principles and practices of plant biotechnology, plant tissue culture, genetic transformation and transgenic plant production to students.
2. This course presents the applications of plant tissue culture and plant biotechnology for the improvement of agricultural crops.
3. Students will be able to gain fundamental knowledge of plant tissue culture and plant biotechnology for the production of important secondary metabolites.

Course content

SECTION -A

Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids, History of plant cell culture, Culture media types, Media composition, Plant growth regulators, Gelling agents, Cellular totipotency, Dedifferention and Redifferentiation, Callus and cell culture, Organogenesis and embryogenesis.

SECTION -B

Micropropagation methods, stages of micropropagation, types, applications and limitations. Somatic embryogenesis types, protocol, media requirements, embryogenic callus, Embryogenic determined cells (EDCs), advantages and disadvantages of somatic embryogenesis. Applications of propagation techniques in crop improvement. Acclimatization of micropropagated plantlets, Technical problems in PTC. Axillary bud, shoot tip and meristem culture. Embryo culture technique and rescuing hybrid embryos.

SECTION -C

Production of synthetic seed and their applications. Virus free plant production by PTC. Anther and microspore culture, Development of haploid plants, diploidization, applications. Protoplast isolation, culture and fusion, Somatic hybridization, Methods of somatic cell fusion, selection of somatic hybrids, cybrids and their applications. Somaclonal variations, isolation of useful variants at cellular level, Production of disease resistance, herbicide resistance and salt tolerance plants.

SECTION –D

Secondary metabolites production: Methods: Hairy Root Culture, Biotransformation, Plant Cell Immobilization and free cell suspension culture, Applications and Limitations. Production of transgenic plants, Ti plasmids, *Agrobacterium* infection and tumour growth, *Agrobacterium* mediated genetic transformation of plants, Direct DNA transfer methods for genetic

transformation, Crop improvement through transgenics and applications of transgenic plant production.

Books Recommended

1) Reinert, J. and Bajaj, Y.P.S. (1977). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, Springer Verlang, Berlin.
2) Ammirato, P.V., D.A. Evans, N.D. Sharp and Y.P.S. Bajaj (1990). Hand Book of Plant Cell Culture, Vols. 1 – 5. McGraw Hill Publishing Company, New York.
3) Shaw C.H. (1988), Plant Molecular Biology – A Practical Approach IRL Press Oxford.
4) Gupta P.K., (1990), An Introduction to Biotechnology, Rastogi Publications, Meerut.
5) Kung, Shain – Dow and Arntzen, C.J. (1989). Plant Biotechnology, ButterWorths, London.
6) Bhojwani, S.S. and M.K. Razdan (1983), Plant Tissue Culture. Theory and Practice Elsevier science publications Amsterdam.
7) Draper J.R. Scott, P. Armitage, R. Walden, (1988). Plant Genetic Transformation and Gene Expression – A Laboratory Manual. Blackwell Scientific Publications, Oxford.
8) Grierson, D. and Covey, S.N. (1984). Plant Molecular Biology, Black Publishers, New York
9) Old, R.W. and Primrose S.B. (1991). Principles of Gene Manipulation, An Introduction to Genetic Engineering, Blackwell Scientific Publications, Oxford.
10) Hopkins W.G. (2006) Plant Biotechnology, Infobase Publishing, pp 153

Course Outcome

CO-1 The students willlearn about important milestones in plant tissue culture and plant biotechnology.

CO-2 The students will understand the concepts and principles of plant tissue culture and plant biotechnology.

CO-3 The students willlearn about different pathways of plant regeneration under *in vitro* conditions - organogenesis and somatic embryogenesis.

CO-4 The students willlearn about techniques of establishing cell suspension culture, production of synthetic seeds and their applications.

CO-5 The students willlearn about large scale production of secondary metabolites using different plant tissue culture techniques and bioreactors.

CO-6 The students will gain knowledge about Agrobacterium mediated plant transformation and genetic elements present on the Ti plasmid

CO-7 This course will help students to acquire information about hardening and field transplantation of tissue culture raised plants.

M. Sc. Biotechnology (Semester-III)
MBT 302
Plant Tissue Culture & Plant Biotechnology (Practical)

Practical : 19 marks
Int. assessment: 06 marks
Total : 25 marks
Time : 3 hours

Course Objectives

1. To learn preparation and sterilization of the plant tissue culture medium
2. To study the effect of plant growth hormones on growth and proliferation of explants.
3. To study micro-propagation of plants.
4. To study acclimatization of tissue culture raised plantlets.

Course content

1) Methods of sterilization.
2) Preparation of media-MS (full strength, half strength).
3) Filter sterilization of thermo labile components
4) Micropropagation.
5) Effect of various growth hormones on cell division and cell proliferation
6) Callus induction & sub culturing, organogenesis.
7) Anther culture technique.
8) Acclimatization of tissue culture raised plantlets.

Course outcome

CO-1 The students will be able to prepare and sterilize the plant tissue culture medium
CO-2 The students' will learn the effect of plant growth hormones on cell division and cell proliferation.
CO-3 The students willbe able toknow about different methods and steps involved in micro-propagation of plants.
CO-4 The students will be able to perform experiments related tocallus induction, sub culturing and organogenesis from different explants.
CO-5 The students' will able toacclimatizethe tissue culture raised plantlets.

M. Sc. Biotechnology (Semester-II)
MBT303
Immunology (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates
The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

Course contents are designed to enable students to learn:

1. Basics, organization of immune system, types of immunity and immunoglobulins.
2. Detailed inside out of histocompatibility, lymphocytes and their receptors, Cytokines and other components, immune regulation.
3. Brief account of Mechanisms of cytotoxicity, types of hypersensitivity, autoimmune diseases and infections.
4. Knowledge about transplantation, immunodeficiency diseases, hybridoma technology.

Course content

SECTION –A

Introduction: Phylogeny of immune System, Innate and acquired immunity, Clonal nature of immune response, Organization and structure of lymphoid organs, Nature and biology of antigens and super antigens, Antibody structure and function, Antigen-Antibody interactions.

SECTION –B

Major histocompatibility complex, BCR & TCR, generation of diversity, Complement system. Cells of the Immune system: Heamtopoiesis and differentiation, lymphocytes trafficking, B-lymphocytes, T- lymphocytes, macrophages, dendritic cells, natural killer and lymphokine activated killer cell, eosinophils, neutrophils and mast Cells. Regulation of immune response: Antigen processing and presentation, generation of humoral and cell mediated immune responses, Activation of B- and T- lymphocytes, Cytokines and their role in immune regulation, T- cell regulation, MHC restriction, Immunological tolerance.

SECTION –C

Cell- mediated cytotoxicity; Mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity. Hypersensitivity. Autoimmunity.

SECTION –D

Transplantation, Immunity to infectious agents (intercellular parasites, helminthes & viruses), Tumor immunology, AIDS and other immunodeficiencies, Hybridoma Technology and Monoclonal antibodies.

Books Recommended

1. Kuby, J. (2004), Immunology, 5th Edition. W.H. Freeman and Company, New York
2. Roitt, I.M., Brostoff, J., Male, D.K., & Roth, D. (2006). Immunology (7th ed.). The C.V. Mosby Company. St. Louis
3. Murphy, K.M. (2011). Janeway's Immunobiology, 8th Edition (Immunobiology: The Immune System (Janeway)) Garland Science. Taylor and Francis Group.
4. Kanfmann, S.H.E., Sher A., Ahmed, R. (2002). Immunology of Infections Diseases, ASM Press, Washington
5. Strites D.P., Terr. A.I. & Parslow T.G. (1997), Medical Immunology, 9th Ed., PHI, Cambridge.
6. Paul, W./E. (1995), Fundamental Immunology, 3rd Ed., Raven Press, New York
7. Austyn, J.M. and Wood K.J. (1993), Principles of Cellular and molecular Immunology, Oxford University Press Inc. New York.
8. Britch, J.R. and Lennox, E.S. (1995), Monoclonal Antibodies Principles and Application, Wiley Liss.

Course Outcomes

Upon completion of this course, students will be able to:

1. Acquire the basic knowledge of different immunological components and processes at the cellular levels.
2. Cultivate the apprehension regarding mechanisms of generation of immune response and their different types
3. Learn about the role of specialized lymphocytes, their action process along with diseases related with self defense mechanisms of body like allergic reaction and abnormality in antigen recognition.
4. Realize about the direct involvement of medical science procedures involved in certain disease treatments as well as industrial aspect like monoclonal immunoglobulins generation and their utility.

M. Sc. Biotechnology (Semester-II)
MBT-303
Immunology (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course objectives

Course contents are designed to enable students to

1. Understand the basics of blood and its components.
2. Learn the cellular and other non-cellular factors of blood.
3. Comprehend the antigen-antibody reaction systems
4. Know inside out of certain immunologic techniques.

Course content

1. Blood film preparation and identification of cells.
2. R.B.C. Counting.
3. Total leukocyte count & Differential leukocyte count
4. A.B,O Blood group testing
5. Direct and indirect haemagglutination assays.
6. Isolation of mononuclear cells from peripheral blood and viability test by dye exclusion method
7. Separation of serum / plasma from blood
8. Double immunodiffusion test
9. Dot Immuno blot assay (DIBA).

Books Recommended

1. Stevans, C.D. (2009). Clinical Immunology and Serology : A Laboratory Perspective F.A. Davis Company, Philadelphia
2. Hay, F.C. Westwood O.M.R. (2002). Practical Immunology, 4th Ed., Blackwell Science, U.K.
3. Celis, K.E. (1998). Cell Biology: A laboratory handbook. Vol-I Academic Press, U.K.

Course Outcomes:

Upon completion of the course the students will be capable to understand and perform following in the laboratory

1. Staining techniques and Microscopy for the identification as well as morphological characterization of blood cells.
2. Haematological studies using counting chamber for Erythrocyte, leukocyte count
3. Antigen- antibody interaction studies for blood group testing and immunodiffusion.
4. Erythrocyte cross-links studies by lectin glycoproteins for carbohydrate determinants.
5. Centrifugation technique for serum and plasma separation; Density gradient centrifugation for blood cell isolation and viability test.
6. Immunoblotting to identify target protein among unrelated proteins

M. Sc. Biotechnology (Semester-III)
MBT 304
Bioprocess Engineering & Technology (Theory)

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. To study various optimization methods for the growth of living organismsincluding statistical and mathematical modelling techniques.
2. To make the pupils aware of various types of designs, types, operations and kinetics of industrial bioreactors.
3 The students made to learn all the engineering principles used for metabolite production in industry.
4 The practical work of metabolite separation engineering from the Bioprocess media will be elaborately taught to the students.
5 The students will be given knowledge about various microbiological techniques for primary secondary and tertiary treatment of industrial waste.
6 The pupils will be familiarized with the complete aspect of the Bioprocess Engineering & Technology including Design, Instrumentation, Operation, Maintenance, and Scale-up.

Course content

SECTION –A

Introduction: Historical development of bioprocessing as industry. Scale up of a bioprocesses and its parameters from lab, pilot plant and industrial scales. Growth parameters, growth rate, specific growth rate and biomass doubling, degree of multiplication, growth yield , Ydx/ds, Ydx/do2, metabolic quotient, effect of substrate concentration on growth rate, Monod growth relation, saturation constants and its importance.

SECTION –B

Bioreactors type: Introduction, Basic function of a bioreactor, microbial, animal and plant bioreactors (Wald hof-type acetators and cavitators, tower bioreactor, cylindroconical vessels, air lift bioreators, deep jet bioreactor, cyclone column, packed tower, rotating disc bioreactor). Aspectic operation and contamination. Sterilization of bioreactors and medium, Body construction, Temperature control and measurement. Aeration and agitation, impellers, Stirrer, glands and bearings, packed gland seal, mechanical seal, magnetic drives, Baffles, different types of spargers, different ports, temperature probes. Dissolve oxygen probe. Basic concepts of Valves and stream traps (Gate valves, plug valves, ball valves, butterfly valves, Diaphragm valves, pressure control valves, safety valves, steam traps only).

SECTION –C

Mass and Gas transfer in Microbial systems: Introduction, The oxygen requirement for industrial bioreactors, oxygen demand and supply. Volumetric oxygen transfer, determination of KLa values, sulphite oxidation techniques, gassing out techniques: static method and dynamic method, oxygen balance method. Fluid rheology: Bingham plastic, pseudo plastic, Dilatants, Casson body. Factors affecting KLa values in bioreactors, the effect of medium rheology on KLa values.

SECTION –D

Sterilization

Introduction, design of batch sterilization process, del factor, sterilization cycle, Richards rapid method for design of sterilization cycles, batch sterilization, continuous sterilization, sterilization of feed, sterilization of wastes. Filter sterilization, filter sterilization of media and air, Depth filters design and theory.

Books Recommended

1. Stansbury, P.F., Whittaker, A. Hall, S.J. Principles of Fermentation Technology 3 Edition. Pergamon Press. 2008.
2. Bailey, J.E., and Olis, D.R. Biochemical Engineering Fundamentals. McGraw Hill.
3 Moo-Young, M. Comprehensive Biotechnology. Vol 1-4.
4. Doran, P.M. Bioprocess Engineering Principles. Academic Press 2011.
5. Michael, L. Shuler and Kargi, F. Bioprocess Engineering: Basic Concepts. Pearson-Prentice Hall. 2009.
6. Crueger, W. and Crueger, A. Biotechnology: a Textbook of Industrial Microbiology. Panima Publishing Corporation.
7. McNeil, B and Harvey, L.M. Fermentation a practical approach. IRL Press (Oxford University Press). 2007.
8. Shijie Liu. Bioprocess Engineering: Kinetics, Biosystems, Sustainability, and Reactor Design. Elsevier Sci. Publishers. 2012.
9. Kim Gail Clarke. Bioprocess Engineering: An Introductory Engineering and Life Science Approach. Woodhead Publishing Ltd. 2013.
10. B. Atkinson Biochemical Engineering and Biotechnology Hand Book. MacMillan Press 2009.
11. J.M. Lee. Biochemical Engineering Prentice Hall 2008.

Course Outcome

CO-1. Students will practically learn Bioreaction and process engineering.
CO-2. Students will learn about applications of various types of bioreactors as are scaled – up in industry for industrial fermentations.
CO-3. Students will be able to design up-stream, down-stream, economical, post production, processing and overall aspects of Fermentation technology. This aspect is desirable to join and work in nearly bioprocess industries.
CO-4. Students will be able to compare and use various types of bioprocess for different types of microbial processes.
CO–5. The students are perfectly ready for jobs of Bioprocess Engineer in Distillaries, Breweries, Food processing plants, Soft-drink bottling plants, Milk processing industry etc.

M. Sc. Biotechnology (Semester-III)
MBT304
Bioprocess Engineering & Technology (Practical)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Practical: 19
Time: 3 Hours **Internal Assessment: 6**

Course Objectives

1 To study design of batch bioreactor, one used in nearly all fermentation industries across India.
2 To make the pupils aware of various parts, probes, maintenance, and mantling- dismantling of bioreactors.
3 The students practically produce microbial products in batch bioreactor and use it to treat industrial effluents.
4 The pupils practically learn handling of bioreactor and sterilisation &maintenance of aseptic conditions in lab area.
5 The pupils will be familiarized with the complete aspect of the Bioprocess Engineering & Technology including Design, Instrumentation, Operation, Maintenance, and Scale-up.

Course content

1. Determination of TDS, pH and conductivity of given wastewater sample after standardization of given probes/instruments.
2. Screening and Isolation of cellulose degrading microbes.
3. Bioremediation of dyes using different fungal/bacterial strain isolated from soil at shake flask level.
4. To study the parts of a bioreactor working and functioning of any bioreactor studied in theory paper by bioreactors assembling and dismantling.
5. Sterilization of fermenter and fermentation media.
6. To characterize and isolate the effluent decolourisation product by TLC/GLC.
7. Determinations of thermal death point (TDP) and thermal death time (TDT) of microbes for designing of sterilization.
8. Study the effect agitation on aeration and determination of KLa volumetric oxygen transfer rate in the bioreactor by dynamic gassing out technique.

Course Outcome

CO-1. Students in this course will learn to scale up of a bioprocesses and various growth parameters,
CO- 2. Students will learn about design of batch sterilization process and other sterilization techniques
CO-3. Students will practically learn Bioreaction and process engineering aspects including Students will learn about aeration, agitation, mass flow, gas flow etc. for industrial bioreactors.
CO -4. Students will learn about applications of various types of bioreactors as are scaled – up in industry for industrial fermentations.
CO -5. Students will be able to design up-stream, down-stream, economical, post production, processing and overall aspects of Fermentation technology. This aspect is desirable to join and work in nearly all Bioprocess industries. ng,
CO-6. Students will be able to compare and use various types of bioprocess for different types of microbial processes.

M. Sc. Biotechnology (Semester-III)
MBT305
Seminar

Credit Hours: 2 Hrs/week/teacher
Total Hours: 30/teacher
Maximum Marks: 50

To make the students conversant with latest happening in the field of Biotechnology and to improve their communicational skill, seminars covering latest topics in Biotechnology have been included in the curriculum. Each candidate will select topic and deliver seminar on important recent scientific discovery published in prestigious scientific journals. Presentation of Seminars will carry 25 marks. An objective type common paper of 25 marks on all the seminars will be taken at the end of the session. The question paper will be set and evaluated by a board of three internal examiners.

M. Sc. Biotechnology (Semester-IV)
Genomics and Proteomics
MBT401A

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. Genomics and Proteomics aims to give students an overview of the fundamental technological concepts of genomics, functional genomics, and proteomics methods.
2. To acquaint the student with genome organization, gene identification, expression and applications of genomics analysis. Also about proteomics, analysis and its applications.
3. Genomics and Proteomics give students foundational skills in omics data analysis, as well as a broad overview on genomics and proteomics technologies and show how these are applied to real-life biomedical problems.
4. Students will learn about genomics and proteomics methods, the data these experiments produce, as well as about sequence and proteome analysis.

Course content

SECTION –A

Whole genome analysis: Preparation of genomic library in vectors, ordered cosmid libraries, BAC libraries, shotgun libraries, comparative genomes (Arabidopsis, rice and panda)
DNA sequencing: conventional sequencing (Sanger, Maxam and Gilbert), pyrosequencing, next generation sequencing, automated sequencing, translation to large scale projects, epigenomics, cancer genomes.

SECTION –B

FISH, Comparative Genomic Hybridization (CGH), SKY (Spectral Karyotyping).
DNA Microarrays: Chemical DNA synthesis, Printing of oligonucleotides and PCR products on glass slides, nitrocellulose paper. Fluorescence based assay formats and signal amplification strategies, Analysis of single nucleotide polymorphism using DNA chips.
Gene Identification and Expression Analysis: DNA microarrays, ESTs, SAGE, MPSS.

SECTION –C

Proteome analysis: Two dimensional separation of total cellular proteins, isolation and sequence analysis of individual protein spots by mass spectroscopy. Protein microarrays, differential display proteomics, yeast 2-hybrid system, FRET, bimolecular fluorescence complementation assay.

SECTION –D

Advantages and disadvantages of DNA and protein microarrays. Total expression vs functional proteomics, oligosaccharide microarrays for glycomics, pharmacogenomics, introduction to metabolomics.

Books Recommended

1. Peruski, L.F. Jr. and Peruski, A.H. (1997). The Internet and New Biology: Tools for Genomic and Molecular Research ASM.
2. Schena, M.ed. (1999). DNA Microarrays: A practical approach. Oxford University Press.
3. Hunt, S. and Livesey, F. ed. (2000). Functional Genomics: A practical approach. Oxford University Press.
4. Josip Lovric. (2011). Introducing Proteomics: From concepts to sample separation, mass spectrometry and data analysis. Wiley
5. R. Varshney. (2013). Translational Genomics for Crop Breeding. Wiley-Blackwell Ltd.
6. Sandy B. Primrose, Richard Twyman (2009). Principles of Gene Manipulation and Genomics, 7th Edition. Wiley.
7. Genomics: Essential Methods (2010). by Mike Starkey (Editor), Ramnath Elaswarapu (Editor). Wiley.
8. Nawin C. Mishra, Günter Blobel (2010). Introduction to Proteomics: Principles and Applications. Wiley
9. Jonathan Pevsner. (2009). Bioinformatics and Functional Genomics, 2nd Edition. Wiley Blackwell.
10. Molecular Analysis and Genome Discovery, 2nd Edition (2011). Ralph Rapley (Editor), Stuart Harbron (Editor). Wiley Sci Publishers.
11. Introduction to Proteomics. (2008). Agnieszka Kraj (Editor), Jerzy Silberring (Editor). Wiley Publishers.

Course outcomes

On completion of this course, the student will be able to:

1. Explain basic concepts of vectors, gene libraries and next generation sequencing including the differences between the conventional and modern methods;
2. Develop technical skills for analysis and interpretation of data employing techniques like FISH, Microarray, SAGE and MPSS.
3. Know about various methods of analysis proteome of a cell
4. Develop an appreciation of the importance of experimental design for genomics and proteomics and will learn how to apply this knowledge in biomedical field.

M. Sc. Biotechnology (Semester-IV)
MBT401B
Introduction to Bioinformatics

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates
The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. To make students aware of the importance and applications of bioinformatics.
2. To provide students with the knowledge of genome sequencing projects including Human genome project
3. To increase student's learning about numerous protein and nucleic acid databases and have insights about the algorithms (BLAST, Smith-Waterman, Needleman-Wunch)
4. To give students hands on practical training on running sequence search tools, construct phylogenetic tree, perform and analyse sequence alignments.

Course content

SECTION –A
Introduction to Bioinformatics: History of Bioinformatics, milestones, Genome sequencing Projects, Human Genome Project, objectives and applications of Bioinformatics.
Introduction to databases: Type and kind of databases, e.g. PUBMED, MEDLINE
Nucleic acid and protein databases: GenBank, EMBL, DDBJ, SWISS PROT, INTERPRO, UNIPROT. Genome project TIGR database, SGD, PLASMODB Data format

SECTION –B
Sequence alignment: Scoring matrices, PAM, BLOSUM, Local and global alignment concepts; Dot matrix sequence comparison; Dynamic programming; Needleman-Wunch algorithm, SmithWaterman algorithm;

SECTION –C
Database searches for homologous sequences, FASTA and BLAST, PSSM searching, PSIBLAST and PHI-BLAST, Multiple sequence alignment; Phyllogenetic analysis Motifs and Pattern Databases: PROSITE, Pfam, BLOCKS, PRINTS

SECTION –D
Protein sequence analysis tools, secondary structure prediction, tertiary structure prediction homology modelling, fold recognition, ab initio methods structure visiualization and analysis

tools, rasmol chimera spdviwer, Structure analysis Structural databases: PDB, PDBsum, NDB etc. SCOP, CATH

Books Recommended

1) Cynthia Gibas & Per Jamesbeck, (2000). " Developing Bioinformatics Computer Skills," O' Rilley & Associates.
2) Campbell and Heyer, Discovering Genomics, Proteomics & Bioinformatics, 2nd Edition, Benjamin Cummings, 2002.
3) Bourhe P. E. and Weissig H. (2003). Structural Bioinformatics (Methods of structural Analysis). Wiley-Liss.
4) Mount D. W. (2004). Bioinformatics & Genome Analysis. Cold Spring Harbor Laboratory Press.
5) Wayne W. Danile (2004), Biostatistics: A foundation for Analysis in the Health Sciences, 8th Edition Wiley.

Course Outcome

At the end of this course, students will

CO-1. Learn about Genome sequencing Projects, various primary and secondary databases.

CO-2. Be able to perform sequence alignment, multiple sequence alignment; Phyllogenetic tree construction and analysis.

CO-3. Have insights into sequence search tool algorithms; dynamic programming; structural databases and learn about the tools for protein structure prediction.

M. Sc. Biotechnology (Semester-IV)
MBT402A
Medical Biotechnology

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates
The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives:
1. To understand and link various assets of Biotechnology to the medical field.
2. Students will learn how stem cells can be applied for the treatment of various dieases.
3. Different immune molecules can be applied for overcoming human ailments which will be clarified in this course.
4. Student will be introduced in detailed to the process of gene therapy.
5. Process of drug developments and its various stages will be learned.

Course content

SECTION –A

Cellular therapy; Stem cells: definition, properties and potency of stem cells; Sources: embryonic and adult stem cells; Genetically engineered stem cells in cancer treatment, Concept of tissue engineering; Role of scaffolds; Role of growth factors; Role of adult and embryonic stem cells; Clinical applications; Ethical issues

SECTION –B

Immunotherapy: Cancer immunotherapy; Role of cytokine therapy in cancers; Monoclonal antibodies and their role in cancer; Role of recombinant interferons; Immunostimulants; Clinical transplantation and immunosuppressive therapy; Vaccine development; recombinant vaccines and clinical applications.

SECTION –C

Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome and nanoparticles mediated gene delivery Recombinant therapy; Clinical applications of recombinant technology; Erythropoietin; Insulin analogs and its role in diabetes; Recombinant human growth hormone; Streptokinase and urokinase in thrombosis; Recombinant coagulation factors

SECTION –D

Genetic markers-Biomarkers in early drug development; Biomarkers in Clinical development; Biomarkers for molecular Diagnostics- example of cancer biomarkers; IVET

Drugs; Types of Drugs - examples of latest drugs; steps in drug designing, HTS, In silico drug designing, structure based drug designing, methods of docking concept of ADME metabolism & Drug Excretion; QSAR; Drug Legislation & safety.

Books Recommended:

1) Spier, R.R. and Griffttths, J.B. (1994). Animal Cell biotechnology, 6th Ed., Academic Press, London.
2) Krogsgaard-larsen P. , Liljefors T., Madsen U. and Larsen K, Liljefors T. Madsen U. (2002).
3) Text Book of Drug Design and Discovery, Taylor and Francis Publications, Washington D.C. Palson, O.B. and Bhatia, N.S. (2009). Tissue Engineering. Dorling Kindersley (India) Pvt.Ltd.
4) Robert L. and other (2009) .Essentials of Stem Cell Biology. 2nd Ed. Academic Press, London.
5) Khan, F.A. (2013) Medical Biotechnology, Academic Press, pp 368

Course Outcomes:

CO-1. In this course students will learn about the role of genetically engineered stem cells in cancer treatment, clinical applications of tissue engineering.
CO-2. Students will acquire in depth knowledge about Immunotherapy, significance of monoclonal antibodies, Vaccine development and clinical applications of recombinant vaccines.
CO-3.Students will learn about various concepts about Gene therapy; Recombinant therapy and Clinical applications of recombinant technology.
CO-4.Students will learn about biomarkers in early drug development, Clinical development and in molecular Diagnostics, methods of docking concept of ADME metabolism & Drug Excretion, in silico drug designing, structure based drug designing.

M. Sc. Biotechnology (Semester-IV)
Advances in Plant Biotechnology
MBT402B

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates
The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course objectives
1. The main objective of this course is to introduce recent technolgies of secondary metabolities production

2. This course presents various plant biotechnology techniques and their applications for the crop improvement.

3. Students will be able to gain fundamental knowledge of genetic transformation and transgenic plant production.

Course content

SECTION-A

Hairy Root Research: Recent Scenario and Exciting Prospects Production of hairy root cultures, hairy roots for high-value metabolite production, Biotransformation, Plant Cell Immobilization and free cell suspension cultures.

SECTION-B

Gene Silencing Techniques and Crop Improvement, Overview of different strategies for gene silencing, RNA interference, Construction of RNA interference vectors, Applications of RNA interference in crop improvements

SECTION-C

Reactive Oxygen Species (ROS) in Plants, ROS in biotic and abiotic stress, ROS in plant growth and development. Hormonal Regulation of Plant Growth and Development. Interplay of different hormones for plant growth and development.

SECTION-D

Production of transgenic plants,Crop improvement through transgenics, *Agrobacterium* mediated genetic transformation of plants, Direct DNA transfer methods for genetic transformation, Applications of transgenic plant production.

Books Recommended

1. Cellular and Molecular Biology of Plant Seed Development. Larkins, Brian A.; Vasil, Indra K. (Eds.), Vol. 4, 1997, ISBN 978-0-7923-4645-6
2. Mei-Liang Zhou, Xue-Mei Zhu, Ji-Rong Shao,Yi-Xiong Tang & Yan-Min Wu (2011) Production and metabolic engineering of bioactive substances in plant hairy root culture. Appl Microbiol Biotechnol 90:1229–1239
3. Klaus Apel and Heribert Hirt (2004) Reactive Oxygen Species: Metabolism, Oxidative Stress, and Signal Transduction. Annu. Rev. Plant Biol. 2004. 55:373–99
4. Ron Mittler, Sandy Vanderauwera, Nobuhiro Suzuki, Gad Miller, Vanesa B. Tognetti, Klaas Vandepoele, Marty Gollery, Vladimir Shulaev, Frank Van Breusegem (2011) ROS signaling: the new wave? Trends in Plant Science. 16 (6), 300-309
5. Matthew, L. (2004), RNAi for plant functional genomics, Comparative and Functional Genomics, 5, 240-244.
6. Umesh Balkrishna Jagtap, Ranjit Gajanan Gurav and Vishwas Anant Bapat Role of RNA interference in plant improvement. Naturwissenschaften (2011) 98:473–492
7. William M Gray (2004) Hormonal Regulation of Plant Growth and Development. PLoS Biology. 2 (9) e311
8. Stephen Depuydt and Christian S. Hardtke (2011) Hormone Signalling Crosstalk in Plant Growth Regulation. Current Biology 21: R365–R373
9. Hopkins W.G. (2006) Plant Biotechnology, Infobase Publishing, pp 153
10. Grierson, D. and Covey, S.N. (1984). Plant Molecular Biology, Black Publishers, New York
11. Old, R.W. and Primrose S.B. (1991). Principles of Gene Manipulation, An Introduction to Genetic Engineering, Blackwell Scientific Publications, Oxford.

Course outcomes

CO-1: The students will learn about production of secondary metabolites using different techniques.

CO-2: The students will understand the concepts and principles of gene silencing techniques.

CO-3: The students will learn about hormonal regulation of growth and development in plants.

CO-6: The students will gain knowledge about Agrobacterium mediated genetic transformation and production of transgenic plants

M. Sc. Biotechnology (Semester-IV)
MBT402C
Microbial Biotechnology

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates
The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives:

1. This course presents the utility of Microbes and their products in food, health and health care industry
2. Students will be introduced to the advanced techniques like competitive genomics and genome sequencing projects.
3. the student will understand: Fermentation and production of Microbial products, Vaccine and antibiotics.
4. Students will also acquire knowledge about application of microbes in nanotechnology and bioremediation of xenobiotics.

Course content

SECTION –A

Introduction to microbial technoloogy, Microbial metabolites : Primary & Seondary, microbial applications in food and health care industries. Introduction to microbial genomes, phylogenetic relationships between various genera of microbes- 16SrRNA sequencing and Ribosomal Database project.

SECTION –B

Prokaryotic genome organization, chromids, Bacterial and viral metagenomics, synthetic genomics, microbial sequencing projects, comparative genomics of relevant organisms such as pathogens and non-pathogens, human microbiome project.

SECTION–C

Microbial biofilms, polyketide synthase, antibiotic resistance, extremophiles and extremophilic biocatalysts, lantibiotics, biosynthesis of nanomaterials, probiotics, microbial degradation of xenobiotics, viral enzymes in modern biotechnology and clinical applications.

SECTION –D

Microbial bio-products : penicillin G, Microbial Enzymes : amylases, cellulases, cellobiohydrolase, endoglucanase, cellobiase, β-glucosidase, proteases. Microbial cultures, microbial product recovery. Alcohol biotechnology : Beer, Whisky, and Wine. Microbial culture, fermentation media, microbial bio-processes and product recovery for beer, whisky and wine.

Course Outcomes:

1. Important Goals of this course is to make the student to learn the wide range of applications of Microbes.
2. Students will understand microbes and their products and will be acquainted with the techniques to identify the useful microbes.
3. Various aspects of fermentation technology and their application in the productions of various products of microbial origin will be studied.
4. Recent application of microbes will be explored in detailed.

M. Sc. Biotechnology (Semester-IV)
MBT-403
Intellectual Property Rights, Bioethics and Biosafety

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 100
Theory: 75
Time: 3 Hours **Internal Assessment: 25**

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Course Objectives

1. Introduction to different types of IPR.
2. It will help in the introduction of history of IPR in India, Benefits, Problems and Management of IPR.
3. To deal with Principles, objectives, structure and functions of various international organizations like WTO, WIPO, GATT, USPTO, TRIPS, TRIMS, MFN.
4. It will help in learning the bio-entrepreneurship Patentability of Biotech inventions.
5. It will inculcate the basic information about the biosafety of Genetically Engineered Products, Ecological Safety Assessment of Recombinant Organisms, Good Laboratory Biosafety Practices, Web-based Information of Biosafety on GMO.

Course content

SECTION –A

Introduction to intellectual property rights and its different forms. Ownership of Tangible and Intellectual Property, Farmers Rights, Animal and Plant Breeders Rights, Brief history of IPR system in India. Introduction to Indian Patent law, Basic requirements of patentability, Patentable subject matter.

SECTION –B

World Trade Organization and its related intellectual property provisions, TRIPS agreement, Patent Cooperation Treaty, Budapest treaty. Patent Litigation: Substantive Aspects of Patent Litigation, Procedural Aspects of Patent Litigation. Recent Development in Patent System. Compulsory licensing, Patent infringements and revocation. Patentability of Biotechnological invention

SECTION –C

Ethical issues of patenting in Biotechnology, Disclosure Requirements. Collaborative and competitive research, Challenges for the Indian Biotechnological research and industries. Introduction to Biosafety, Overview of biosafety, Biological Safety Cabinets,, Genetically modified organisms (GMOs), Concerns and Challenges, National and International Regulatory Mechanism for GMOs, Cartegana Protocol

SECTION –D

Biosafety of Genetically Engineered Products, Ecological Safety Assessment of Recombinant Organisms, Good Laboratory Biosafety Practices, Web-based Information of Biosafety on GMO. Introduction to Bioethics, Different Approaches to Ethics, Biological Weapons and Their Social and Ethical Implications. NGOs for Biosafety and Bioethics. Public and Private sector organizations for biosafety and bioethics

Books Recommended

1. Beier F.K, Crespi R.S and Straus T. Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi.
2. Jeffrey M. Gimble, Academia to Biotechnology, Elsevier Academic Press.
3. Rajmohan Joshi (Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.
4. Sasson A, Biotechnologies and Development, UNESCO Publications.
5. Senthil Kumar Sadasivam and Mohammed Jaabir M. S. (2008). IPR, Biosafety and Biotechnology Management, Jasen Publications, India.
6. Intellectual Property rights in the WTO and Developing countries (2001) by Watal, J. Oxford University Press, New Delhi.
7. Law Relating to Intellectual Property Rights, 1st Edition (2007) by Ahuja, V.K
8. Patent law and Entrepreneurship, 3rd Edition, Kalyani publishers (2010) by Singh, I. and Kaur, B
9. New developments in biotechnology: Patenting life-special report (1990) Office of Technology Assessment (OTA), US Congress (Washington D.C. Dekker).
10. Draft manual of patent practice and procedure (2008) Patent Office, India.
11. Intellectual Property Bulletin.

Course Outcome

CO-1. The goal of this course is to introduce to the students the concept of intellectual property rights and its different forms, introduce Indian Patent law and patentable subject matter.

CO-2. Students will learn about World Trade Organization, Patentability of Biotechnological invention, TRIPS agreement, National and international regulatory mechanisms for genetically modified organisms, Cartegana protocol

CO-3. At the end of this course students will be able to define the Bio-ethics, good laboratory and bio-safety practices, NGOs, public and private sectors for bio-safety and bio-ethics.

M. Sc. Biotechnology (Semester-IV)
MBT404
Research Project

Credit Hours: 6 Hrs/week/teacher
Total Hours: 90
Maximum Marks: 50

To give the students sufficient experience and proficiency in the research methodology and to enable them to carry out independent research, projects will be assigned to the students as per individual interest and availability of specialized faculty. The project report will be submitted in the form of dissertation. The project will be presented for evaluation at the end of semester and viva voce examination will be conducted.

M. Sc. Biotechnology (Semester-IV)
MBT405
Educational Tour/Industrial Visit

Maximum Marks: 50

To enrich students' learning experiences and to help them to acquire practical knowledge about the subject, industrial visits will be arranged by the Department. The students are required to submit written report about the visit at the end of semester. Viva voce will be conducted.