FACULTY OF SCIENCES

SYLLABUS FOR THE BATCH FROM THE YEAR 2022 TO YEAR 2025

Programme Code: BSBT

Programme Name: B.Sc.Biotechnology

(Semester I- VI)

Examinations: 2022-2025

P.G.Department of Biotechnology

Khalsa College, Amritsar

S.No.	PROGRAMME 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.

S.No.	PROGRAMME SPECIFIC OUTCOMES (PSOS)
PSO-1	Developing a solid understanding of all concepts related to life science and core biology.
PSO-2	Developing a scientific aptitude and a keen interest in biological sciences,which will aid in the formation of evaluative decisions.
PSO-3	Creates an interdisciplinary approach by combining basic sciences and cutting-edge technology.
PSO-4	Recognizing the world's needs and thinking rationally about how to meet themin an environmentally friendly manner.
PSO-5	Applying the fundamentals of biotechnology to everyday life and societal upliftment.
PSO-6	Developing abilities to manage personnel, space, inventory, and technical equipments.
PSO-7	Adherence to safety and health regulations.
PSO-8	The goal is to train long-term biotech professionals and researchers in advanced research methods.

COURSE SCHEME							
SEMESTER - I							
Course Code	**Course Name**	**Hours/Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
BT-BTL111	Cell Biology	4	30	-	10	40	10
BT-BTP111	Cell Biology Lab	4	-	15	5	20	12
BO-BTL112	Botany-I	4	30	-	10	40	14
BO-BTP112	Botany-I Lab	4	-	15	5	20	16
BT-BTL113	Biochemistry-I (Biomolecules)	4	30	-	10	40	17
BT-BTP113	Biochemistry-I (Biomolecules) Lab	4	-	15	5	20	19
BT-BTL114	General Microbiology-I	4	30	-	10	40	21
BT-BTP114	General Microbiology-I Lab	4	-	15	5	20	23
CH-BTL115	Chemistry-I (Inorganic Chemistry)	4	30	-	10	40	25
CH-BTP115	Chemistry-I (Inorganic Chemistry) Lab	4	-	15	5	20	27
BCSE-1122	Communicative English-I	4	37	-	13	50	28
BHPB-1101 BPBI-1102 BPHC-1104	Punjabi Compulsory **OR #ਮੁੱਢਲੀ ਪੰਜਾਬੀ OR** **Punjab History & Culture	4	37	-	13	50	30
ZDA-111	***Drug Abuse : Problem, Management and Prevention (Compulsory Course)	4	37	-	13	50	34
Total		52	261	75	114		

Note:

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

SEMESTER - II							
Course Code	**Course Name**	**Hours/ Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
ZO-BTL121	Zoology-I	4	30	-	10	40	36
ZO-BTP121	Zoology-I Lab	4	-	15	5	20	38
BT-BTL122	Genetics	4	30	-	10	40	39
BT-BTP122	Genetics Lab	4	-	15	5	20	41
BT-BTL123	Biochemistry-II (Bioenergetics and Enzymology)	4	30	-	10	40	43
BT-BTP123	Biochemistry-II (Bioenergetics and Enzymology) Lab	4	-	15	5	20	45
BT-BTL124	General Microbiology-II	4	30	-	10	40	47
BT-BTP124	General Microbiology-II Lab	4	-	15	5	20	49
MA-BTL125	Biomathematics and Biostatistics	4	30	-	10	40	50
BCSE-1222	Communicative English-II	4	37	-	13	50	52
BHPB-1201 BPBI-1202 BPHC-1204	Punjabi Compulsory **OR** #ਮੁੱਢਲੀ ਪੰਜਾਬੀ **OR** **Punjab History& Culture	4	37	-	13	50	54
ZDA-121	***Drug Abuse : Problem, Management and Prevention (Compulsory Course)	4	37	-	13	50	58
Total		52	261	60	109	430	

Note:

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

SEMESTER - III							
Course Code	**Course Name**	**Hours/Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
BTL201	Fundamentals of biotechnology	4	30	-	10	40	60
BTP221	Fundamentals of biotechnology Lab	4	-	15	5	20	62
BTL202	Immunology-I	4	30	-	10	40	63
BTP222	Immunology-I Lab	4	-	15	5	20	65
BTL203	Chemistry-II (Organic)	4	30	-	10	40	66
BTP223	Chemistry-II (Organic) Lab	4	-	15	5	20	68
BTL204	Botany-II	4	30	-	10	40	69
BTP224	Botany-II Lab	4	-	15	5	20	71
BTL205	Biochemistry-III (Metabolism of Carbohydrates and Lipids)	4	30	-	10	40	72
BTP225	Biochemistry-III (Metabolism of Carbohydrates and lipids) Lab	4	-	15	5	20	74
BTL206	Molecular Biology	4	30	-	10	40	75
BTP226	Molecular Biology Lab	4	-	15	5	20	77
ESL-221	Environmental Studies-I (Compulsory Paper)	4	37	-	13	50	78
Total		152	217	90	103	410	

Note: * ESL-221 Environmental Studies (Compulsory Paper) marks will not be included in theTotal marks.**

SEMESTER - IV							
Course Code	**Course Name**	**Hours/Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
BTL251	Industrial Biotechnology-I	4	30	-	10	40	81
BTP271	Industrial Biotechnology-I Lab	4	-	15	5	20	83
BTL252	Immunology-II	4	30	-	10	40	84
BTP272	Immunology-II Lab	4	-	15	5	20	86
BTL253	Biochemistry-IV (Metabolism of Proteins and Nucleic acid)	4	30	-	10	40	87
BTP273	Biochemistry-IV (Metabolism of Proteins and Nucleic Acid) Lab	4	-	15	5	20	89
BTL254	Skill Development in Biotechnology	4	30	-	10	40	90
BTP274	Skill Development in Biotechnology Lab	4	-	15	5	20	92
BTL255	Fundamental of Bioinformatics	4	30	-	10	40	93
BTP275	Fundamental of Bioinformatics Lab	4	-	15	5	20	95
BTL256	Zoology-II	4	30	-	10	40	96
BTP276	Zoology-II lab	4	-	15	5	20	98
BTP277	Industrial/Institutional Visit	-	-	-	-	20	99
ESL222	Environmental Studies-II (Compulsory Paper)	4	37	-	13	50	100
Total		152	217	90	103	430	

Note: * ESL-221 Environmental Studies (Compulsory Paper) marks will not be included in theTotal marks.**

SEMESTER - V							
Course Code	**Course Name**	**Hours/ Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
BTL301	r-DNA Technology-I (Theory)	4	30	-	10	40	103
BTP321	r-DNA Technology-I Lab	4	-	15	5	20	105
BTL302	Plant Biotechnology-I (Theory)	4	30	-	10	40	106
BTP322	Plant Biotechnology-I Lab	4	-	15	5	20	108
BTL303	Animal Biotechnology-I (Theory)	4	30	-	10	40	109
BTP323	Animal Biotechnology-I Lab	4	-	15	5	20	111
BTL304	Bioprocess Engineering-I (Theory)	4	30	-	10	40	112
BTP324	Bioprocess Engineering-I Lab	4	-	15	5	20	114
BTL305	Biochemical and Biophysical Techniques-I (Theory)	4	30	-	10	40	115
BTP325	Biochemical and Biophysical Techniques-I Lab	4	-	15	5	20	117
BTL306	Industrial Biotechnology-II (Theory)	4	30	-	10	40	118
BTP326	Industrial Biotechnology-II Lab	4	-	15	5	20	120
Total		48	180	90	90	360	

SEMESTER - VI							
Course Code	**Course Name**	**Hours/ Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
BTL351	r-DNA Technology-II (Theory)	4	30	-	10	40	121
BTP371	r-DNA Technology-II Lab	4	-	15	5	20	123
BTL352	Animal Biotechnology-II (Theory)	4	30	-	10	40	124
BTP372	Animal Biotechnology-II Lab	4	-	15	5	20	126
BTL353	Plant Biotechnology-II (Theory)	4	30	-	10	40	127
BTP373	Plant Biotechnology-II Lab	4	-	15	5	20	129
BTL354	Bioprocess Engineering-II (Theory)	4	30	-	10	40	130
BTP374	Bioprocess Engineering-II Lab (Industrial Training)	4	-	15	5	20	132
BTL355	Chemistry-III (Physical) (Theory)	4	30	-	10	40	133
BTP375	Chemistry-III (Physical) Lab	4	-	15	5	20	135
BTL356	Biochemical and Biophysical Techniques-II (Theory)	4	30	-	10	40	137
BTP376	Biochemical and Biophysical Techniques-II Lab	4	-	15	5	20	139
BTP377	Term Paper*	4	-	-	-	20	141
Total		52	180	90	90	360	

B.Sc. Biotechnology

Syllabus
SEM I to VI (2022-25)

KHALSA COLLEGE
AMRITSAR

B.Sc. Biotechnology (Semester-I)
BT-BTL111
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 : bacteria, eukaryotic microbes, plant and animal cells
3. To make students understand the structural organization of cell and function of different organelles.
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)
BT-BTP111
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.

B.Sc.
Biotechnology
(Semester-I)

BO-BTL112
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

1. To study the plant diversification and their different groups.
2. To study the internal structure (anatomy) of plants (root, stem and leaf).
3. The study the concept of reproduction (vegetative and sexual) in flowering plants.
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 malegametophyte, 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

BO-BTP-112
Botany –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 study micro and megasporogenesis and female gametophytes and endosperms.
2. To study the internal structure (anatomy) of plants (root, stem and leaf).
3. The study floral diagram and floral formula of different flowers.
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

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

BT-BTL-113

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)

BT-BTP113

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)

BT-BTL114

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)

BT-BTP114

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)

CH-BTL115

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)

CH-BTP115
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)

BCSE-1122

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. Thequestions 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)

BHPB-1101

ਲਾਜ਼ਮੀ ਪੰਜਾਬੀ

ਸਮਾਂ : 3 ਘੰਟ ਕ੍ਰੈਡਿਟ ਪ੍ਰਤੀ ਹਫਤਾ : 04

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

ਅੰਕ-ਵੰਡ ਅਤੇ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

- ਸਿਲੇਬਸ ਦ ਚਾਰ ਭਾਗ ਹਨ ਪਰ ਪ੍ਰਸ਼ਨ-ਪੱਤਰ ਦ ਪੰਜ ਭਾਗ ਹੋਣਗੇ। ਪਹਿਲੇ ਚਾਰ ਭਾਗਾਂ ਵਿਚ 02-02 ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ। ਹਰੇਕ ਭਾਗ ਵਿਚੋਂ 01-01 ਪ੍ਰਸ਼ਨ ਕਰਨਾ ਲਾਜ਼ਮੀ ਹੋਵੇਗਾ। ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦ ਬਰਾਬਰ (08) ਅੰਕ ਹੋਣਗੇ। ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦ ਪੰਜਵੇਂ ਭਾਗ ਵਿਚ ਸਾਰ ਸਿਲੇਬਸ ਵਿਚ 01-01 ਅੰਕ ਦ ਛੇ ਪ੍ਰਸ਼ਨ ਪੁੱਛ ਜਾਣਗੇ, ਜਿਨਾਂ ਵਿਚੋਂ 05 ਪ੍ਰਸ਼ਨਾਂ ਦ 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, ਜ ਕਾਲਜ ਵੱਲ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਥਿਊਰੀ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ । ਇਸ ਪੇਪਰ ਦ ਕੁੱਲ ਅੰਕ 37+13 = 50 ਹਨ ।

ਕੋਰਸ ਦਾ ਉਦੇਸ਼ ਕੋਰਸਆਉਟਕਮਬਜਏਚਟਵਿਏ

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

ਪਾਠ—ਕ੍ਰਮ

ਭਾਗ—ਪਹਿਲਾ

ਸਾਹਿਤ ਦੇ ਰੰਗ, ਡਾ. ਮਹਿਲ ਸਿਘ (ਸੰਪਾ.), ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ ।
ਭਾਗ ਪਹਿਲਾ - ਕਵਿਤਾ ਅਤੇ ਕਹਾਣੀ, ਡਾ. ਮਹਿਲ ਸਿੰਘ ਅਤੇ ਡਾ. ਆਤਮ ਰੰਧਾਵਾ (ਸਹਿ ਸੰਪਾ.)
(ਕਵਿਤਾ ਭਾਗ ਵਿਚੋਂ ਪ੍ਰਸੰਗ ਸਹਿਤ ਵਿਆਖਿਆ/ਵਿਸ਼ਾ-ਵਸਤੂ। ਕਹਾਣੀ ਭਾਗ ਵਿਚ 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

(a) ਪੈਰ੍ਹਾ ਰਚਨਾ (ਤਿੰਨਾਂ ਵਿਚੋਂ ਇਕ)

(A) ਪੈਰ੍ਹਾ ਪੜ੍ਹ ਕ ਪ੍ਰਸ਼ਨਾਂ ਦ ਉੱਤਰ

ਭਾਗ—ਚੌਥਾ

(a) ਭਾਸ਼ਾ ਵੰਨਗੀਆਂ : ਭਾਸ਼ਾ ਦਾ ਟਕਸਾਲੀ ਰੂਪ, ਭਾਸ਼ਾ ਅਤੇ ਉਪ-ਭਾਸ਼ਾ ਵਿਚਲਾ ਅੰਤਰ, ਪੰਜਾਬੀ ਉਪ-ਭਾਸ਼ਾਵਾਂ ਦੇ ਪਛਾਣ-ਚਿੰਨ

(A) ਪੰਜਾਬੀ ਭਾਸ਼ਾ : ਨਿਕਾਸ ਤੇ ਵਿਕਾਸ

ਪਾਠ—ਕ੍ਰਮ ਨਤੀਜਾ ਕੋਰਸਆਉਟਕੋਮਜ਼ (ਕੋਸ)

- 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 ਦ ਕਾਬਲ ਹੋਵੇਗਾ।
- ਉਹ ਮਾਤ ਭਾਸ਼ਾ ਦ ਵਿਕਾਸ ਵਿਚ ਵਿਸ਼ੇਸ ਯੋਗਦਾਨ ਪਾਉਣਗੇ।

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

BPBI-1102

ਮੁਢਲੀ ਪੰਜਾਬੀ

(In Lieu of Compulsory Punjabi)

ਸਮਾਂ : 3 ਘੰਟ ਕ੍ਰੈਡਿਟ ਪ੍ਰਤੀ ਹਫਤਾ : 04

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

ਅੰਕ-ਵੰਡ ਅਤੇ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

- ਪਹਿਲੇ ਭਾਗ ਵਿਚੋਂ ਚਾਰ ਵਰਣਨਾਤਮਕ ਪ੍ਰਸ਼ਨ ਪੁੱਛ ਜਾਣਗੇ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਤਿੰਨ ਪ੍ਰਸ਼ਨਾਂ ਦਾ ਉੱਤਰ ਦੇਣਾ ਲਾਜ਼ਮੀ ਹੈ। ਹਰ ਪ੍ਰਸ਼ਨ ਦ ਚਾਰ-ਚਾਰ ਅੰਕ ਹਨ। ਭਾਗ ਦੂਸਰਾ ਵਿਚੋਂ ਦ-ਦ ਅੰਕ ਦ ਪੰਜ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ। ਸਾਰ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹਨ। ਭਾਗ ਤੀਸਰਾ ਵਿਚੋਂ ਤਿੰਨ ਪ੍ਰਸ਼ਨ ਪੁੱਛ ਜਾਣਗੇ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਦ ਪ੍ਰਸ਼ਨ ਹੱਲ ਕਰਨ ਲਾਜ਼ਮੀ ਹਨ ਜਿਨ੍ਹਾਂ ਦਪੰਜ-ਪੰਜ ਅੰਕ ਹਨ। ਭਾਗ ਚੌਥਾ ਵਿਚ ਪੰਜ ਅਸ਼ੁੱਧ ਸ਼ਬਦਾਂ ਨ ਸ਼ੁੱਧ ਕਰਕੇ ਲਿਖਣਾ ਹੋਵਗਾ।
- **ਨੋਟ:** ਇੰਟਰਨਲ ਅਸੈੱਸਮੈਂਟ 13 ਅੰਕਾਂ ਦੀ ਹੈ, ਜ ਕਾਲਜ ਵੱਲ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਥਿਊਰੀ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ। ਇਸ ਪੇਪਰ ਦ ਕੁਲ ਅੰਕ 37+13 = 50 ਹਨ।

ਕੋਰਸ ਦਾ ਉਦੇਸ਼ ਕੋਰਸਆਊਟਬਜਏਚਟਵਿਏ

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

ਪਾਠ—ਕ੍ਰਮ

ਭਾਗ—ਪਹਿਲਾ

(a) ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਤੇ ਗੁਰਮੁਖੀ ਲਿਪੀ :

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

(A) ਸਿਖਲਾਈ ਤੇ ਅਭਿਆਸ

ਭਾਗ—ਦੂਜਾ

ਗੁਰਮੁਖੀ ਆਰਥੋਗਰਾਫੀ ਅਤੇ ਉਚਾਰਨ :

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

ਭਾਗ—ਤੀਜਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਜੋੜ :

ਮੁਕਤਾ (ਦ ਅੱਖਰਾਂ ਵਾਲ ਸ਼ਬਦ, ਤਿੰਨ ਅੱਖਰਾਂ ਵਾਲ ਸ਼ਬਦ), ਸਿਹਾਰੀ ਵਾਲ ਸ਼ਬਦ, ਬਿਹਾਰੀ ਵਾਲ ਸ਼ਬਦ, ਔਂਕੜ ਵਾਲ ਸ਼ਬਦ, ਦੁਲੈਂਕੜ ਵਾਲ ਸ਼ਬਦ, ਲਾਂ ਵਾਲ ਸ਼ਬਦ, ਦੁਲਾਵਾਂ ਵਾਲ ਸ਼ਬਦ, ਹੋੜੇ ਵਾਲੇ ਸ਼ਬਦ, ਕਨੌੜਵਾਲ ਸ਼ਬਦ, ਲਗਾਖਰ (ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ) ਵਾਲ ਸ਼ਬਦ

ਭਾਗ—ਚੌਥਾ

ਸ਼ੁੱਧ-ਅਸ਼ੁੱਧ ਸ਼ਬਦ

ਪਾਠ—ਕ੍ਰਮ ਨਤੀਜਾ ਕੋਰਸਆਊਟਕੋਮਅਸ (ਕੋਸ)

- 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 ਨਵਿਕਸਿਤ ਕਰਨਗੇ।
- ਉਹ ਪੰਜਾਬੀ ਸ਼ਬਦ-ਜੋੜਾਂ ਦੀ ਜਾਣਕਾਰੀ ਹਾਸਿਲ ਕਰ ਵਿਦਿਆਰਥੀ ਸ਼ੁੱਧ ਪੰਜਾਬੀ ਲਿਖਣ-ਪੜ੍ਹਨ ਦ ਸਮਰੱਥ ਹੋਣਗੇ।
- ਉਹ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦ ਵਿਆਕਰਨ ਪ੍ਰਬੰਧ ਦੀ ਜਾਣਕਾਰੀ ਹਾਸਿਲ ਕਰਨਗੇ।

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

BPHC-1104

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 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 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. 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 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)

Course Code: ZDA111
Course Title- Drug Abuse: Problem, Management and Prevention
PROBLEM OF DRUG ABUSE
(Compulsory for all Under Graduate Classes)

Credit Hours (per week): 1.5 hrs.
Total Hours: 22.5 hrs.
Time 3 hrs **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 aims to:

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

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 and 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: Counseling, Behavioral 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, "voZrI d[otos'A^(BPky'oh) ;wZf;Nk, gqpzXB Ns/ o'eEkw", 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, "voZrI d[otos'A^(BPky'oh) gqpzXB Ns/ o'eEkw", 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)

ZO-BTL121
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)

ZO-BTP121

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

BT-BTL-122

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)

BT-BTP122

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)

BT-BTL123

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)

BT-BTP123

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)

BT-BTL124

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 Sciencess 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)

BT-BTP124

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)

MA-BTL125

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:

The question paper will consists of five sections A, B, C, D and E. Section A will consists of 6 short answer type questions which cover the entire syllabus and will carry 1 mark each. Section A is compulsory. Section B, C, D, E will have two questions from the respective sections of the syllabus and carry 6 marks each. Candidates are required to attempt one question each from Section B, C, D and E of the question paper.

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)

BCSE-1222

COMMUNICATION SKILLS IN ENGLISH

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. Thequestions 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:
   1. 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 nuancesof an effective group discourse.
5. Communicate contextually in specific and professional situations with courtesy.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)
BHPB-1201
ਲਾਜ਼ਮੀ ਪੰਜਾਬੀ

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

ਅੰਕ—ਵੰਡ ਅਤ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

- ਸਿਲੇਬਸ ਦ ਚਾਰ ਭਾਗ ਹਨ ਪਰ ਪ੍ਰਸ਼ਨ-ਪੱਤਰ ਦ ਪੰਜ ਭਾਗ ਹੋਣਗੇ। ਪਹਿਲੇ ਚਾਰ ਭਾਗਾਂ ਵਿਚ 02-02 ਪ੍ਰਸ਼ਨ ਪੁੱਛ ਜਾਣਗੇ। ਹਰੇਕ ਭਾਗ ਵਿਚੋਂ 01-01 ਪ੍ਰਸ਼ਨ ਕਰਨਾ ਲਾਜ਼ਮੀ ਹੋਵੇਗਾ। ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦ ਬਰਾਬਰ (08) ਅੰਕ ਹੋਣਗੇ। ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦ ਪੰਜਵੇਂ ਭਾਗ ਵਿਚ ਸਾਰ ਸਿਲੇਬਸ ਵਿਚ 01-01 ਅੰਕ ਦ ਛੇ ਪ੍ਰਸ਼ਨ ਪੁੱਛ ਜਾਣਗੇ, ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ 05 ਪ੍ਰਸ਼ਨਾਂ ਦ ਉੱਤਰ ਦੇਣ ਲਾਜ਼ਮੀ ਹੋਵੇਗਾ। ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੰਗੋਂ ਵੱਧ ਤੋਂਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।
  ਨੋਟ: ਇੰਟਰਨਲ ਅਸੈੱਸਮੈਂਟ 13 ਅੰਕਾਂ ਦੀ ਹੈ, ਜ ਕਾਲਜ ਵੱਲ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਥਿਊਰੀ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ । ਇਸ ਪੇਪਰ ਦ ਕੁੱਲ ਅੰਕ 37+13 = 50 ਹਨ ।

ਕੋਰਸ ਦਾ ਉਦੇਸ਼ ਫ਼ੋਰਸਟੋਬਜਇਚਟਵਿਇ

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

ਪਾਠ—ਕ੍ਰਮ

ਭਾਗ—ਪਹਿਲਾ

ਸਾਹਿਤ ਦੇ ਰੰਗ, ਡਾ. ਮਹਿਨ੍ਦਰ ਸਿਘ (ਸੰਪਾ.), ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ ।
ਭਾਗ ਦਜਾ - ਵਾਰਤਕ ਅਤੇ ਰੇਖਾ-ਚਿੱਤਰ, ਡਾ. ਪਰਮਿੰਦਰ ਸਿੰਘ, ਡਾ. ਭੁਪਿੰਦਰ ਸਿੰਘ ਅਤੇ ਡਾ. ਕਲਦੀਪ 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

(a) ਦਫ਼ਤਰੀ ਚਿੱਠੀ ਪੱਤਰ
(A) ਮੁਹਾਵਰੇ ਅਤੇ ਅਖਾਣ

ਭਾਗ—ਚੌਥਾ

(a) ਸ਼ਬਦ-ਬਣਤਰ ਅਤੇ ਸ਼ਬਦ-ਰਚਨਾ – ਪਰਿਭਾਸ਼ਾ ਅਤੇ ਮੁੱਢਲੇ ਸੰਕਲਪ
(A) ਸ਼ਬਦ-ਸ਼੍ਰੇਣੀਆਂ

ਪਾਠ—ਕ੍ਰਮ ਨਤੀਜਾ ਫ਼ੋਰਸਟੋਟਚੋਮਇਸ (ਫ਼ੌਸ)

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

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)
BPBI-1202
ਮੁਢਲੀ ਪੰਜਾਬੀ
(In Lieu of Compulsory Punjabi)

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

ਅੰਕ—ਵੰਡ ਅਤ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

- ਭਾਗ ਪਹਿਲਾ ਵਿਚੋਂ ਚਾਰ ਪ੍ਰਸ਼ਨ ਪੁੱਛ ਜਾਣਗੇ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਤਿੰਨ ਪ੍ਰਸ਼ਨਾਂ ਦਾ ਉੱਤਰ ਦੇਣਾ ਲਾਜ਼ਮੀ ਹੈ। ਹਰ ਪ੍ਰਸ਼ਨ ਦ ਚਾਰ-ਚਾਰ ਅੰਕ ਹਨ। ਭਾਗ ਦੂਸਰਾ ਵਿਚੋਂ ਦ-ਦ ਅੰਕ ਦ ਪੰਜ ਪ੍ਰਸ਼ਨ ਪੁੱਛ ਜਾਣਗੇ। ਸਾਰ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹਨ।
  ਭਾਗ ਤੀਸਰਾ ਵਿਚੋਂ ਚੌਰ ਪ੍ਰਸ਼ਨ ਪੁੱਛ ਜਾਣਗੇ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਦ ਪ੍ਰਸ਼ਨ ਹੱਲ ਕਰਨ ਲਾਜ਼ਮੀ ਹਨ। ਭਾਗ ਚੌਥਾ ਵਿਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛ ਜਾਣਗੇ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਹੱਲ ਕਰਨਾ ਹੋਵੇਗਾ।

ਨੋਟ: ਇੰਟਰਨਲ ਅਸੈੱਸਮੈਂਟ 13 ਅੰਕਾਂ ਦੀ ਹੈ, ਜ ਕਾਲਜ ਵੱਲ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਥਿਓਰੀ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ। ਇਸ ਪੇਪਰ ਦ ਕੁਲ ਅੰਕ 37+13 = 50 ਹਨ।

ਕੋਰਸ ਦਾ ਉਦੇਸ਼ ਫ਼ੋਰਸਏ ਬਜਏਚਟਵਿਏ

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

ਪਾਠ—ਕ੍ਰਮ

ਭਾਗ—ਪਹਿਲਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ :

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

ਭਾਗ—ਦੂਜਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਪ੍ਰਕਾਰ :

(a) ਸੰਯੁਕਤ ਸ਼ਬਦ, ਸਮਾਸੀ ਸ਼ਬਦ, ਦੋਜਾਤੀ ਸ਼ਬਦ, ਦੋਹਰੇਦੁਹਰੁਕਤੀ ਸ਼ਬਦ ਅਤੇ ਮਿਸ਼ਰਤ ਸ਼ਬਦ

(A) ਸਿਖਲਾਈ ਤੇ ਅਭਿਆਸ

ਭਾਗ—ਤੀਜਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਰਚਨਾ :

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

ਭਾਗ—ਚੌਥਾ

ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ

ਖਾਣ-ਪੀਣ, ਸਾਕਾਦਾਰੀ, ਰੁੱਤਾਂ, ਮਹੀਨਿਆਂ, ਗਿਣਤੀ, ਮੌਸਮ, ਬਾਜਾਰ, ਵਪਾਰ, ਧੰਦਆਂ ਨਾਲ ਸੰਬੰਧਿਤ

ਪਾਠ—ਕ੍ਰਮ ਨਤੀਜਾ ਫ਼ੋਰਸਏ ਟਚੋਮਏਸ (ਫ਼ੌਸ)

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

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

BPHC-1204

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.

Course content

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 7th century to1000AD.

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

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

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

Course Code: ZDA121

Course Title-DRUG ABUSE: PROBLEM, MANAGEMENT AND PREVENTION

DRUG ABUSE: MANAGEMENT AND PREVENTION

(Compulsory for all Under Graduate Classes)

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 aim is to

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

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. voZrI dotos (BPkyoh) gqpzXB Ns oeEkw. 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), Applications of PCR, 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 Outcome

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

Time: 3 Hours
Note for the paper setters/examiners:
Credit Hours: 3 Hrs/week

Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

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

Cells of the immune system: haematopoiesis and differentiation (erhthrocytes, leucocytes and platelets). Types of immunity-innate and adaptive; Features of immune response-memory; Specificityand 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 processing of 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 achiral structures, chiral centers 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 centers, chemical reactions that produce stereoisomers, Resolution of enantiomers, chiral centers 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 stereochemistry of SN1reactions, carbocation real arrangements in SN^1 reactions, solvent effects, substitution 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)
Programme Code: BSBT
Course Code: BTL204
Course Title: Botany-II

Credit Hours (Per Week): 3
Total Hours : 45
Maximum Marks : 40
BTL204 : 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 Objectives:

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.

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 mode of transmission & control measures of plant diseases; host-pathogen interaction: 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:

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)
Programme Code: BSBT
Course Code: BTP224
Course Title: Botany-II Lab

Credit Hours (Per Week): 3
Total Hours : 45
Maximum Marks : 20
BTL224 : 15 Marks
Internal Assessment : 05 Marks

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

CO-1	To study the basic plant physiological processes.
CO-2	To study the relative moisture contents in plants (leaf), osmotic potential.
CO-3	To study the process of transpiration in plants by mercury method.
CO-4	To study the evolved oxygen during the process of photosynthesis in plants.
CO-5	To study the different types of pigments present in plants and their separation *via* TLC method.
CO-6	To study the basics of plant pathology which includes plant pathogens and their symptoms appears on plants.

Practicals

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 the percentage of moisture content present in plants (leaf)
CO-2	To know about the concept of osmotic potential and their measurement by prescribed method
CO-3	To know about the transpiration process, evolution of oxygen though laboratory techniques
CO-4	Students will know about the nature and importance of plant pigments
CO-5	They will learn about the plant pathology, causal organisms and know about the symptoms appears on infected plants.

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, Glycogenesis, Glycogenolysis, Regulation of carbohydrates metabolism.

SECTION-B

Pyruvate dehydrogenase complex, 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 synthesis.

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

Time: 3 Hours
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 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. Nucleic acid as the genetic (Griffith material experiment, Avery Mcleod and Harshey chase experiment, Meselson and stahl experiment), Structure of DNA & RNA, A, B, Z form of DNA, 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, Principles of gene regulation, negative and positive regulation, concept of operon (Lac operon).

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 bromide) 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.

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

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

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.

Unit-I

The Multidisciplinary Nature of Environmental Studies: Definition, components, scope and importance of environment/environmental studies, Need for public awareness.

Natural Resources: Definition, types, use, overexploitation, benefits, case studies (if any) and associated problems of following natural resources: Forest Resources, Water Resources, Mineral Resources, Food Resources, Energy Resources, Land Recourses *etc.*

Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit-II

Ecosystem:

General introduction, types (Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems *viz.* ponds, streams, lakes, rivers, oceans, estuaries), Structure and functions of an

ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.

Unit-III

Social Issues and Environment: Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting. 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 andholocause. Case studies. Wasteland reclamation.

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.

Suggested Books:

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2013 . Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Basu, M., Xavier, S. 2016. Fundamentals of Environmental Studies, Cambridge University Press, India
3. Down to Earth, Centre for Science and Environment, New Delhi.
4. Jadhav, H. and 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. and Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
7. Mahapatra, R., Jeevan, S.S. and Das, S. 2017. Environment Reader for Universities, Centre for Science and Environment, New Delhi.
8. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.

9. Raven, P.H., Hassenzahl, D.M. and Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.
10. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
11. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar
12. Kanta, S., 2012. Essentials of Environmental Studies, ABS Publications, Jalandhar.
13. Saroj A., Kaur R., Walia H., Kaur T, 2021. Environmental Studies - A Holistic Approach, KLS Publishers.

Suggested Websites:

1. https://nss.gov.in
2. https://moef.gov.in
3. http://punenvis.nic.in
4. https://www.unep.org

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. Production of modern biotechnology products- recombinant proteins having therapeutic and diagnostic applications (insulin and growth hormones)

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. Flow cytometry and fluorescence.

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 feedback inhibition.

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. Disorders of nucleotide metabolism: Lesch Nyhan syndrome, Gout, SCID, Adenosine deaminase deficiency.

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

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).
Disease management of medicinal and aromatic plants.

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 legalaspects. 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 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 biofertilizers in agricultural processes.
2. Students will learn about the different types of microorganisms that are used in the production of biofertilizers.
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 flavonoid 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 biofertilizers.

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 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 datastorage 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, Role of bioinformatics in biotechnology.

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 become 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 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 hemorrhagic 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.

SEMESTER–IV

Course Code: ESL–222
Course Title: ENVIRONMENTAL STUDIES–II (COMPULSORY)

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

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.

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. Threatened and endemic species of India.
- Endangered species, vulnerable species, and rare species.
- Conservation of Biodiversity: In situ and Ex-situ conservation of biodiversity. National Parks, Wild life sanctuaries, Biosphere reserve, Project Tiger, Project Elephant.

Unit-II

Environmental Pollution:
Environmental Pollution: Concepts and Types

- Definition, causes, effects and control measures of:
- Air Pollution

- Water Pollution
- Soil Pollution
- Marine Pollution
- Noise Pollution
- Thermal Pollution
- Nuclear Hazards
- Electronic Waste
- Concepts of hazards waste & human health risks.
- Solid Waste Management: Causes, effects and control measures of municipal, biomedical and e-waste
- 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**
- Human population growth: impacts on environment.
- Population explosion-Family welfare programme.
- Environment and human health: Concept of health and disease, common communicable and non communicable diseases, public awareness
- Human rights.
- Value education.
- Women and child welfare.
- Role of information technology in environment and human health.
- Environment movments in India: Chipko movement, Silent valley movement and other case studies.
- Road Safety Rules & Regulations**:** Use of Safety Devices while Driving, Do's and Don'tswhile Driving, Role of Citizens or Public Participation, Responsibilities of Public underMotor 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.
- Visit to Museum/Science City
- Municipal solid waste management and handling.

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.

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, PearsonEducation (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. Asthana, D.K. 2006. Text Book of Environmental Studies, S. Chand Publishing.
11. Kanta, S., 2012. Essentials of Environmental Studies, ABS Publications, Jalandhar.
12. Basu, M., Xavier, S. 2016. Fundamentals of Environmental Studies, Cambridge University Press, India.
13. Mahapatra, R., Jeevan, SS, Das S. 2017. Environment Reader for Universities, Centre for Science and Environment, New Delhi.

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

BTL301 r-DNA Technology-I

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

Time: 3 Hours

Instructions for the Paper Setters:
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 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

Section-A

Nucleases (DNases, RNases), Ligases for blunt & sticky end ligation, DNA Polymerases, Klenow fragment, Phosphatases, Polynucleotide kinase, Terminal deoxynucleotidyl transferase, Restriction Endonucleases and reverse transcriptase.

Section-B

Cloning Vectors for E.coli: Features of plasmids, Properties of an ideal vector and development of plasmids as vector: (α-complementation), Lytic and Lysogenic cycle in Lambda bacteriophages as vector, Selection of transformants, M13 as cloning vector, cosmids.

Section-C

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

Section-D

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.

Books Recommended

1. Principles of Gene Manipulation and Genomics Kindle Edition,2013, by Sandy B. Primrose, Richard Twyman, Wiley-Blackwell
2. Recombinant DNA: Genes and Genomes A Short Course Third Edition| ©2007 James D. Watson; Richard M. Myers; Amy A. Caudy; Jan A. Witkowski

3. Gene Cloning and DNA Analysis: An Introduction, 2010, by T. A Brown, Blackwell Publishing.
4. rDNA technology:2nd edition, 2017, AD SHARMA. Himalaya publishing house
5. Analysis of Genes and Genomes, 2004, Richard J. Reece, Wiley-Blackwell

Course Outcome

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

BTP321 r-DNA Technology-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 the preparation 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.

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. 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

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

BTL302 Plant Biotechnology-I

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

Time: 3 Hours
Instructions for the Paper Setters:

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. 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

SECTION-A

Introduction to plant tissue culture and its historical perspective, Cellular totipotency; differentiation, dedifferentiation and redifferentiation of cells; tissue competency; plant-explant-plant concept. Plant tissue culture lab: Layout and organization, infrastructure, equipment and instruments. Sterilization methods for lab, glassware, tools, culture media and plant materials.

SECTION-B

Culture Media: Nutritional requirements for plant tissue culture; types of media and role of different components; preparation of culture media. Physiological functions and biosynthesis of major plant growth regulators such as auxins, cytokinins, gibberllins and abscisic acid.

SECTION-C

Modes of regeneration: Organogenesis and somatic embryogenesis; types and applications of somatic embryogenesis. Micropropagation methods (axillary bud, shoot- tip and meristem culture); stages of micropropagation, factors affecting micropropagation and technical problems; acclimatization of tissue culture raised plants; applications of micropropagation; a brief account of synthetic seeds.

SECTION-D

Haploid and triploid plant production through tissue culture & their applications; ovary and ovule culture; embryo culture and rescuing hybrid embryos; somaclonal variations, selection of variant cell lines and its applications.

Books Recommended

1. Plant Tissue Culture: An Introductory Text By Sant Saran Bhojwani, Prem Kumar Dantu • 2013 Publisher: Springer India
2. Introduction to Plant Tissue Culture. M. K. Razdan • 2019 ISBN: 9788120417939 Publisher: OXFORD & IBH PUBL
3. Plant Cell Culture: Essential Methods. Michael R. Davey, Paul Anthony • 2010 Publisher:Wiley

Course Outcome

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

BTP322 Plant 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 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 students 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 Outcome

CO-1: The students will know the functions and operations of various instruments in planttissue culture laboratory.
CO-2: The students will be able to know the design set up for a plant tissue culture laboratory.
CO-3: The students will learn cleaning of glassware, plastic ware and contaminated cultures.
CO-4: The students will learn about different types of enclosure used in plant tissue cultures.
CO-5: The students will learn different 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

BTL303 Animal Biotechnology-I

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

Time: 3 Hours

Instruction for the Paper Setters:

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 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

Section-A

Historical background, Advantages & Disadvantages of animal tissue culture, Design and layout of ATC Lab, Equipment 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.

Section-B

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

Section-C

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

Section-D

Primary culture and Established cell line Culture (Finite & continuous cell lines),

Isolation of cells-Enzyme digestion, perfusion and mechanical disaggregation. Culture ofattached 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. Freshney, R.I (2015) Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 7th Edition, John Wiley and Sons, New Delhi.
2. Animal Cell Culture: Essential Methods. Edited by John M. Davis. John Wiley & Sons, Ltd.UK. 2011
3. Cell Biology: A Laboratory Handbook. Volume 1-4, 3rd Edition. Edited by Julio E. Celis.Nigel Carter, Kai
4. Simons, J. Victor Small, Tony Hunter and David Shotton. Academic Press. USA, 2005
5. Butler, M. (2004). Animal Cell Culture and Technology, 2nd Ed., BIOS Scientific Publishers,Taylor &Francis group, London and New York.
6. Basic Cell Culture: A Practical Approach, 2nd ed. Edited by John Davis Oxford UniversityPress, Oxford and New York. 2002

Course Outcome

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

BTP323 Animal Biotechnology-I Lab

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

1. To gain important skills like preparation 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. Sources of contamination and decontamination measures.
2. Preparation of Hanks Balanced salt solution
3. Preparation of Minimal Essential Growth medium.
4. Separation of Serum from blood
5. 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 Outcome

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

BTL304 Bioprocess Engineering-I

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

Time: 3 Hours
Instructions for the Paper Setters:

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

Course content

Section-A

Introduction: Fundamental principles of Chemical Engineering and biochemical engineering. Fourier's Laws of heat transfer, Molecular 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.

Section-B

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.

Section-C

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

Section-D

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

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

4. Academic Publications, New Delhi. 5. 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 Outcome

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 sterilization cycles for batch and continuous processes.

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

BTP324 Bioprocess Engineering-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. 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.

Course Outcome

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 about the ex–situ and in–situ methods of sterilization.
CO-3. Analyze various parameters such as temperature and pH for optimum growth ofbacterial cultures.
CO-4. Learn about the production process of enzymes at industrial scale including the type of substrate, pH, temperature, dissolved oxygen concentration, required for the enzyme production.

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)

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

BTL305 Biochemical and Biophysical Techniques-I

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

Time: 3 Hours

Instructions for the Paper Setters: 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 objectives of this course are to make students

1. To make students understand the basic concept of centrifugation, its types and applications, different 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

Section-A

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.

Section-B

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 affinitychromatography.

Section-C

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

Section-D

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

Course Outcome

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.

Books Recommended

1 Upadhyay, A., Upadhyay, K. and Nath N. (2005) Biophysical chemistry: Principles and Techniques. Himalaya Publishing House, India.
2 Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd., Chichester, England.
3. Friefelder, D. (1999). Physical Biochemistry - Application of Biochemistry and Molecular Biology, 2nd Edition, W.H.Freeman and Co.
4. Plummer D (2006) An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Co., New Delhi.
5. Wilson K and Walker J (2010) Principles and Techniques of Practical Biochemistry, Cambridge University Press, UK
6. Boye R (2006) Modern Experimental Biochemistry, Pearson Education, Asia, New
7. Sawhney, S.K. and Singh, R. (2001). Introductory Practical Biochemistry. Narosa Pub. House, New Delhi.

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

BTP325 Biochemical and Biophysical Techniques-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 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 Outcome

CO-1. The students will get good knowledge about the different types of rotors and also learn about how and when to use particular types of rotors 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 help students to separate protein from given sample mixture and also to learn about affinity properties of particular
CO-5. These techniques will help students to understand the biophysical and biochemical properties of different types of bio-molecules.

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

BTL306 Industrial Biotechnology-II

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

Time: 3 Hours

Instructions for the Paper Setters: 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 production of antibiotics, enzymes, solvents and bacterial biofertilizers in detail.
2. They will learn about fermented foods and production of various microbial products.
3. Students will understand the role of agriculture in biotechnology, the idea, process and advantages of transgenic crops, biogas production, xenobiotic compound.
4. Students will recognize the importance of nitrogen cycle, nitrogen fixing bacteria and their role in maintaining a sustainable agriculture ecosystem.

Course content

Section-A

Antibiotics production: Penicillin and Streptomycin, Enzymes production: amylases and cellulases, solvent production: Acetone, butanol and ethanol. Vermicomposting, Microbial inoculants and production of bacterial biofertilizers, Biocontrol agent and their significance.

Section-B

Fermented foods: Sauerkraut and pickles, Biotransformation, organic acids: production of citric Acid and acetic acid, microbial production of vitamin B12 and vitamin C, amino acids: Glutamic acid and lysine production, single cell protein: spirulina production, alcohols, wine, beers, and mycotoxins (Aflatoxins).

Section-C

Fuel Biotechnology, transgenic crops (BT cotton and maize) and their potentials in agro industry, soil treatment with microbes, Mycorrhizal fungi, Biogas production, Biodegradation of xenobiotic compound.

Section-D

BNF and its significance, diazotrophs and their characterization, Microbial association and their interaction with plants, nitrogen cycle and role of Nitrogen fixing microbes in sustainable agriculture.

Books Recommended

1. Davis, B.D., Dulbecco. R., Eisen, H.N. and Ginsberg, H.S. (1990). Microbiology : 4th
2. TEodrittioorna,, HGa.rJp.,e rF &un Rkeo,w B, .PRu.b alinsdh eCrsa, sSei,n Cga.Lpo. r(e1994). Microbiology : An introduction : 5th Edition, The Benjamin / Cummings Publishing Company, Inc.
3. Stanier, R.Y. (1995). General Microbiology, MacMillan Press, London.
4. Pelczar, M.T (1995). Microbiology, Tata McGraw Hill Publication, New Delhi.
5. Schlegel. H.G., (1995). General Microbiology 7th Edition, Cambridge University Press.
6. Prescott and Dunn (1999). Industrial Microbiology 4th Edition, By S.K.Jain for CBS
7. PPuurbolihsiht,e Srs. S&. (D20is0tr0i)t.u Mtorisc.robiology : Fundamentals and Applications (6th Edition), Agrobios (India).
8. Postgate. J. (2000). Microbes & Man 4th Edition, Cambridge University 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
11. F2nrda zEide.r,, PWer.gCa.m aonnd PWreessst,h Oofxff,o Drd.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

CO-1 Students will have gained enough knowledge about the production of antibiotics such as penicillin, streptomycin; enzymes like amylases and cellulases, solvents like acetone, butanol and ethanol. Students will have learnt about vermicomposting, bacterial biofertilizers and the significance of biocontrol agents

CO-2 Students at the end of this course will have enough insights into the importance of food fermentation, biotransformation, microbial products such as Vit B12, Vit C, amino acids.

CO-3 Students will have learnt about the importance of transgenic crops like BT cotton and maize, learn about Biogas production

CO-4 Students will also have knowledge about the importance about BNF, Microbial association and their interaction with plants, the importance of nitrogen cycle and Nitrogen fixing microbes.

BTP326 Industrial Biotechnology-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. Students in this course will learn to screen cellulose producing microorganisms,observe the additive and synergistic effect of antibiotics, and minimum inhibitory concentration of antibiotics on these micro-organisms.
2. Learn microbial counting, perform MBRT test.
3. Learn to isolate and identify microbes using spoiled food samples.

Course content

1. Screening of cellulose producing microorganism from wood degrading soil.
2. Additive and Synergistic effect of two antibiotics on the above microorganism.
3. Minimum inhibitory concentration of a antibiotics for the above microorganism.
4. Plating the milk samples for microbial counting.
5. MBRT Test for determination of milk quality.
6. Isolation and identification of microbes from spoiled food sample.

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

At the end of the course students will be able to

CO-1 Identify the microorganisms isolated from wood degrading soil
CO-2 Evaluate the effects of antibiotics on isolated microorganisms and understand the importance of MIC of anantibiotic on microorganism
CO-3 Do plating and perform counting.
CO-4 Perform MBRT test

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BTL351 r-DNA Technology-II

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

Time: 3 Hours
Instructions for the Paper Setters:

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

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

Section-A

Cloning vectors for Eukaryotes (TAC, YAC, BAC, Ti plasmids), Expression Vectors pET28a, pGEX, role of promoter, cassettes and gene fusion,important components of shuttle vectors.

Section-B

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

Section-C

Principles & applications of PCR, Types of PCR (Nested, RT-PCR, Multiplex, Touchdown, Hot stat), Fundamental concepts & applications of microarray.

Section-D

DNA Sequencing: Sanger-Coulson method (chain terminating nucleotides), Maxam Gilbert method (chemical degradation of DNA), Changing genes: site directed mutagenesis, cassette mutagens, single primer method, PCR methods of site directed mutagenesis, phage display: selection of mutant peptides.

Books Recommended

1. Principles of Gene Manipulation and Genomics Kindle Edition,2013, by Sandy B. Primrose, Richard
Twyman , Wiley-Blackwell

2. Recombinant DNA: Genes and Genomes A Short Course Third Edition| ©2007 James D. Watson;
   Richard M. Myers; Amy A. Caudy; Jan A. Witkowski
3. Gene Cloning and DNA Analysis: An Introduction, 2010, by T. A Brown, Blackwell Publishing.
4. rDNA technology:2nd edition, 2017, AD SHARMA. Himalaya publishing house
5. Analysis of Genes and Genomes, 2004, Richard J. Reece, Wiley-Blackwell peptides.

Course Outcome

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)

BTP371 r-DNA Technology-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. 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. Ligation of DNA 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 Outcome

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 DNA ligation.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BTL352 Animal Biotechnology-II

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

Time: 3 Hours

Instructions for the Paper Setters:
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 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

Section-A

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.

Section-B

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.

Section-C

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 plications.

Section-D

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. Freshney, R.I (2015) Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 7th Edition, John Wiley and Sons, New Delhi.
2. Animal Cell Culture: Essential Methods. Edited by John M. Davis. John Wiley & Sons, Ltd. UK. 2011
3. Cell Biology: A Laboratory Handbook. Volume 1-4, 3rd Edition. Edited by Julio E. Celis. Nigel Carter, Kai

4. Simons, J. Victor Small, Tony Hunter and David Shotton. Academic Press. USA, 2005
5. Butler, M. (2004). Animal Cell Culture and Technology, 2nd Ed., BIOS Scientific Publishers, Taylor &Francis group, London and New York.
6. Basic Cell Culture: A Practical Approach, 2nd ed. Edited by John Davis Oxford University Press, Oxford and New York. 2002

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 taught.
CO-4. Students will study genetic engineering of animal cells and techniques of animal cloning.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BTP372 Animal Biotechnology-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. 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.
3. Resolving DNA on Agarose Gel.
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.

Course Outcome

CO-1. Students 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 establishment, subculturing and checking doubling time of a cell line.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BTL353 Plant Biotechnology-II

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

Time: 3 Hours

Instructions for the Paper Setters:

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 main objective of this course is to introduce the practices of plant tissue culture, geneticengineering and transgenic production of plants.
2. This course presents the applications of micro-propagation and somatic embryogenesis forthe large-scale propagation of plants.
3. Students will learn about somatic hybridization, cybridization and production of secondarymetabolites from plants.

Course content

Section-A

Protoplast isolation and culture, viability of protoplasts, protoplast fusion, selection of somatic hybrids and cybrids, applications of somatic cell hybridization.
Cell suspension culture, production of secondary metabolites by plant tissue culture, immobilized plant cell culture and use of bioreactors in secondary metabolite production.Cryopreservation of germplasm: short term and long-term conservation of plant genetic resources.

Section-B

Organization of genes in plants; promoter and regulatory sequences; reporter genes, marker genes (scorable and selectable).
Genetic transformation of plants by *Agrobacterium tumefaciens* and *A. rhizogenes*, natural mode of infection, Ti/Ri plasmids, vir functions, binary and cointegrate vectors, features of transgene integration; use of plant viruses as vectors, RNA interference and its applications.

Section-C

Direct DNA transfer/physical methods of gene transfer in plants: micro-projectile bombardment, electroporation, liposome mediated, calcium phosphate mediated etc; advantages and disadvantages; screening and selection of transformants: PCR and hybridization methods; transgene selection and silencing; generation and maintenance of transgenic plants.

Section-D

Applications of Transgenic Plants: Developing insect resistance, bacterial and fungal disease resistance, virus resistance and abiotic stress tolerance in plants. Improving food quality – nutritional enhancement of plants (carbohydrates, seed storage proteins and vitamins). Biopharming: plant cells as factories for production of industrial enzymes, biodegradable plastics, antibodies, edible vaccines.

Books Recommended

1. Plant Tissue Culture: An Introductory Text By Sant Saran Bhojwani, Prem Kumar Dantu 2013 Publisher: Springer India
2. Introduction to Plant Tissue Culture.M. K. Razdan • 2019 ISBN: 9788120417939 Publisher: OXFORD & IBH PUBL
3. Plant Cell Culture: Essential Methods. Michael R. Davey, Paul Anthony • 2010 Publisher: Wiley IVF & embryo transfer

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)

BTP373 Plant Biotechnology-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. 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 know the 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.

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B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BTL354 Bioprocess Engineering-II

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

Time: 3 Hours
Instructions for the Paper Setters:
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 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 industrial level setup

Course content

Section-A

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.

Section-B

Control and measurement equipment of fermenter, pH & D.O. probes, Operation and agitation and its kinetics. Power requirements in bioreactor, Reynolds number and Power number, Rheological characteristics of fermentation fluids.

Section-C

Down Stream Processing: Introduction, removal of microbial cells and other solid matters. Foam separation, filtration, industrial filters and its principles, centrifugationand industrial centrifuges, cell disruption, aqueous two-phase extraction system, super critical fluid extraction, whole broth processing.

Section-D

Effluent treatment, aerobic and anaerobic slug treatment process, fermentation economics.

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
4. Academic Publications, New Delhi. 5. 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 Outcome

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, industrial filters and centrifugations,extraction systems, super critical fluid extraction,

CO-4. Students will have knowledge about slug treatment processes and economical importance of fermentation

BTP374 Bioprocess Engineering-II Lab (Industrial Training)

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20

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.

BTL355 Chemistry-III (Physical)

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

Time: 3 Hours

Instructions for the Paper Setters:
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 main aim of the course is to familiarize the students to few major areas of Physical Chemistry ie Thermodynamics, Solution Chemistry, Electrochemistry, Chemical Kinetics and Catalysis as these fields find wide applications in large number of industrialventures.

Course content

Section-A

CHEMICAL THERMODYNAMICS:
Objectives and limitations of Chemical Thermodynamics, State functions, thermodynamic equilibrium, work, heat, internal energy, enthalpy. First Law of Thermodynamics: First law of thermodynamics for open, closed and isolated systems. Reversible isothermal and adiabatic expansion/compression of an ideal gas. Irreversible isothermal and adiabatic expansion. Enthalpy change and its measurement, standard heats of formation and absolute enthalpies. Kirchoff's equation. Second and Third Law: Various statements of the second law of thermodynamics. Efficiency of a cyclic process (Carnot's cycle). Entropy. Entropy changes of an ideal gas with changes in P,V, and T. Free energy and work functions. Gibbs-Helmholtz Equation. Criteria of spontaneity in terms of changes in free energy. Third law of thermodynamics: Absolute entropies. Thermodynamics of Simple Mixtures: Partial molar quantities and their significance. Chemical potential and its variation with T and P. Fugacity function and its physical significance. Concept of activity and activity coefficient.

Section-B

SOLUTIONS:
Ideal and non- ideal solutions, method of expression concentrations of solution, activity and activity coefficients, dilute solution, Osmotic pressure, its law and measurements, Elevation of boiling point and depression of freezing points. Chemical Equilibrium: General characteristics of chemical equilibrium, thermodynamic derivation of the law of chemical equilibrium, Van't Hoff reaction isotherm. Relation between Kp, Kc and Kx. Temperature dependence of equilibrium constant Van't Hoff equation, homogeneous & heterogeneous equilibria, Le Chetalier's principle.

Section-C

CHEMICAL KINETICS AND CATALYSIS: Scope, rate of reaction, influencing factors such as concentration, temperature, pressure, solvent etc. theories of chemical kinetics. Arrhenius equation, concept of activation energy. Rates of reactions, rate constant, order and molecularity of reactions. Chemical Kinetics: Differential rate law and integrated rate expressions for zero, first, second and third order reactions. Half-life time of a reaction. Methods for determining order of reaction. Effect of temperature on reaction rate and the concept of activation energy. Reaction mechanism. Steady state hypothesis. Catalysis: Homogeneous catalysis, Acid-base catalysis and enzyme catalysis (Michaelis-Menten equation). Heterogeneous catalysis. Unimolecular surface reactions.

Section-D

ELECTRO-CHEMISTRY: Specific conductance, molar conductance and their dependence on electrolyte concentration. Ionic Equilibria and conductance, Essential postulates of the Debye-Huckel theory of strong electrolytes. Mean ionic activity coefficient and ionic strength. Transport number and its relation to ionic conductance and ionic mobility. Conductometric titrations. pH scale. Buffer solutions, salt hydrolysis. Acid-base indicators.

Books Recommended

1. Physical Chemistry by Peter Atkius 10th edition.
2. Thermodynamics for chemists by Samuel Glasstone 2009
3. Chemical Kinetics by Keith J. Laidler 10th edition.
4. Modern Electrochemistry by John O‟M Backris and K.N. Reddy 10th edition.

Course outcomes:

Sr. No.	On completing the course,
CO1	Students will able to understand the Laws of Thermodynamics and its applications on the chemical systems.
CO2	Students will be having the knowledge of Solution Chemistry, Chemical equilibrium and its applications.
CO3	Students will learn about Chemical kinetics, homogeneous catalysis, autocatalysis, and oscillation reactions. Enzyme catalysis and heterogeneous catalysis
CO4	Students will be having knowledge on the advance topics of Electrochemistry and its application in constructions of cells, batteries, analytical techniques etc.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BTP375 Chemistry-III (Physical) 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

Students will gain the practical knowledge of handling chemicals and some lab instruments. Students will learn some physical techniques of quantitative analysis like calorimetry, conductometry, Photometry, pH-metry and Polarimetry as these techniques find wide applications in various Industries.

Course content

1. Calorimetry:
   a) Determination of Heat of neutralization
      (i) Strong acid-strong base
      (ii) Weak acid-strong base.
   b) Determination of Heat of solution of KCl, NH_4Cl, KNO_3
2. Conductometry:
   a) Determination of cell constant.
   b) Determination of specific and equivalent conductance of electrolyte (NaCl and HCl).
   c) Precipitation titration of Na_2SO_4 vs. $BaCl_2$.
   d) Neutralization titrations NaOH vs. HCl and NaOH vs. CH_3COOH.
3. Photometry.
   Verification of Lambert beer's law for solution of $CoCl_2H_2O$ (in water) and $K_2Cr_2O_7$ (in water)
4. a) pH of buffer solution
   b) Acid base titration HCl vs. NaOH.
   c) Determination of ionization constant of a weak acid (CH_3COOH)
5. Determine composition of HCl and CH_3COOH in the given solution pH metrically.
6. Polarimetry: Determine the %age composition of an optically active solution.

Books Recommended

1. Findlay‟s Practical Physical Chemistry, 9th Edition, Revised by B.P. Levitt
2. Experimental Physical Chemistry by RC DAS and B. Behera 9th Edition,

Course outcomes

S. No.	On completing the course,
CO1	Students will learn to calibrate the conductivity meter, operate and obtain conductance values from various solutions
CO2	Learn to carry out quantitative analysis using pH titration.
CO3	Student will be able to find the enthalpies of neutralization, solution etc. calorimetrically.
CO4	Quantitatively measure the composition using Polarimeter.
CO5	Trouble shoot instrument related or solution related issues.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BTL356 Biochemical and Biophysical Techniques-II

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

Time: 3 Hours
Instructions for the Paper Setters:

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 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 withradioactive studies.

Course content

Section-A

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

Section-B

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.

Section-C

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.

Section-D

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, Fourier Transform Infrared Spectroscopy (FTIR).

Books Recommended

1 Upadhyay, A., Upadhyay, K. and Nath N. (2005) Biophysical chemistry: Principles and Techniques. Himalaya Publishing House, India.
2 Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd., Chichester, England.

1. Friefelder, D. (1999). Physical Biochemistry - Application of Biochemistry and MolecularBiology, 2nd Edition, W.H.Freeman and Co.
2. Plummer D (2006) An Introduction to Practical Biochemistry, Tata McGraw HillPublishing Co., New Delhi.
3. Wilson K and Walker J (2010) Principles and Techniques of Practical Biochemistry,Cambridge University Press, UK
4. Boye R (2006) Modern Experimental Biochemistry, Pearson Education, Asia, New
5. Sawhney, S.K. and Singh, R. (2001). Introductory Practical Biochemistry. Narosa Pub.House, New Delhi.

Course Outcome

At the end of this course. Students will be:

CO-1. Able to run different electrophoretic gels such as native, SDS- PAGE, agarose gel andtwo-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)

BTP376 Biochemical and Biophysical Techniques-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

4. Students will perform qualitative and quantitative estimation of DNA samples.
5. Students will learn the preparation of standard curve of DNA and protein sample.
6. 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 Outcome

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 radio isotopic 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)

BTP377 Term Paper

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum 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.