



ಕ್ರಮಾಂಕ/No. : MU/ACC/CR.11/2025-26/A2

ಕುಲಸಚಿವರ ಕಛೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ - 574 199
Office of the Registrar
Mangalagangothri - 574 199
ದಿನಾಂಕ/Date: 10.07.2026

NOTIFICATION

Sub: Revised syllabus of M.Sc. in Biochemistry Programme.

Ref: Academic Council approval vide agenda No.: ಎಸಿಸಿ:ಶೈ.ಮ.ಸಾ.ಸ.1:12
(2026-27) dtd 29.06.2026.

The revised syllabus of M.Sc. in Biochemistry programme which has been approved by the Academic Council at its meeting held on 29.06.2026 is hereby notified for implementation with effect from the academic year 2026-27 and onwards.

Copy of the Syllabus shall be downloaded from the University Website
(www.mangaloreuniversity.ac.in)


REGISTRAR
07/07

To,

1. The Registrar (Evaluation), Mangalore University.
2. The Chairman, UG and PG Combined Board of Studies in Biochemistry, Biochemistry Programme, Mangalore University.
3. The Co-ordinator, Biochemistry Programme, Mangalore University.
4. The Asst. Registrar (ACC), O/o the Registrar, Mangalore University.
5. The Director, DUIMS, Mangalore University – with a request to publish in the website.
6. Guard File.

Mangalore University

M. Sc. Programme in Biochemistry

Mangalagangothri-574 199

PREAMBLE

The Master of Science (M.Sc.) in Biochemistry is a postgraduate Programme provides students with an in-depth understanding of the molecular and chemical foundations of biological systems. This curriculum is designed to equip students with the knowledge and skills necessary to excel in various sectors, including healthcare, research, pharmaceuticals, and biotechnology. Structured under the Choice Based Credit System (CBCS), the Programme offers a flexible and comprehensive approach to learning. It encompasses a blend of Hard Core, Soft Core, and Open Elective courses, ensuring a balanced acquisition of theoretical knowledge and practical expertise. The inclusion of a compulsory research project in the final semester fosters critical thinking, problem-solving abilities, and hands-on experience in scientific inquiry. By the end of the Programme, graduates will possess a robust foundation in biochemical principles, coupled with the analytical and technical skills required to contribute effectively to scientific research and industry applications. The M.Sc. in Biochemistry thus serves as a gateway for students aspiring to make significant contributions to the ever-evolving field of life sciences.

The Board of Studies (BOS) in Biochemistry has comprehensively revised and structured the syllabi for the Postgraduate (PG) Programme in Biochemistry, aligning it with the Choice Based Credit System (CBCS). This curriculum model integrates Hard Core, Soft Core, and Open Elective courses to ensure academic rigor, flexibility, and interdisciplinary exposure.

The PG Programme in Biochemistry is structured as follows: A total of **11 Hard Core** courses comprising **10 theory courses, One Practical Course**, and (spanning Semesters I to III) **One Project Work (Semester IV)**. These constitute a total of **56 Credits**. The Programme offers **12 Soft Core Courses**, which include: **Six Theory Courses, Eight Practical Courses** and **One Project Viva -Voce**. These are designed to provide academic flexibility and specialization options, contributing **28 Credits in Total**. Open Elective Courses are open to students from disciplines other than Biochemistry, **Two Open Elective Courses** are offered in Semesters II and III, contributing **Six Credits**. A compulsory project is undertaken in the fourth semester, providing hands-on research experience and application of theoretical knowledge.

The overall credit requirement for successful completion of the PG Programme in Biochemistry is **90 Credits**.

Learning Objectives:

1. Develop a strong foundational understanding of biochemical concepts including the structure and function of biomolecules, metabolic pathways, and enzyme kinetics.
2. Gain proficiency in laboratory skills through hands-on experience in biochemical techniques such as chromatography, spectrophotometry, electrophoresis, and clinical diagnostics.
3. Enhance analytical and problem-solving abilities by interpreting experimental data, designing scientific experiments, and applying biochemical knowledge to research

questions.

4. Understand the molecular mechanisms underlying human physiology, disease processes, microbial functions, and genetic regulation to integrate biochemistry with applied biomedical sciences.
5. Foster scientific communication and ethical research practices by encouraging clear reporting of results, literature analysis, project work, and adherence to biosafety and research ethics.

Program Outcomes:

1. **Scientific Knowledge and Research Proficiency:** Graduates will acquire advanced knowledge in core areas of Biochemistry, enabling them to design, conduct, and interpret experimental research using modern biochemical, molecular, and analytical techniques.
2. **Critical Thinking and Problem-Solving Skills:** Students will develop the ability to critically analyze scientific problems, interpret data, and apply biochemical principles to solve issues related to health, disease, environment, and industry.
3. **Technical Competence and Laboratory Skills:** Learners will gain hands-on experience in diverse biochemical techniques, including spectroscopy, chromatography, enzymology, molecular biology, and clinical diagnostics, preparing them for academic and industrial lab settings.
4. **Communication and Teamwork:** The program fosters effective communication skills in scientific writing and oral presentations, along with the ability to work collaboratively in multidisciplinary research and healthcare environments.
5. **Ethics, Sustainability, and Lifelong Learning:** Graduates will demonstrate an understanding of ethical responsibilities in biochemical research and its applications, with a commitment to sustainable practices and continuous professional development.

Program Specific Outcomes:

1. **Core Biochemical Understanding:** Students will demonstrate comprehensive knowledge of biomolecules, metabolism, enzymology, and molecular biology essential to understanding biochemical processes in living organisms.
2. **Experimental Skills and Instrumentation:** Students will apply advanced techniques in chromatography, electrophoresis, spectroscopy, and isotopic labeling to investigate biochemical phenomena and solve real-world problems.
3. **Clinical and Diagnostic Application:** Learners will interpret biochemical parameters relevant to human health and disease, including liver, kidney, hormonal, and metabolic disorders, through clinical biochemistry techniques.
4. **Molecular and Cellular Insight:** Students will integrate knowledge of molecular and cell biology to study gene expression, cell signaling, and membrane transport systems, aiding in understanding physiological and pathological states.
5. **Microbiological and Immunological Proficiency:** The Programme prepares students to explore microbial physiology and immune mechanisms, enabling them to understand host-pathogen interactions and immune diagnostics.
6. **Biochemical Research Competence:** Students will acquire the ability to plan, execute, analyze, and report biochemical research projects ethically and effectively using modern tools and scientific

methodologies.

7. **Bioinformatics and Data Analysis:** Learners will utilize bioinformatics tools, statistical methods, and computational approaches for analyzing biological data and solving problems in genomics, proteomics, and drug discovery.
8. **Industrial and Pharmaceutical Applications:** Students will gain practical exposure to bioprocess technology, enzyme immobilization, biotechnology, and nutritional biochemistry, with relevance to food, pharma, and biotech industries.
9. **Readiness for Higher Education and Careers:** Graduates will be well-prepared for careers in research, teaching, clinical diagnostics, biotechnology, pharmaceuticals, or for pursuing doctoral studies and competitive exams.

Two-year Master's Degree Course (Four Semesters)

M.Sc. Biochemistry (CBCS)

Sl. No.	Semester	Hard core credits	Soft core credits	Open elective credits	No. of Practical Paper/ Project*	No. of Theory Papers	Total credits
1.	I Semester	12	9	-	3 (S)	3(H) +1(S)	21
2.	II Semester	12	10	3	3 (S)	3(H)+1(S)	25
3.	III Semester	16	7	3	1(H)+2(S)	3(H)+1(S)	26
4.	IV Semester	16	02	--	Project Work 1(H) +1(S)	-----	18
	Total	56	28	6			90

DETAILS OF THE CREDIT DISTRIBUTION OF THE PROGRAM

I SEMESTER

	Title of the Course	Courses (Hard Core/ Soft core)	Teaching Hrs./week	Credits	Hrs. of Exam	Max Marks: Exam + IA =Total
HARDCORE COURSES-THEORY						
BCH101	Biomolecules	H	4	4	3	70+30=100
BCH102	Cell Biology	H	4	4	3	70+30=100
BCH103	Biochemical Techniques	H	4	4	3	70+30=100
SOFT CORE COURSES –THEORY (Any ONE to be Opted)						
BCS104	Biophysical & Bioorganic Chemistry	S	3	3	3	70+30=100
BCS105	Human Physiology					
PRACTICAL COURSES						
BCP106	Practical General Biochemistry	S	6	2	6	70+30=100
BCP107	Practical Cell Biology	S	6	2	6	70+30=100
BCP108	Practical Biochemical Techniques	S	6	2	6	70+30=100
	Total	3(H), 4(S)	33	21		700

II SEMESTER

HARDCORE COURSES-THEORY						
BCH201	Microbiology	H	4	4	3	70+30=100
BCH202	Genetics	H	4	4	3	70+30=100
BCH203	Enzymology	H	4	4	3	70+30=100
SOFT CORE COURSES –THEORY (Any ONE to be opted)						
BCS204	Metabolism	S	3	3	3	70+30=100
BCS205	Metabolic Disorders					
OPEN ELECTIVE COURSE –THEORY (To be Offered to Other Disciplines)						
BCE206	Biochemistry in Daily Life	S	3	3	3	70+30=100
PRACTICAL COURSES						
BCP207	Practical Microbiology and Genetics	S	6	2	6	70+30=100
BCP208	Practical Enzymology	S	6	3	6	70+30=100
BCP209	Practical Clinical Biochemistry	S	6	2	6	70+30=100
	Total	3(H), 4(S)	36	25		800

III SEMESTER

HARDCORE COURSES-THEORY						
BCH301	Molecular Biology	H	4	4	3	70+30=100
BCH302	Immunology	H	4	4	3	70+30=100
BCH303	Industrial Biotechnology and Bioprocess Technology	H	4	4	3	70+30=100
SOFT CORE COURSES –THEORY (Any ONE to be opted)						
BCS304	Bioinformatics and Biostatistics	S	3	3	3	70+30=100
BCS305	Cancer Biology					
OPEN ELECTIVE COURSE –THEORY (To be Offered to Other Disciplines)						
BCE306	Health and Disease	S	3	3	3	70+30=100
PRACTICAL COURSES						
BCP307	Practical Molecular Biology and Immunology	S	6	2	6	70+30=100
BCP308	Practical Industrial Biotechnology and Bioprocess Technolgy	S	6	4	6	70+30=100
BCP309	Practical Bioinformatics, Biostatistics	S	6	2	6	70+30=100
	Total	3(H), 4(S)	36	26		800

Visit to Industry/Academic Institutions

IV SEMESTER

BCH 401	Project Dissertation*	H	16	16		200+100=300
BCH 402	Viva-Voce Examination	S	02	02		100
	Total	1(H), 1(S)	18	18		400
	Grand Total		90	90		2700

***Internal Assessment for Project:** Students shall deliver two seminar presentations during the semester—one after completion of two months and another at the end of the semester—covering the progress of their research work.

University Theory Question Paper Pattern

Sl. No.	Question type	Marks
1.	Write Short Notes on any FIVE out of Seven Questions	2 x 10 = 20
2	Answer any FIVE out of Seven Questions	6 x 5 = 30
2.	Answer any TWO questions out of Three Questions	10 x 3 = 30

University Practical question paper pattern

Sl. No.	Question type	Marks (70)
1.	Procedure writing	10
2.	Major Experiment	25
3.	Minor Experiment	15
4.	Record	10
5.	Viva-Voce	10

Internal Assessment (Theory) Examination

Sl. No.	Description	Marks
1.	IA test of 15 marks x 2 tests = 30 Brought down to 15(Average of C1 and C2)	15
2	MCQs	05
2.	Assignment/Seminars	05
4.	Attendance	05
	Total	30

Internal Assessment (Practical) Examination

Sl. No.	Description	Marks
1.	Practical Test	20
2.	Record	05
3.	Viva voce	05
	Total	30

Total Credits of all the Semesters

Semester	Total IV edits		Cores	Credits	%
First Semester	21		Hard Core	56	62.22
Second Semester	25		Soft Core	28	31.11
Third Semester	26		Open Elective	06	06.67
Fourth Semester	18		Total	90	100.00
Total	90				

FIRST SEMESTER

BCH 101: BIOMOLECULES: HARD CORE

Lecture hours: 52

Total Credits: 04

COURSE OBJECTIVES:

1. To Understand the structure, classification, and functions of carbohydrates, proteins, lipids, and nucleic acids.
2. To Learn analytical methods for elucidating the structure of biomolecules.
3. To Study protein folding, stability, and structure–function relationships.
4. To Explore diversity and physiological roles of nucleic acids and lipids.

UNIT I

13 hrs.

Carbohydrates: Structure and classification of carbohydrates, monosaccharides, disaccharides and polysaccharides. Monosaccharides and Disaccharides- Pentoses, hexoses, deoxy sugars, amino sugars, muramic acid, neuraminic acid. Linkages in sucrose, lactose and maltose, trehalose and glycosides. Polysaccharides- Homopolysaccharides and heteropolysaccharides; starch, cellulose, glycogen, hyaluronic acid, chondroitin sulphate, chitin, bacterial cell wall polysaccharides. Glycoproteins, Proteoglycans- characteristics and functions in biological system.

UNIT II

13 hrs.

Amino acids -Nomenclature classification of amino acids, Zwitter ionic structure, reaction of amino acids, stereochemistry of amino acid D and L, R and S. Physical and chemical properties including pKa values. Non-standard, non–protein and biologically active amino acids. Essential/non-essential amino acids, Unusual amino acids. Naturally occurring peptides. Peptide synthesis–Merrifield solid phase peptide synthesis. **Primary structure:** Elucidation of primary structure of proteins – Determination of amino acid composition, end group analysis, cleavage by enzymes and chemicals, separation of fragments. Manual and modern methods of sequencing and reconstructing the protein sequence. Assignment of disulfide bonds.

UNIT III

13 hrs.

Secondary structure: Peptide bond - structure and conformation, Ramachandran plot. Secondary structure: α helix and other types of helices, β pleated sheets, irregular, turns, loops and triple helical structures. Helix stabilizing and destabilizing amino acids. Motifs (super secondary structure – triose phosphate isomerase, concanavalin-A and Rossmann fold) and domain structure (glyceraldehyde-3-phosphate dehydrogenase). **Protein folding:** Tertiary structure of myoglobin. Forces stabilizing tertiary structure of proteins. Protein denaturation and renaturation, Anfinsen's experiment. **Quaternary structure and symmetry:** Structure and function of myoglobin and hemoglobin. **Protein folding pathways:** Protein dynamics – kinetics of protein folding and disulfide bond formation.

UNIT IV

13 hrs.

Lipids: Classification of lipids. Occurrence and Properties of Fatty Acids, Phospholipids, Glycolipids, sphingolipids, gangliolipids, Ceramide, Sphingosine, essential, non-essential

fatty acids, omega 3 and omega 6 fatty acids, micelles, vesicles, liposome, mixed micelles, trans fatty acids, Prostaglandins, Thromboxanes.

Nucleic Acids: Nucleoside, nucleotides of nucleic acids. shorthand notation for nucleic acids. Physiochemical properties of nucleic acids- Melting of DNA, T_m, factors affecting T_m, Cot curve, classification of DNA based on cot curve. Chargaff's rule. Watson and Crick model. A, Z DNA other models of DNA structure, forces stabilizing the structure of DNA. Denaturation- hypochromic and hyperchromic effect. Renaturation kinetics-effect of salts and complexity. Types of RNAs-mRNA, rRNA, tRNA, snRNA, miRNA, siRNA and parasitic RNAs (viroid and satellite RNA). Primary, secondary and tertiary structure of tRNA.

COURSE OUTCOMES:

1. Classify and describe the structural features and linkages in key biomolecules.
2. Apply classical and modern techniques for biomolecular structural analysis.
3. Explain protein structure–function relationships and folding pathways.
4. Analyze lipid and nucleic acid diversity and modern RNA concepts like miRNA

REFERENCES:

1. Voet D, Voet JG. *Biochemistry*. 4th ed. Wiley; 2011.
2. Berg JM, Tymoczko JL, Gatto GJ, Stryer L. *Biochemistry*. 9th ed. Freeman; 2019.
3. Lehninger AL, Nelson DL, Cox MM. *Lehninger Principles of Biochemistry*. 7th ed. Freeman; 2017.
4. Satyanarayana U, Chakrapani U. *Biochemistry*. 5th ed. Elsevier; 2021.
5. Deb AC. *Fundamentals of Biochemistry*. 8th ed. New Central Book Agency; 2011.
6. Jain JL, Jain S, Jain N. *Fundamentals of Biochemistry*. 6th ed. S. Chand; 2016.
7. Garrett RH, Grisham CM. *Biochemistry*. 6th ed. Cengage Learning; 2016.
8. Conn EE, Stumpf PK, Bruening G, Doi RH. *Outlines of Biochemistry*. 5th ed. Wiley; 2009.
9. Dickerson RE, Geis I. *The Structure and Function of Proteins*. 2nd ed. Benjamin-Cummings; 1983.
10. Nelson DL, Cox MM. *Principles of Biochemistry*. 6th ed. MacMillan; 2012.
11. Zubay G. *Biochemistry*. 4th ed. McGraw-Hill; 1998.
12. Murray RK, Bender DA, Botham KM. *Harper's Illustrated Biochemistry*. 31st ed. McGraw-Hill; 2018.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO5	PSO1	PSO 2
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	✓
CO 3	✓	✓			✓	
CO 4	✓	✓		✓	✓	

BCH 102: CELL BIOLOGY: HARD CORE

Lecture hours: 52

Total Credits: 04

COURSE OBJECTIVES

1. To provide a comprehensive understanding of chromosome structure, organization, and function in cellular processes.
2. To familiarize students with the principles and applications of microscopy and other basic tools used in cell biology research.
3. To develop an understanding of the structural and functional aspects of biological membranes and membrane transport mechanisms.
4. To impart knowledge of cellular communication, signal transduction pathways, and the role of signalling molecules in regulating cellular activities.

UNIT I

13 hrs.

Membrane structure: Different models of membrane structure - Lipid bilayer, membrane proteins, membrane carbohydrate, transport across bio membranes, Mechanisms of endocytosis and exocytosis, Ion channels, Electrical properties of membranes; Nerve impulse transmission. Chemical composition of cell walls, cross linkage, porosity, tensile strength, turgor modifications in special types of cells, plasmodesmata, fluid transport between cells. Integrating cells into tissues: Cell adhesion, Cell junctions; Extracellular matrix, extracellular matrix receptors and signaling.

UNIT II

13 hrs.

Subcellular Organization: Ultrastructural organization and functions of Golgi complex, endoplasmic reticulum, mitochondria, chloroplast, peroxisomes, lysosomes, ribosomes, nucleus and nucleolus. Structure, organization and types of eukaryotic chromosomes, Heterochromatin, euchromatin, telomeres, types of chromosomes, polytene chromosomes and lamp brush chromosomes. Banding techniques; karyotyping, FISH. Chromosome dynamics during cell division: Mitosis, meiosis, microtubules, centrosome, centromere, kinetochore, metaphase and anaphase movements, motor proteins, cytokinesis. Cell cycle and its regulation: checkpoints, CDKs. Apoptosis – apoptotic pathways. Autophagy.

UNIT III

13hrs.

Cell signaling: Various types of cells signaling-endocrine, paracrine, juxtacrine and autocrine. Signaling molecules – hormones, growth factors (EGF, NGF and Insulin), neurotransmitters, gases, lipids, peptides. Structure of transmembrane receptors and mechanism of signal transduction: G-protein coupled receptors, Ion channel receptors, tyrosine kinase linked receptors & with intrinsic enzyme activity. Second messengers – Ca^{2+} , IP_3 , cAMP, cGMP. MAPK/ERK signaling pathways. Nitric oxide signaling; generation and action. Receptor downregulation, sensitization and upregulation. Mechanism of action of steroid hormones: intracellular receptors (cytosolic and nuclear receptors). Insect hormones: structure, function and applications of molting hormone, juvenile hormone, pheromones. Plant hormones.

UNIT IV

13hrs.

Molecular biology of cancer: Differences between benign and malignant tumors. Hallmarks of cancer. Epidemiology of cancer. Morphological and ultrastructural properties of cancer

cells. Abnormal cell growth: mechanism of transformation of cells. Types of growth-hyperplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. Stages and grades of cancer - initiation, promotion and progression Genetic basis of cancer, physical and chemical carcinogenic agents; Viral and cellular oncogenes, tumor suppressor genes, Telomerases and their role in cancer. Free radicals, antioxidants in cancer.

COURSE OUTCOMES:

1. Comprehend the general structure and molecular organization of chromosomes.
2. Gain theoretical knowledge of how to use basic tools and techniques such as microscopy
3. Explain the physiochemical properties of biological membranes with structural and functional insights.
4. Understand how cells communicate with one another and the role of various messenger molecules in signal transduction.

REFERENCES:

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. (2010). Essential Cell Biology, 3rd Ed., Garland Publishing, Inc., New York.
2. Avers, C.J. (1986). Molecular Cell Biology. Addison-Wesley Publ Co, England.
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22. Voet, D., Pratt, C.W., Voet J.G. (2008) Fundamentals of biochemistry: Life at the molecular level, 3rd Ed. John Wiley & Sons
23. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick R. (2004) Molecular biology of the gene, 5th Ed., Cold Spring Harbor Laboratory Press
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Course Articulation Matrix Mapping

CO	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2
CO 1	✓	✓			✓	
CO 2	✓		✓		✓	✓
CO 3	✓	✓			✓	
CO 4	✓	✓		✓	✓	

BCH 103: BIOCHEMICAL TECHNIQUES: HARD CORE

Lecture hours: 52

Total Credits: 04

COURSE OBJECTIVES:

1. To Understand principles of biochemical instrumentation and model systems.
2. To Learn about techniques in cell fractionation and sub-cellular component analysis.
3. To Study chromatographic, electrophoretic, and spectroscopic techniques.
4. To Explore the use of isotopes and radioactivity in biochemical research.

UNIT I

13 hrs.

Separation techniques: Physical and chemical methods of cell disruption techniques, Precipitation of proteins (salt, acid, organic solvent, isoelectric precipitation, immunoprecipitation), Principle and applications of Lyophilization, Dialysis and Ultra-filtration. **Centrifugation:** Basic Principles of centrifugation – Relative centrifugal force (RCF). Svedberg coefficient, sedimentation velocity and equilibrium. Classification of rotors. Types of centrifuges-Preparative centrifugation- Differential and density gradient centrifugation, Sub-cellular fractionation, Analytical ultracentrifugation-design and applications.

UNIT II

13 hrs.

Chromatographic techniques: Introduction, principle, procedure and applications of- Adsorption chromatography (hydroxyapatite and Hydrophobic interaction), Partition (normal phase and reverse phase), Paper chromatography and Thin-layer Chromatography (TLC). Ion exchange (Cation and anion exchange), Gel filtration, Affinity chromatography (immune affinity and IMAC), Gas liquid chromatography (GLC), High performance liquid chromatography (HPLC), Fast protein liquid chromatography (FPLC).

UNIT III

13 hrs.

Electrophoretic techniques for biomolecule separation: Theory of electrophoresis, factors affecting electrophoresis. Principle and applications of Native PAGE, SDS-PAGE, Agarose

gel electrophoresis, zymogram, gradient gels, 2-D gel electrophoresis, isoelectric focusing, pulsed field electrophoresis, DNA sequencing gels, capillary electrophoresis. Visualizing separated components - staining for proteins nucleic acids, fluorescence, PAS staining.

Spectroscopic techniques: Basic principles and electromagnetic spectrum. Beer-Lambert's Law and its applications and limitations, Molar extinction coefficient. Principle & applications of spectrosopes in biochemical and biomedical sciences- Colorimeter, Fluorimetry, Turbidometry, UV-Vis Absorption spectroscopy, atomic absorption spectroscopy, Fluorescence Spectroscopy, CD/ORD spectroscopy, Mass spectrometry, Infrared and Raman Spectroscopy, Nuclear Magnetic Resonance, Electron Spin Resonance, X-ray crystallography. Fiber pattern of DNA, Cytophotometry and flow cytometry.

UNIT IV

13 hrs.

Isotopes in Biochemistry: Definition and types of radiation. Units of radioactivity, Specific activity, and half-life of radioisotopes. Interaction of radioactivity with matter, Basic principles and applications of Geiger-Muller counter, scintillation counters, Autoradiography, Application of commonly used isotopes (Tritium, Carbon-14, Phosphorous-32, Sulfur-35, Iodine-131) in biological sciences. Advantages and restriction of radiotracer experiments and safety aspects.

COURSE OUTCOMES:

1. Understand the relevance of model systems in biochemical investigations.
2. Demonstrate proficiency in centrifugation, chromatography, and electrophoresis.
3. Apply knowledge of spectroscopy and microscopy in research.
4. Understand radioactive isotopes and their safe use in biochemical analysis.

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1. Wilson K, Walker JM. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th ed. Cambridge Univ Press; 2010.
2. Upadhyay A, Upadhyay K, Nath N. *Biophysical Chemistry*. 4th ed. Himalaya Publishing House; 2010.
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12. Cooper TG. *Tools of Biochemistry*. Wiley-Interscience; 1977.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 4	PSO 2	PSO 6
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	✓
CO 3	✓	✓	✓	✓	✓	
CO 4	✓		✓		✓	

BCS 104: BIOPHYSICAL AND BIO-ORGANIC CHEMISTRY: SOFT CORE

Lecture hours: 39

Total Credits: 03

COURSE OBJECTIVES:

1. To Study acid-base principles and buffer systems in biological contexts.
2. To Understand stereochemistry and radical chemistry relevant to biomolecules.
3. To Analyze reaction intermediates and kinetics in biological reactions.
4. To Explore the structure and function of biologically relevant heterocycles.

UNIT I

13 hrs.

Properties of water: Physical and chemical properties of water, ionization and ionic product of water, structure of liquid water and ice. Hydrophilic, hydrophobic and amphipathic molecules in aqueous solution. Importance of water in biological systems with special reference to the maintenance of native structure of biological molecules. Biological relevance of pH and pKa, determination of pKa of weak acid. Buffers, buffer action, and buffer capacity. Henderson–Hasselbalch equation, preparation of buffers. Importance of buffers in biological systems (cytosol and blood).

UNIT II

13 hrs.

Thermodynamics, stereochemistry and Radical chemistry: First law of thermodynamics, basic concepts of entropy and second law of thermodynamics, free energy changes, standard free energy change and its relation to equilibrium constant. Oxidation – reduction reactions in biological systems. Stereochemistry: Optical isomerism, chirality, symmetry elements, enantiomers, diastereomers, DL and RS notations, racemization, stereoisomerism and geometrical isomerism, cis – trans and E – Z conventions. Free radicals: Introduction, formation – photolysis, thermolysis, redox reactions, radical reactions with biomolecules.

UNIT III

13 hrs.

Mechanism of Bio-organic reactions: Introduction, Homo and heterolytic cleavage, structure and reactivity of carbocation (C⁺), carbanion (C⁻) and carbon free radical (C[•]) characteristic

aspects of ionic, radical and concerted reactions, substitution, addition, elimination and rearrangements.

Heterocyclic systems: Occurrence in biological systems, structure and properties of furan, pyrrole, indole, thiazole, imidazole, pyridine, pyrimidine, purine, quinone, pteridine and isoalloxazine containing biomolecules.

COURSE OUTCOMES:

1. Comprehend acid-base chemistry and buffer systems in physiology.
2. Understand stereochemistry and apply it to biochemical structures.
3. Analyze reaction mechanisms in biomolecular transformations.
4. Recognize biologically important heterocyclic compounds and their functions

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1. Van Holde KE, Johnson WC, Ho PS. *Principles of Physical Biochemistry*. 2nd ed. Pearson Education; 2005.
2. Upadhyay A, Upadhyay K, Nath N. *Biophysical Chemistry: Principles and Techniques*. 4th ed. Himalaya Publishing; 2014.
3. Freifelder D. *Physical Biochemistry: Applications to Biochemistry and Molecular Biology*. 2nd ed. W.H. Freeman; 1982.
4. Segel IH. *Biochemical Calculations*. 2nd ed. John Wiley & Sons; 1976.
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8. Morrison RT, Boyd RN. *Organic Chemistry*. 6th ed. Prentice Hall; 2004.
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10. Lehninger AL, Nelson DL, Cox MM. *Lehninger Principles of Biochemistry*. 7th ed. Freeman; 2017.
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Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 2
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	✓
CO 3	✓	✓	✓		✓	✓
CO 4	✓			✓	✓	

BCS 105: HUMAN PHYSIOLOGY: SOFTCORE

Lecture Hours: 39

Total Credits: 03

COURSE OBJECTIVES:

1. To Learn the structure and function of blood and components.
2. To Understand nervous system and neurotransmission.
3. To Study the physiology of various organ systems in detail.
4. To Gain insight into biochemical processes underlying human health.

UNIT I

13 hrs.

Blood: Composition of blood, formed elements – types, structure and function, Haemoglobin, Erythropoiesis, Blood volume, Packed cell volume and blood indices, Plasma proteins and its functions, Coagulation of blood (haemostasis), intrinsic and extrinsic pathways, Clot digestion, Blood groups and blood transfusion, Buffer systems in blood.

UNIT II

13 hrs.

Nervous system: Brief account on divisions of the nervous system (CNS, PNS, SNS, ANS), receptors, neurons and other cells of nervous system, Types and structure of neurons, neurotransmission, neurotransmitters, post synaptic potential, Action potential, Gated and non-gated channels, Blood-brain barrier. Mechanism of synaptic transmission. **Biochemistry of Vision:** Anatomy and Biochemistry of eye, Photoreceptor cells - structure and function, visual pigments, Rhodopsin cycle, role of Vitamin A in vision, visual transduction. Taste, olfactory organs and audio responses.

UNIT III

13 hrs.

Muscular, respiratory and excretory System: Muscles – types and structures. Muscle Biochemistry and contraction mechanism. Regulation in muscle contraction. **Respiratory System:** Anatomy of the Respiratory System. Pulmonary ventilation, Gaseous exchange and transport, oxygen binding by haemoglobin, factors affecting oxygenation, regulation of respiration. **Excretory System:** Kidney and Nephron Structure. Renal circulation. Urine Formation and Composition, Concentration of urine, Urine Analysis. Regulation of Acid-Base, Water, and Electrolyte Balance.

COURSE OUTCOMES:

1. Demonstrate understanding of physiological systems and their coordination.
2. Correlate organ function with physiological and biochemical processes.
3. Apply knowledge to interpret normal and abnormal physiological states.
4. Promote healthy living through physiological awareness

REFERENCES:

1. Pal GK, Pal P. *Textbook of Medical Physiology*. Ahuja Publishing; 2007.
2. Hall JE. *Guyton and Hall Textbook of Medical Physiology*. 12th ed. Elsevier; 2011.
3. Barrett KE, Barman SM, Boitano S, Brooks HL. *Ganong's Review of Medical Physiology*. 23rd ed. McGraw-Hill; 2009.
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5. Tortora GJ, Derrickson BH. *Principles of Anatomy and Physiology*. 13th ed. Wiley; 2012.
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7. Rhoades RA, Bell DR. *Medical Physiology: Principles for Clinical Medicine*. 4th ed. Lippincott Williams & Wilkins; 2012.
8. Sherwood L. *Human Physiology: From Cells to Systems*. 8th ed. Brooks/Cole; 2012.
9. Silverthorn DU. *Human Physiology: An Integrated Approach*. 7th ed. Pearson; 2015.
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11. Widmaier EP, Raff H, Strang KT. *Vander's Human Physiology*. 13th ed. McGraw-Hill; 2014.
12. Seeley RR, Stephens TD, Tate P. *Anatomy and Physiology*. 9th ed. McGraw-Hill; 2010.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 4	PO 5	PSO 4	PSO 09
CO 1	✓	✓	✓		✓	✓
CO 2	✓	✓			✓	
CO 3	✓	✓		✓	✓	✓
CO 4		✓		✓		✓

BCP 106: PRACTICAL GENERAL BIOCHEMISTRY: SOFT CORE

Practical: 6 hours/week

Total Credits: 02

COURSE OBJECTIVES:

1. To teach foundational laboratory techniques in general biochemistry.
2. To understand preparation and application of biological buffers.
3. To quantify biomolecules using colorimetric assays.
4. To familiarize students with sample preparation and analysis protocols.

Experiments:

1. Buffers: a) Introduction b) Preparation of acetate, citrate and phosphate buffers
2. Quantitative determination of protein concentration by Biuret method.
3. Estimation of protein by Lowry's method.
4. Estimation of protein by Bradford method.
5. Measurement of protein concentration by UV spectroscopy.

6. Estimation of glucose from natural or synthetic source by Dinitro salicylic acid method.
7. Estimation of total carbohydrates from natural source by Phenol sulphuric acid method.
8. Estimation of starch by Anthrone method
9. Estimation of ascorbic acid from natural source (guava, green chilli, orange etc.) by DNPH method.
10. Estimation of inorganic phosphate by Fiske- Subba Rao's method.
11. Estimation of DNA by Diphenylamine method
12. Estimation of RNA by Orcinol acid method
13. Estimation of protein by Kjeldhal digestion.

COURSE OUTCOMES:

1. Prepare and use common laboratory buffers and solutions.
2. Estimate proteins, carbohydrates, nucleic acids, and vitamins using spectrophotometric methods.
3. Demonstrate precision in laboratory experimentation and calculations.
4. Analyze and interpret biochemical assay results for research applications.

REFERENCES:

1. Plummer DT. *An Introduction to Practical Biochemistry*. 3rd ed. New Delhi: Tata McGraw-Hill; 1988.
2. Sadasivam S, Manickam A. *Biochemical Methods*. 3rd ed. New Delhi: New Age International Publishers; 2008.
3. Nigam A. *Lab Manual of Biochemistry*. New Delhi: Tata McGraw-Hill Education; 2007.
4. Varley H. *Practical Clinical Biochemistry*. 6th ed. New Delhi: CBS Publishers & Distributors; 2006.
5. Copeland RA. *Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis*. 2nd ed. New Jersey: Wiley-VCH; 2000.
6. Wilson K, Walker JM. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th ed. Cambridge: Cambridge University Press; 2010.
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Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 6
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	
CO 3	✓	✓	✓		✓	✓
CO 4	✓	✓	✓	✓	✓	✓

BCP 107: PRACTICAL CELL BIOLOGY: SOFT CORE

Practical: 6hours/week

Total Credits: 02

COURSE OBJECTIVES:

1. To provide hands-on training in fundamental cell biology techniques and microscopy.
2. To develop skills in the isolation, identification, and characterization of cellular organelles and structures.
3. To familiarize students with cytological, cytogenetic, and histopathological methods used in biological research.
4. To introduce students to basic mammalian cell culture techniques and cellular viability assessment methods.

Experiments:

1. Basics of microscopy: Handling, calibration and cell preparation
2. Mammalian cell culture (demonstration)
3. Clonogenic assay (demonstration)
4. Cell count and viability assessment- trypan blue staining
5. Mounting of Barr bodies
6. Study of mitosis using onion root tips
7. Study of meiosis
8. Isolation of nucleus
9. Isolation of mitochondria
10. Isolation of chloroplast
11. Lymphocyte culture and chromosome preparation
12. Histopathological analysis of tissues

COURSE OUTCOMES

1. Demonstrate proficiency in microscopy, specimen preparation, and observation of cellular structures and processes.
2. Perform isolation and characterization of cellular organelles such as nuclei, mitochondria, and chloroplasts using standard laboratory techniques.
3. Analyze cell division, chromosomal organization, and genetic material through mitotic, meiotic, and cytogenetic studies.
4. Apply cell biology techniques including cell viability assays, tissue histopathology, and cell culture-based methods for biological investigations.

REFERENCES:

1. Plummer DT. *An Introduction to Practical Biochemistry*. 3rd ed. New Delhi: Tata McGraw-Hill; 1988.
2. Sadasivam S, Manickam A. *Biochemical Methods*. 3rd ed. New Delhi: New Age International Publishers; 2008.
3. Nigam A. *Lab Manual of Biochemistry*. New Delhi: Tata McGraw-Hill Education; 2007.
4. Varley H. *Practical Clinical Biochemistry*. 6th ed. New Delhi: CBS Publishers & Distributors; 2006.

5. Copeland RA. *Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis*. 2nd ed. New Jersey: Wiley-VCH; 2000.
6. Wilson K, Walker JM. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th ed. Cambridge: Cambridge University Press; 2010.
7. Segel IH. *Biochemical Calculations*. 2nd ed. New York: John Wiley & Sons; 1976.
8. Kaplan LA, Pesce AJ. *Clinical Chemistry: Theory, Analysis, and Correlation*. 4th ed. St. Louis: Mosby; 2003.
9. Biochemical Methods. S. Sadasivam and A. Manickam. 3rd ed, New Age International P.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 2	PSO 6
CO 1	✓	✓	✓		✓		
CO 2	✓	✓	✓		✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	
CO 4	✓	✓	✓	✓	✓	✓	✓

BCP 108: PRACTICAL BIOCHEMICAL TECHNIQUES: SOFT CORE

Practical: 6 hours/week

Total Credits: 02

COURSE OBJECTIVES:

1. To introduce chromatographic techniques for the qualitative detection of amino acids, carbohydrates, and lipids.
2. To train students in biochemical separation techniques including precipitation, dialysis, and electrophoresis.
3. To enable students to estimate physicochemical properties of lipids such as saponification and iodine numbers.
4. To develop hands-on skills in protein extraction, purification, and analysis.

Experiments:

1. Detection of amino acids by circular chromatography
2. Detection of amino acids by ascending chromatography.
3. Detection of amino acids by descending chromatography.
4. Detection of amino acids by 2D- paper chromatography.
5. Detection of amino acids by thin layer chromatography.
6. Detection of lipids by thin layer chromatography.
7. Detection of carbohydrates by paper chromatography.
8. Detection of carbohydrates by thin layer chromatography.
9. Saponification number of oil and fat.
10. Iodine number of oil and fat.
11. Trichloroacetic acid precipitation of proteins.
12. Preparation of casein from milk.
13. Acetone precipitation of proteins

COURSE OUTCOMES:

1. Students will be able to detect and differentiate biomolecules using various chromatographic methods.
2. Students will demonstrate skills in protein precipitation, dialysis, and purification techniques.
3. Students will accurately determine lipid quality through saponification and iodine value estimation.
4. Students will perform PAGE for protein separation and analyze electrophoretic patterns.

REFERENCES:

1. Plummer DT. *An Introduction to Practical Biochemistry*. 3rd ed. New Delhi: Tata McGraw-Hill; 1988.
2. Sadasivam S, Manickam A. *Biochemical Methods*. 3rd ed. New Delhi: New Age International Publishers; 2008.
3. Nigam A. *Lab Manual of Biochemistry*. New Delhi: Tata McGraw-Hill Education; 2007.
4. Varley H. *Practical Clinical Biochemistry*. 6th ed. New Delhi: CBS Publishers & Distributors; 2006.
5. Copeland RA. *Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis*. 2nd ed. New Jersey: Wiley-VCH; 2000.
6. Wilson K, Walker JM. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th ed. Cambridge: Cambridge University Press; 2010.
7. Segel IH. *Biochemical Calculations*. 2nd ed. New York: John Wiley & Sons; 1976.
8. Kaplan LA, Pesce AJ. *Clinical Chemistry: Theory, Analysis, and Correlation*. 4th ed. St. Louis: Mosby; 2003.
9. Biochemical Methods. S. Sadasivam and A. Manickam. 3rd ed, New Age International P.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 6
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	
CO 3	✓	✓	✓		✓	✓
CO 4	✓	✓	✓	✓	✓	✓

II SEMESTER

BCH 201: MICROBIOLOGY: HARD CORE

Lecture hours: 52

Total Credits: 04

COURSE OBJECTIVES:

1. To provide a comprehensive understanding of the origin, evolution, diversity, classification, and ecological significance of microorganisms.
2. To familiarize students with the structural organization of bacteria, fungi, and viruses, and the principles and applications of microscopy and staining techniques used in microbiology.
3. To develop an understanding of microbial nutrition, growth, cultivation, preservation, and factors influencing microbial growth and survival.
4. To impart knowledge of sterilization, disinfection, biosafety practices, culture collection systems, and the role of microorganisms in health, disease, and environmental interactions.

UNIT I

13 hrs.

Introduction to microbiology: Contributions of early microbiologists, Koch Postulates. Branches and scope of microbiology. Origin and evolution of microorganisms, the discovery of anaerobic life, trends in the evolution of archaebacteria, eubacteria and eukaryotes. Evolution of prokaryotic and eukaryotic metabolism. Modern methods of tracing and analysis of evolution. Microbial diversity, habitats, lifecycles, structure and classification of bacteria, cyanobacteria, actinomycetes, fungi and viruses; numerical and molecular taxonomy. General account of symbiosis, mutualism, antagonism, parasitism and commensalism in microorganisms.

UNIT II

13 hrs.

Microscopy: Principle and applications of Light, Phase contrast, differential interference contrast, fluorescence, Confocal and Electron Microscopy. Stains and staining- Principles of staining, simple staining, negative staining, differential staining, Gram and acid fast staining, flagella staining, capsule and endospore staining.

Bacteria: Morphological types; cell wall – cell walls of Gram negative, Gram positive, cell membrane, capsule type's composition and function. Structure and function of flagella, pili, gas vesicles, Intracytoplasmic inclusions. Endospore and exospores. Bacterial chromosomes and bacterial plasmids.

UNIT III

13 hrs.

Fungi: General characters, Distribution and Nutrition in fungi, Ultra structure of fungal cell, Reproduction in fungi - vegetative, asexual and sexual. Fungal systematics - Chytridiomycota, Hypochytridiomycota, Oomycota, Zygomycota, Basidiomycota, Ascomycota, Deuteromycota, Fungal fruiting bodies, Types of spores. **Viruses:** Discovery, nomenclature, classification and properties of viruses, Morphology and ultra structure - capsid and their arrangement, envelope - types and their composition, viral genome - types and structure, Sub viral agents - viroids, prions, virusoids and satellite viruses. Corona virus. Risk levels and Biosafety laboratories. Biological warfare and Bioterrorism (diseases associated with bacterial, viral, fungal infections)

UNIT IV

13 hrs.

Microbial nutrition and cultivation: Nutritional categories of microorganisms, the role of microbial nutrients. Selective media, selective isolation and methods of preservation of microbes. Microbial growth, population, growth kinetics and growth curves, generation time, batch and continuous cultures (e.g. chemostat, turbidostat), measurement of growth, microbiological assays (e.g. antibiotics, amino acids and vitamins). Factors affecting growth of microorganisms: temperature, pH, water activity, O-R potential, salinity, hydrostatic pressure, disinfectants, antiseptics and chemotherapeutic agents. Methods of sterilization: disinfection, antiseptic, tyndallisation, pasteurization: Physical- dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter, Chemical-phenol and phenolic compounds, (halogen aliphatic alcohol, formaldehyde, ethylene oxide, heavy metals) anionic and cationic detergents. Culture collection centres (ATCC, IMTECH, NCCS-MCC etc.).

COURSE OUTCOMES:

1. Understand the evolution of prokaryotic and eukaryotic metabolism
2. Learn about microbial nutrition and the culture of microbes in the laboratory.
3. Discern various factors affecting the growth and death of microorganisms.
4. Explain the microbial nutrition and cultivation

REFERENCES:

1. Brock, T.B. and Madigan (2003). Brock Biology of microorganisms. 10th Ed. Prentice Hall.
2. Pelczar, J. and Chan, E.C.S. (1988). Elements of microbiology. Mac Graw Hill New York.
3. Rosenberg E and Cohen I R (1983). Microbial biology Saunders Coll. Pub.
4. Stanier R.Y. (1990). The microbial world. Prentice Hall New Delhi, 5th ed.
5. Prescott, Harley & Klein (2002). Microbiology, 5th, 6th, 7th Eds., McGraw Hill Pub.
6. Black, J.G. (2004). Microbiology, Principles & Exploration. 6th Ed, John Wiley & sons, Inc.
7. Rao, N.S.S. (1999). Soil Microbiology 4th Ed, Oxford IBH Pub.
8. Flint, S.J. (2006). Principles of Virology, Molecular Biology, Pathogenesis & control ASM press.
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10. Nester, E.W., Anderson, D.G., Roberts E.C. (2004) Microbiology: a Human Perspective, 4th Ed.
11. Talaro, K.P. and Chess, B. (2011) Foundations in Microbiology, 8th Ed. McGraw Hill.
12. Ananthanarayan R. and Paniker C.K.J., (2009) Medical Microbiology. 8th Ed., Universities Press.
13. Tortora G.J; Funke B.R., Case, C.L. (2010) Microbiology: An Introduction, 10th Ed. Benjamin Cummings.
14. Hall FR & Menn JJ, (1998) Biopesticides: Use and Delivery. Methods in Biotechnology, Humana Press
15. Brooks, G.F., Carroll, K.C., Butel, J.S., Morse, S.A. (2008) Jawetz, Melnick & Adelberg's Medical Microbiology, 24th Ed., McGraw Hill
16. Faruque, S.M. (Ed.) (2012) Foodborne and Waterborne Bacterial Pathogens: Epidemiology, Evolution and Molecular Biology Caister Academic Press
17. Kayser, F.H., Bienz, K.A., Eckert, J. and Zinkernagel, R.M. (2005). Medical Microbiology, Thieme.

18. Bauman, R.W. (2012) Microbiology with Diseases by Body System, 3rdEd. Benjamin Cummings
19. Ryan, K.J. and Ray, C.J. (2004) Sherris Medical Microbiology–An Introduction to Infectious Diseases, 4th Ed. McGraw Hill
20. Gillespie, S. and Hawkey, P. (2006) Principles and Practice of Clinical Bacteriology, 2ndEd. Wiley,
21. Microbenet: the Microbiology of the Built Environment network (<http://microbe.net/microbenet-social-media/microbiology-blogs/>)
22. <http://www.microbiologymaven.com/>
23. <http://twistedbacteria.blogspot.in/2011/09/microbiology-blogs-list-of-20-great.html>
24. Bauman, R.W. (2016). Microbiology with diseases by taxonomy. Pearson.
25. Pollack, R.A., & Findlay, L. (2009). Laboratory exercises in microbiology. John Wiley & Sons, Inc.
26. Anderson, D.G., Salm, S., & Allen, D.P. (2016). Nester's Microbiology: A Human Perspective p. 896. McGraw-Hill.
27. Mitchell, R., & Gu, J.D. (Eds.). (2010). Environmental microbiology. John Wiley & Sons.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 4	PO 5	PSO 1	PSO 4
CO 1	✓	✓			✓	
CO 2	✓	✓			✓	
CO 3	✓	✓		✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓

BCH202: GENETICS: HARD CORE

Lecture Hours: 52

Total Credits: 04

COURSE OBJECTIVES:

1. To provide a comprehensive understanding of classical and molecular genetics.
2. To study gene structure, function, and inheritance patterns.
3. To explore genetic mapping and mutational analysis.
4. To analyze the molecular basis of genetic diseases.

UNIT I

13 hrs.

Mendelian inheritance: Principles, Modifications of Mendelian monohybrid and dihybrid ratios-Incomplete dominance, Codominance, Lethal genes and Multiple alleles. Applications of Mendel's principles- the punnet square method, forked-line method, probability method; Formulating and testing genetic hypothesis-the chi-square-test, linkage and crossing over. **Cytological basis of inheritance:** Linkage and crossing over; Genetic mapping of chromosomes. Sex determination, Dosage compensation in mammals and drosophila. Sex-linked inheritance (*Drosophila* and Human). Sex-related traits, genetic disorders.

UNIT II

13 hrs.

Genetics of Bacteria: Transformation, transduction, Conjugation. Plasmids. Extra chromosomal inheritance with examples; Genomic organization in prokaryotes and eukaryotes; Laws of DNA constancy and C-value paradox. **Mutations:** Classification, types

of mutations with examples - deletion, duplication, translocation, inversion, transversion, transition, spontaneous and induced mutations, molecular mechanisms of mutations. Biochemical basis for mutations; Detection of mutations –mutagenicity testing-Ames test, tests in *Drosophila* (CIB, SMART) and mouse (DLT, MNT, Mitotic and meiotic, specific locus test)

UNIT III

13 hrs.

Genetic recombination at Molecular level: Reciprocal recombination, site-specific recombination, models of recombination (Holliday model), Role of Rec A in Recombination. Transposable genetic elements: Bacterial transposons, Is elements, Composite transposons, Tn3 elements, Eukaryotic transposons- Ac and Ds elements in maize; P elements and Hybrid dysgenesis, Retrotransposons. Alu sequences.

Human genetics: Human chromosomes, Sex chromosomal and autosomal diseases, Pedigree analysis and genetic counseling, gene therapy.

UNIT IV

13 hrs.

Population and evolutionary genetics: Genetic variation, Gene pool, allele frequencies, Hardy-Weinberg equilibrium, inbreeding, outbreeding and changes in allelic frequency. Natural selection, Genetic drift, gene flow, Speciation: allopatric and sympatric; Convergent evolution; Sexual selection; Co-evolution, proteins and DNA sequence polymorphism, Molecular basis of evolution in human.

COURSE OUTCOMES:

1. Explain principles of inheritance, linkage, and recombination.
2. Apply genetic mapping and mutation analysis techniques.
3. Correlate genotype with phenotype in hereditary disorders.
4. Evaluate the role of genetics in personalized medicine and gene therapy.

REFERENCES:

1. Griffiths AJF et al. *Introduction to Genetic Analysis*. 11th ed. W.H. Freeman; 2015.
2. Snustad DP, Simmons MJ. *Principles of Genetics*. 6th ed. Wiley; 2015.
3. Hartl DL, Jones EW. *Genetics: Analysis of Genes and Genomes*. 8th ed. Jones & Bartlett; 2017.
4. Klug WS et al. *Concepts of Genetics*. 11th ed. Pearson; 2015.
5. Russell PJ. *iGenetics: A Molecular Approach*. 3rd ed. Pearson; 2010.
6. Gardner EJ, Simmons MJ, Snustad DP. *Principles of Genetics*. 8th ed. Wiley; 2006.
7. Tamarin RH. *Principles of Genetics*. 7th ed. McGraw-Hill; 2001.
8. Griffiths AJF. *Genetics and Genomics in Medicine*. Garland Science; 2014.
9. Singh BD. *Fundamentals of Genetics*. 3rd ed. Kalyani Publishers; 2015.
10. Pierce BA. *Genetics: A Conceptual Approach*. 6th ed. Macmillan; 2017.
11. Brown TA. *Genomes*. 3rd ed. Garland Science; 2006.
12. Strachan T, Read AP. *Human Molecular Genetics*. 4th ed. Garland Science; 2010.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 5	PSO 1	PSO 2	PSO 6
CO 1	✓	✓			✓		
CO 2	✓	✓	✓		✓	✓	✓
CO 3	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓		✓	✓	✓	✓

BCH 203: ENZYMOLOGY: HARD CORE

Lecture Hours: 52

Total Credits: 04

COURSE OBJECTIVES:

1. To Understand enzyme classification, isolation, and purification.
2. To Learn enzyme kinetics including inhibition and bisubstrate reactions.
3. To Study catalytic mechanisms of enzymes.
4. To Understand coenzymes, enzyme cooperativity, and fast reactions.

UNIT I

13 hrs.

Introduction to enzymes: Nomenclature and IUB classification of enzymes. Nature of enzymes, localization, isolation, precautionary techniques for purification, characterization of enzymes. Criteria of purity for enzymes. Active site structure. Methods of determining active site structure-isolation of ES complex, affinity labeling, chemical modification studies. Units of enzyme activity, specificity and specific activity of enzymes. Assay methods-coupled enzyme assays, continuous, end point and kinetic assay.

UNIT II

13 hrs.

Enzyme Kinetics: Rate of reaction, order and molecularity. Michaelis Menton equation, initial velocity approach, steady state approach. V_{max} , K_m and their significance. Linear transformation of Michaelis- Menton equation- Line weaver Burk plot, Eddie Hofstee, Haynes-Wolf and Cornish-Bowden plot. Turnover number. Inhibition-Competitive, non-competitive, un-competitive and product inhibition. Irreversible inhibition- suicide inhibition. Determination of K_i . Bi-substrate Reaction- Cleland's notation with examples or ordered, Ping-Pong, and random. General rate equation. Primary and secondary plots.

UNIT III

13 hrs.

Nature of Enzyme Catalysis-Transition state theory, proximity and orientation, orbital steering, acid base catalysis, covalent catalysis, metal ion catalysis, nucleophilic catalysis, intermolecular catalysis, entropy effects. Effect of temperature and pH on enzyme catalyzed reaction. Mechanisms of Action of Specific Enzymes- Chymotrypsin, zymogen activation, acid-base catalysis, charge relay network. Lysozyme, Alcohol dehydrogenase, Ribonuclease, Carboxypeptidase A, RNA as enzyme.

UNIT IV

13 hrs.

Coenzymic action of NAD^+ , FAD, TPP, PLP, biotin, CoA, Folic acid, Lipoic acid. Multimolecular Forms- LDH, multifunctional enzyme (DNA polymerase), multi enzyme

complex (PDC), Metabolic Cooperativity- Binding of ligands to macromolecules-scatchard plot, cooperativity, positive and negative cooperativity. Oxygen binding to hemoglobin. Hill equation, homotropic and heterotrophic effectors, aspartyl transcarbamylase as an allosteric enzyme. Immobilization of enzymes and their applications. Applications of enzymes in medicine and industries, Unconventional forms of enzymes- synzymes, abzymes, DNAzymes, allozymes, nanozymes.

COURSE OUTCOMES:

1. Explain principles of enzyme isolation, purification, and active site studies.
2. Analyze kinetic data using Michaelis-Menten and linear transformations.
3. Describe enzyme catalysis mechanisms and the role of coenzymes.
4. Distinguish between types of enzyme inhibition and their relevance in drug design

REFERENCES:

1. Price NC, Stevens L. *Fundamentals of Enzymology*. 3rd ed. Oxford University Press; 2012.
2. Palmer T. *Enzymes: Biochemistry, Biotechnology and Clinical Chemistry*. 2nd ed. Horwood Publishing; 2001.
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4. Segel IH. *Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady-State Enzyme Systems*. Wiley-Interscience; 1993.
5. Dixon M, Webb EC. *Enzymes*. 3rd ed. Longman; 1979.
6. Lehninger AL, Nelson DL, Cox MM. *Lehninger Principles of Biochemistry*. 7th ed. Freeman; 2017.
7. Boyer PD. *The Enzymes*. Vol I–XII. Academic Press; 1985.
8. Berg JM, Tymoczko JL, Stryer L. *Biochemistry*. 9th ed. Freeman; 2019.
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11. Voet D, Voet JG. *Biochemistry*. 4th ed. Wiley; 2011.
12. Cook PF, Cleland WW. *Enzyme Kinetics and Mechanism*. Garland Science; 2007.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 2
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	✓
CO 3	✓	✓	✓		✓	✓
CO 4	✓	✓		✓	✓	✓

BCS 204: METABOLISM: SOFT CORE

Lecture Hours:39

Total Credits: 03

COURSE OBJECTIVES:

1. To understand carbohydrate catabolism and anabolism.
2. To study lipid biosynthesis and degradation pathways.
3. To explore amino acid and nucleotide metabolism
4. To learn integration and regulation of metabolic pathways.

UNIT I

13 hrs.

Metabolism of carbohydrates: Catabolic, anabolic and amphibolic pathways. Glycolysis, energetics, regulation. Pathways of utilization of pyruvate, lactate, ethanol: gluconeogenesis, regulation, citric acid cycle, its regulation, energetics, anapleurosis, HMP pathway, Glucuronate and Glyoxylate pathway, Cori cycle, Futile cycles and anaplerotic reactions. Interconversion of hexoses. Glycogen and starch degradation, synthesis and regulation, **Lipid metabolism-** Degradation of triacylglycerols and phospholipids- lipase, hormone sensitive lipase phospholipases. Fatty acid degradation -Beta oxidation, saturated and unsaturated FA, Regulation, α and ω - oxidation, Energetics, Biosynthesis of FA- FA synthetase complex, chain elongation and desaturation. conversion of linoleate to arachidonate (scheme only). Cholesterol Biosynthesis and degradation, regulation.

UNIT II

13 hrs.

Amino acid Metabolism: General metabolic reaction of amino acids–transamination, pseudo-transamination, glucose – alanine cycle, oxidative deamination (glutamate dehydrogenase), Urea cycle– regulation and metabolic disorders. Biosynthesis of creatine and creatine phosphate, polyamines– putrescine, spermidine and spermine, glutathione (γ -glutamyl cycle), physiologically active amines (γ -aminobutyric acid, serotonin, histamine and catecholamines– dopamine, epinephrine and epinephrine). **Nucleotide Metabolism:** Biosynthesis of purine and pyrimidine nucleotides and their inter conversion, regulation of biosynthesis. Other pathways of purine nucleotide formation. Biosynthesis of deoxyribonucleotides and coenzymes nucleotides. Degradation of purine and pyrimidines

UNIT III

13 hrs.

Mitochondrial Electron transport- Entry of reducing equivalents for oxidation-malate aspartate shuttle, glycerol phosphate shuttle. Organization of respiratory chain complexes, structure and function of the components Fe-s proteins, cytochromes, Q cycle, proton transfer P/O ratio, respiratory control, oxidative phosphorylation, un-couplers and inhibitors, sequence

of electron carriers based on redox potentials. ATP synthesis, ATP synthase complex, binding change mechanism, proton motive force, Mitchell's hypothesis.

COURSE OUTCOMES:

1. Analyze glycolysis, TCA cycle, and their regulation.
2. Explain energy production through mitochondrial pathways.
3. Understand lipid metabolism and its physiological relevance.
4. Describe amino acid and nucleotide metabolism

REFERENCES:

1. Nelson DL, Cox MM. *Lehninger Principles of Biochemistry*. 7th ed. Freeman; 2017.
2. Voet D, Voet JG. *Biochemistry*. 4th ed. Wiley; 2011.
3. Berg JM, Tymoczko JL, Gatto GJ, Stryer L. *Biochemistry*. 9th ed. Freeman; 2019.
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5. Rawn JD. *Biochemistry*. Neil Patterson Publishers; 1989.
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7. Devlin TM. *Textbook of Biochemistry with Clinical Correlations*. 7th ed. Wiley-Liss; 2010.
8. Murray RK et al. *Harper's Illustrated Biochemistry*. 31st ed. McGraw-Hill; 2018.
9. Campbell MK, Farrell SO. *Biochemistry*. 9th ed. Cengage Learning; 2018.
10. Mathews CK, van Holde KE, Appling DR, Anthony-Cahill SJ. *Biochemistry*. 4th ed. Pearson; 2013.
11. Conn EE, Stumpf PK. *Outlines of Biochemistry*. 5th ed. Wiley; 2009.
12. Smith EL et al. *Principles of Biochemistry*. McGraw-Hill; 1986.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 5	PSO 1	PSO 4
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	
CO 3	✓	✓	✓		✓	
CO 4	✓	✓		✓	✓	✓

BCS 205: METABOLIC DISORDERS: SOFT CORE

Lecture Hours:39

Total Credits: 03

COURSE OBJECTIVES:

1. To understand enzyme use in disease diagnosis.
2. To study disorders related to hemoglobin, liver, and kidney.
3. To analyze endocrine, GIT, and metabolic dysfunctions.
4. To learn biochemical tests for various disease states

UNIT I

13 hrs.

Diagnostic enzymes and haematological disorders; Health and disease – Cellular changes and physiological causes of cell death. **Diagnostic Enzymology-** Mechanisms of elevated enzyme activities. Some important enzymes -Alkaline phosphatase, Creatine Kinase, LDH, AST, ALT-isoenzyme changes, Acid phosphatase. **Blood-** Function of plasma proteins and lipoproteins in diseases. Disorders of Hemoglobin-Thalassemia, Sickle cell anemia. Anemias-Microcytic, normocytic & macrocytic, diagnostic tests for blood disorders. Metabolism of circulating lipids-chylomicrons, HDL, LDL and VLDL. Reverse cholesterol transport by HDL. Bile pigments formation of bilirubin, urobilinogen; bile acids, jaundice-pre-hepatic, hepatic and post-hepatic.

UNIT II

13hrs.

Diseases of the liver –Hepatitis, Cholestasis, Cirrhosis, Gallstones, Acute phase proteins, diagnosis: liver function tests. **Kidney Assessment of renal function-**creatinine clearance, renal calculi, uremia, laboratory investigation of kidney disorders. Urea, creatine, creatinine, serum and blood urea **Gastrointestinal Disorder-** Fractional gastric analysis, hypo and hyper acidity, gastric ulcers, malabsorption syndrome, steatorrhea, diarrhea. **Cardiovascular Disorders-** Major cardiovascular system -Atherosclerosis-risk factors, Pathogenesis. Diagnosis and Prognosis. **Endocrine Disorders-** Disorders - Grave's disease, Addison's disease, Cushing's syndrome, hypo and hyper secretion of hormones. Infertility tests. Laboratory diagnosis. **Cancer-**Apoptosis, Oncogenesis, Necrosis, Angiogenesis, Carcinogens, mechanisms of cancer developments.

UNIT III

13 hrs.

Metabolic Disorders- Disorders of carbohydrate metabolism Diabetes mellitus, classification, etiology, laboratory investigations-GTT, HbA1c, diabetic complications. Inborn errors of carbohydrate metabolism - glycogen storage diseases, galactosemia, lactose intolerance, pentosuria. **Disorders of nitrogen and lipoProtein Metabolism-** Inborn errors of amino acid metabolism -Phenyl ketonuria (PKU), Alkaptonuria, Tyrosinemia, Maple Syrup Urine Disease, disorders of protein pattern studies. **Disorders of Purine and Pyrimidine Metabolism-** Gout, Lesch-Nyhan syndrome, Orotic aciduria. **Disorders of Lipid Metabolism-** Hyper lipoproteinemia, Niemann Pick disease, Tay-Sach's disease, Fabry's disease, Refsum's disease.

COURSE OUTCOMES:

1. Identify diagnostic enzymes and interpret test results.
2. Describe metabolic and inherited disorders (e.g., PKU, alkaptonuria).
3. Understand biochemical basis of cardiovascular diseases.
4. Apply biochemical principles in clinical diagnostics and disease prognosis

REFERENCES:

1. Devlin TM. *Textbook of Biochemistry with Clinical Correlations*. 7th ed. Wiley-Liss; 2010.
2. Burtis CA, Ashwood ER, Bruns DE. *Tietz Textbook of Clinical Chemistry and Molecular Diagnostics*. 6th ed. Elsevier; 2018.

3. Varley H. *Practical Clinical Biochemistry*. 6th ed. CBS Publishers; 2006.
4. Kaplan LA, Pesce AJ. *Clinical Chemistry: Theory, Analysis, Correlation*. 5th ed. Mosby; 2010.
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7. Beckett G, Walker SW, Rae P, Ashby P. *Lecture Notes: Clinical Biochemistry*. 8th ed. Wiley-Blackwell; 2010.
8. Cheesbrough M. *District Laboratory Practice in Tropical Countries Part 1*. 2nd ed. Cambridge Univ Press; 2005.
9. Tietz NW. *Fundamentals of Clinical Chemistry*. 6th ed. Saunders; 2008.
10. McPherson RA, Pincus MR. *Henry's Clinical Diagnosis and Management by Laboratory Methods*. 23rd ed. Elsevier; 2017.
11. Sood R. *Medical Laboratory Technology: Methods and Interpretations*. 6th ed. Jaypee Publishers; 2010.
12. Fischbach FT, Dunning MB. *Manual of Laboratory and Diagnostic Tests*. 9th ed. Lippincott; 2014.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 4	PO 5	PSO 3	PSO 4
CO 1	✓	✓		✓	✓	✓
CO 2	✓	✓			✓	✓
CO 3	✓	✓	✓		✓	✓
CO 4	✓	✓	✓	✓	✓	✓

(OPEN ELECTIVE FOR OTHER DISCIPLINES)

BCE 206: BIOCHEMISTRY IN DAILY LIFE: SOFT CORE

Lecture Hours: 39

Total Credits: 03

COURSE OBJECTIVES:

1. To understand the basic biochemical principles behind common cosmetic products, dietary practices, and food safety.
2. To identify and evaluate ingredients in cosmetics, skin care, and personal care products, with a focus on their function and health effects.
3. To explore and analyse various dietary patterns, including healthy and fad diets, and their biochemical impact on the human body.
4. To recognize common food adulterants, their health hazards, and understand the legal and ethical implications of food adulteration.

UNIT I

13 hrs.

Biochemistry of Cosmetics - Introduction to the beauty industry, Ingredients of skin creams, Biochemistry of skin creams (moisturizers and barrier creams), types of skin creams, sunscreens, and anti-aging products and their uses and effects. Composition of shampoos, types of shampoos and their uses, Reading shampoo labels. Biochemistry of Soaps-ingredients, Types of soaps. Ingredients and types of lipsticks. Marketing vs Reality of cosmetics.

UNIT II

13 hrs.

Biochemistry of Diet - Overview of global dietary guidelines (e.g., WHO, USDA MyPlate, Mediterranean diet), Balanced diet components and meal planning basics, reading food labels and understanding nutritional claims, Common dietary myths and misconceptions, Examples of fad diets: Keto, Paleo, Detox/cleanse, Intermittent fasting, Gluten-free (for non-celiacs), Carnivore. Definition and characteristics junk foods (high sugar, fat, salt, low nutrients), Effect of junk food on children, teens, and long-term health risks.

UNIT III

13 hrs.

Biochemistry of Food Adulteration - Definition and history of food adulteration, Intentional vs. unintentional adulteration, Causes of adulterations- Economics, negligence, and lack of regulation. Common adulterated foods (milk, spices, oil, cereals, sweets, etc.). Common Adulterants and Health Hazards, Harmful chemicals used as adulterants (e.g., urea, chalk powder, brick dust, lead chromate). Health impacts: acute and chronic effects (allergies, cancer, organ damage).

COURSE OUTCOMES:

1. Demonstrate awareness of cosmetic ingredients and critically assess product labels and marketing claims.
2. Apply basic nutritional principles to assess diets and identify misleading or harmful dietary trends.
3. Detect and report common forms of food adulteration using simple tests and informed observation.
4. Exhibit increased consumer awareness regarding health, nutrition, and food product safety in everyday life.

REFERENCES:

1. Swaminathan M. *Essentials of Food and Nutrition*. Vol. 1 & 2. Bangalore Printing & Publishing; 2003.
2. Srilakshmi B. *Food Science*. 7th ed. New Age International; 2021.
3. Brown A. *Understanding Food: Principles and Preparation*. 5th ed. Cengage; 2018.

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- Voet D, Voet JG. *Principles of Biochemistry*. 4th ed. Wiley; 2011.
- Brown A. *The Science of Beauty: The Complete Guide to Skin Care and Cosmetic Chemistry*. CreateSpace; 2010.
- Bhatia BS, Arora R. *Food Adulteration and Food Safety*. Kalyani Publishers; 2015.
- Choudhary RK. *Consumer Awareness and Protection*. S. Chand; 2012.
- Potter NN, Hotchkiss JH. *Food Science*. 5th ed. Springer; 1998.
- Sumati R, Mudambi SR. *Fundamentals of Foods, Nutrition and Diet Therapy*. 5th ed. New Age International; 2007.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 5	PSO 1	PSO 8	PSO 9
CO 1		✓		✓	✓		✓
CO 2		✓	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓		✓
CO 4	✓	✓	✓	✓	✓	✓	✓

BCP 207: PRACTICAL MICROBIOLOGY AND GENETICS: SOFT CORE

Practical: 6 Hours/Week

Total Credits: 02

COURSE OBJECTIVES:

- To provide practical training in microbial culture techniques, sterilization methods, isolation, maintenance, and characterization of microorganisms.
- To develop proficiency in microbiological and cytogenetic techniques including staining, chromosome banding, karyotyping, and pedigree analysis.
- To familiarize students with genetic principles through studies on *Drosophila*, quantitative inheritance, population genetics, and molecular genetic markers.
- To impart hands-on experience in experimental procedures and data interpretation used in microbiology, genetics, and molecular biology research.

Experiments:

- Sterilization techniques Microbial culture media and their preparation
- Isolation techniques, maintenance of microorganisms (stock culture and subculture)
- To cultivate and characterize microbial cultures.
- Staining techniques (a) Simple staining (b) Gram staining (c) Endospore staining (d) Capsule staining (e) AFB staining (f) Negative staining
- Isolation of air/ water microflora
- Morphological features of *Drosophila*
- Mounting genital plate and sex comb in *Drosophila* Mutants of *Drosophila*
- Micronucleus test in mice,
- Banding techniques

10. Karyotyping
11. Chromatographic separation of eye pigments in *Drosophila*
12. Problems on quantitative inheritance Problems on gene frequencies in population
13. Pedigree analysis
14. Restriction fragment length polymorphism (demonstration)

COURSE OUTCOMES:

1. Perform sterilization, media preparation, isolation, cultivation, maintenance, and characterization of microorganisms using standard microbiological techniques.
2. Apply various staining methods and microbial identification techniques for the microscopic examination of microorganisms.
3. Demonstrate practical skills in genetic and cytogenetic analyses including *Drosophila* studies, micronucleus assay, chromosome banding, karyotyping, and pedigree analysis.
4. Analyze inheritance patterns, population genetics parameters, and molecular genetic markers using appropriate genetic and molecular biology techniques.

REFERENCES:

1. Cappuccino JG, Welsh CT. Microbiology: A Laboratory Manual. 12th ed. New York: Pearson Education; 2020.
2. Aneja KR. Experiments in Microbiology, Plant Pathology and Biotechnology. 5th ed. New Delhi: New Age International Publishers; 2018.
3. Harley JP. Laboratory Exercises in Microbiology. 10th ed. New York: McGraw-Hill Education; 2017.
4. Singh BD. Genetics. 5th ed. New Delhi: Kalyani Publishers; 2020.
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8. Russell PJ. iGenetics: A Molecular Approach. 4th ed. New York: Pearson Education; 2020.
9. Sambrook J, Russell DW. Molecular Cloning: A Laboratory Manual. 4th ed. Cold Spring Harbor (NY): Cold Spring Harbor Laboratory Press; 2012.

BCP 208: PRACTICAL ENZYMOLOGY: SOFT CORE

Practical: 6 Hours/week

Total Credits: 03

COURSE OBJECTIVES:

1. To investigate enzyme activity, specificity, and kinetic properties.
2. To purify enzymes from biological sources.
3. To study effects of pH, temperature, and metal ions on enzyme activity.
4. To practice enzyme immobilization techniques.

Experiments:

1. Salivary Amylase:

- a. Activity
- b. Specific activity
- c. Optimum pH and Temperature
- d. pH and Temperature Stability
- e. Energy of activation, K_m , V_{max} ,
- f. Effect of metal ions

3. Assay methods and characterization of

- a. Invertase from yeast
- b. Acid phosphatase from potato
- c. Protease from papaya
- d. Esterase from peas

4. Immobilization of enzymes

COURSE OUTCOMES:

1. Measure and interpret enzyme kinetics including K_m and V_{max} values.
2. Purify enzymes using ammonium sulfate fractionation.
3. Characterize enzymes under various environmental conditions.
4. Apply enzyme immobilization and understand its industrial significance.

REFERENCES:

1. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland, Wiley- VCH Publishers(2000).
2. Enzyme Kinetics and Mechanism; Paul F. Cook, W. W. Cleland, Garland Science (2007).
3. Biochemical Calculations, Irwin H. Segel (1976) 2nd Ed. John Wiley and Sons.
4. Methods in Enzymology; Colowick S.P. et al., Vol. 152, Academic Press, (1987).
5. Methods of Enzymatic Analysis; Berg Meyer Vol. 1-X, (1974).

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 4	PSO 2	PSO 6
CO 1	✓	✓	✓		✓	✓
CO 2	✓	✓	✓		✓	✓
CO 3	✓	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓

BCP 209: PRACTICAL CLINICAL BIOCHEMISTRY: SOFT CORE

Practical: 6hours/week

Total Credits: 02

COURSE OBJECTIVES:

1. To study biochemical markers in diagnosis of human diseases.
2. To analyze clinical samples for diagnostic enzymes and metabolites.
3. To perform urine analysis and interpret clinical parameters.

4. To use commercial kits for biochemical estimations.

Experiments:

1. Urine analysis – Normal and Abnormal.
2. Estimation of serum cholesterol by Zak's method.
3. Estimation of serum proteins by Lowry's method
4. Estimation of protein and A-G ratio by Biuret method
5. Estimation of free Proline by Bate's method
6. Serum SGOT, SGPT, LDH, ALP, urea, uric acid, creatinine, TAG, Cholesterol estimation using kits, determination of HDL and LDL cholesterol.

COURSE OUTCOMES:

1. Perform clinical biochemistry tests such as SGOT, SGPT, urea, and creatinine.
2. Analyze serum lipids and protein profiles using standard methods.
3. Conduct qualitative and quantitative urine analysis.
4. Correlate clinical test results with disease conditions like diabetes and liver disorders.

REFERENCES:

1. Plummer DT. *An Introduction to Practical Biochemistry*. 3rd ed. New Delhi: Tata McGraw-Hill; 1988.
2. Sadasivam S, Manickam A. *Biochemical Methods*. 3rd ed. New Delhi: New Age International Publishers; 2008.
3. Nigam A. *Lab Manual of Biochemistry*. New Delhi: Tata McGraw-Hill Education; 2007.
4. Varley H. *Practical Clinical Biochemistry*. 6th ed. New Delhi: CBS Publishers & Distributors; 2006.
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7. Segel IH. *Biochemical Calculations*. 2nd ed. New York: John Wiley & Sons; 1976.
8. Kaplan LA, Pesce AJ. *Clinical Chemistry: Theory, Analysis, and Correlation*. 4th ed. St. Louis: Mosby; 2003.
9. Biochemical Methods. S. Sadasivam and A. Manickam. 3rd ed, New Age International P.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 2	PSO 6
CO 1	✓	✓	✓		✓		
CO 2	✓	✓	✓		✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	
CO 4	✓	✓	✓	✓	✓	✓	✓

THIRD SEMESTER

BCH 301: MOLECULAR BIOLOGY: HARD CORE

Lecture Hours: 52

Total Credits: 04

COURSE OBJECTIVES:

1. To study DNA replication in prokaryotes, eukaryotes, and viruses.
2. To understand transcription processes and RNA modifications.
3. To analyze protein synthesis mechanisms and genetic code.
4. To explore post-translational modifications and gene regulation.

UNIT I

13 hrs.

Historical perspective and central dogma of molecular biology. Structure and organization of prokaryotic and eukaryotic genomes. Properties and functions of prokaryotic and eukaryotic DNA polymerases. Role of DNA ligases, topoisomerases and accessory proteins. DNA replication: semiconservative nature of replication; Meselson and Stahl experiment. Replicons, origins of replication, primosome and replisome. Mechanism of DNA replication: synthesis of leading and lagging strands, Okazaki fragments and Trombone model. Fidelity of replication and proofreading mechanisms. Differences between prokaryotic and eukaryotic DNA replication. Replication in viruses with reference to M13 phage and ϕ X174. Replication of mitochondrial DNA.

UNIT II

13 hrs.

Transcription - RNA biosynthesis in prokaryotes and eukaryotes: RNA polymerases, promoters, initiation, elongation and termination of transcription. RNA-dependent RNA synthesis and replication of RNA viruses. Post-transcriptional processing of eukaryotic RNA: 5' capping, polyadenylation, RNA editing and RNA splicing. Processing of rRNA and tRNA. **Translation**- Genetic code: triplet nature, universality, degeneracy, wobble hypothesis, codon assignment and codon usage bias. Structure of prokaryotic and eukaryotic ribosomes. Mechanism of protein synthesis: initiation, elongation and termination in prokaryotes and eukaryotes. Translational control and inhibitors of protein synthesis.

UNIT III

13 hrs.

Post-translational modifications of proteins: phosphorylation, glycosylation, acetylation, methylation and ubiquitination. Molecular chaperones and protein folding. Regulation of protein stability: N-end rule, PEST sequences and ubiquitin-mediated protein degradation.

Chromatin organization and nucleosome structure. Epigenetic regulation of gene expression: DNA methylation, histone modifications, chromatin remodelling and higher-order chromatin organization. Epigenetic inheritance and epigenetic regulation and dysregulation.

UNIT IV

13 hrs.

Regulation of gene expression in prokaryotes: operon concept and regulatory mechanisms. Lac operon, arabinose operon and tryptophan operon; positive and negative regulation, attenuation control. Regulation of transcription in eukaryotes: transcription factors, enhancers, silencers and regulatory elements. Regulatory functions of non-coding RNAs: miRNAs, siRNAs, piRNAs, lncRNAs and circRNAs. RNA interference pathways and gene silencing mechanisms. Regulation of genes during development with reference to developmental genes in *Drosophila*.

COURSE OUTCOMES:

1. Explain mechanisms of replication, transcription, and translation across systems.
2. Interpret genetic coding and ribosomal structure–function relationships.
3. Analyze post-translational processing and protein targeting.
4. Apply knowledge in gene regulation and molecular genetic experiments

REFERENCES:

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M, Losick R. Molecular Biology of the Gene. 7th ed. New York: Pearson; 2014.
2. Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, et al. Molecular Biology of the Cell. 7th ed. New York: Garland Science; 2022.
3. Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, et al. Molecular Cell Biology. 9th ed. New York: W.H. Freeman; 2021.
4. Weaver RF. Molecular Biology. 6th ed. New York: McGraw-Hill Education; 2021.
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6. Brown TA. Genomes 4. 4th ed. New York: Garland Science; 2018.
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8. Karp G. Cell and Molecular Biology: Concepts and Experiments. 9th ed. Hoboken (NJ): John Wiley & Sons; 2019.
9. Allis CD, Jenuwein T, Reinberg D, Caparros ML, editors. Epigenetics. 2nd ed. Cold Spring Harbor (NY): Cold Spring Harbor Laboratory Press; 2015.
10. Turner BM. Chromatin and Gene Regulation: Mechanisms in Epigenetics. 2nd ed. Hoboken (NJ): Wiley-Blackwell; 2014.
11. Griffiths AJF, Wessler SR, Carroll SB, Doebley J. An Introduction to Genetic Analysis. 12th ed. New York: W.H. Freeman; 2020.
12. Snustad DP, Simmons MJ. Principles of Genetics. 8th ed. Hoboken (NJ): John Wiley & Sons; 2021.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 2	PSO 6
CO 1	✓	✓			✓	✓	
CO 2	✓	✓	✓		✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓

BCH 302: IMMUNOLOGY: HARDCORE

Lecture hours: 52

Total Credits: 04

COURSE OBJECTIVES:

1. To understand fundamental concepts of immunity.
2. To study the development and function of immune cells.
3. To examine transplantation immunology and hypersensitivity.
4. To understand immunological disorders and immune response diagnostics.

UNIT I

13 hrs.

Introduction to immunology: Historical development and milestones in immunology. Definitions; antigenicity, immunogenicity, innate and acquired immunity. Primary and secondary lymphoid organs, self and non- self- discrimination. Antigens and antibodies, haptens and determinants epitopes and paratopes. Antigenicity of carbohydrates, proteins, nucleic acids and cells as antigens. Valency of antigen, epitope analysis. Classes and subclasses of immunoglobulins, structure of immunoglobulins, hyper variable region isotypic, allotypic and idiotypic variation.

UNIT II

13 hrs.

Cellular Basis of Immunity- Primary and secondary immune response. Reticuloendothelial system, T, B and accessory cells. Development of T and B cells, Subsets of T and B cells. T-helper cells, T-killer cells, T-suppressor cells. T and B cell receptors, antigen processing and presentation. Cytokines and co- stimulatory molecules, Lymphokines and interleukins structure, functions of IL-1B, IL-2 and TNF . T and B interaction. Suppression of immune response, immunoglobulin gene- immunoglobulin diversity, gene rearrangement, clonal selection theory.

UNIT III

13 hrs.

MHC molecules and transplantation: Role of MHC in immune response and transplantation. Non-specific Defence in Man- Barriers to infection-skin, mucous membrane, inflammation, complement hyper sensitivity reactions (Type I, II, III and IV). Transplantation- Autograft, isograft, allograft and xenograft. Graft rejection, the reaction b/t graft and host tissue. Tumour

immunology-tumor associated antigens, factors favouring tumour growth, immune surveillance. Tumour necrosis factors α and β .

UNIT IV

13 hrs.

Disorders of Immunity- Immunological tolerance, auto immune disorders, Acquired Immuno-Deficiency syndrome (AIDS), Severe Combined Immune Deficiency (SCID). Vaccines- adjuvants, vaccines and their preparations. Polyclonal and monoclonal antibodies, hybridoma technique. In vitro antigen-antibody reaction, precipitation, agglutination, complements fixation, immunodiffusion, immuno-electrophoresis, immunofluorescence, RIA, ELISA.

COURSE OUTCOMES:

1. Define and distinguish antigens, antibodies, and immune responses.
2. Identify roles of T-cells, B-cells, cytokines, and MHC in immunity.
3. Explain graft rejection, tumor immunology, and hypersensitivity types.
4. Apply techniques such as ELISA, RIA, and immunoelectrophoresis

REFERENCES:

1. Abbas AK, Lichtman AH, Pillai S. *Basic Immunology: Functions and Disorders of the Immune System*. 6th ed. Elsevier; 2020.
2. Abbas AK, Lichtman AH. *Cellular and Molecular Immunology*. 10th ed. Elsevier; 2021.
3. Janeway CA Jr, Travers P, Walport M, Shlomchik MJ. *Immunobiology*. 8th ed. Garland Science; 2012.
4. Kindt TJ, Goldsby RA, Osborne BA. *Kuby Immunology*. 7th ed. W.H. Freeman; 2013.
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7. Paul WE. *Fundamental Immunology*. 7th ed. Lippincott Williams & Wilkins; 2012.
8. Murphy K, Weaver C. *Janeway's Immunobiology*. 9th ed. Garland Science; 2016.
9. Playfair JHL, Chain BM. *Immunology at a Glance*. 10th ed. Wiley-Blackwell; 2012.
10. Parham P. *The Immune System*. 4th ed. Garland Science; 2014.
11. Tizard IR. *Immunology: An Introduction*. 5th ed. Saunders; 2004.
12. Owen JA, Punt J, Stranford SA, Jones PP. *Kuby Immunology*. 9th ed. W.H. Freeman; 2021.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 5	PSO 2	PSO 4	PSO 5	PSO 6
CO 1	✓	✓			✓		✓	
CO 2	✓	✓	✓		✓	✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓	✓

BCH 303:-INDUSTRIAL BIOTECHNOLOGY AND BIOPROCESS TECHNOLOGY: HARD CORE

Lecture Hours: 52

Total Credits: 04

COURSE OBJECTIVES:

1. To introduce the principles and applications of modern biotechnology.
2. To understand the molecular basis and techniques used in genetic engineering.
3. To learn the tools for gene cloning, recombinant DNA technology, and transgenics.
4. To explore biotechnological approaches in healthcare, agriculture, and industry.

UNIT I:

13 hrs.

Fundamentals of Industrial Biochemistry and Biotechnology: Introduction to industrial biotechnology: scope, importance and applications. Isolation, screening and preservation of industrially important microorganisms. Strain improvement methods: mutation and recombinant DNA approaches. Fermentation technology: fermentation media, inoculum preparation and optimization of culture conditions. Batch, fed-batch and continuous fermentation processes. Types of fermenters and principles of scale-up. Industrial production of selected products: alcohols, organic acids, industrial enzymes and single-cell proteins.

UNIT II

13 hrs.

Animal and plant Biotechnology: Principles of plant tissue culture and animal cell culture. Composition and preparation of culture media. Establishment of primary cultures and maintenance of cell lines. Cell separation and cell viability assessment methods. Plant tissue culture techniques: micropropagation, callus culture, haploid production, somatic embryogenesis and somatic hybridization. Production of disease-free and genetically improved plants. Animal cell culture applications in biotechnology, vaccine production, monoclonal antibodies and biopharmaceuticals. Introduction to cell immobilization and its industrial applications.

UNIT III

13 hrs.

Genetic Engineering: Principles and applications of genetic engineering. Tools of recombinant DNA technology: restriction endonucleases, DNA ligases and cloning vectors. Plasmid and bacteriophage vectors. Gene cloning strategies and transformation methods. Polymerase Chain Reaction (PCR): principles, types and applications. DNA sequencing methods and their applications. Blotting techniques: Southern, Northern and Western blotting. Introduction to genome engineering technologies. CRISPR-Cas systems and applications in genome modification, gene regulation and biotechnology. Overview of base editing and prime editing technologies.

Biopharmaceuticals, Downstream Processing and Biosafety: Production of recombinant products: insulin, vaccines and growth hormones, Antibiotic production: penicillin and streptomycin, Downstream processing: filtration, centrifugation and chromatography, Product recovery and purification techniques, Quality control and quality assurance in biotechnology industries Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP), Biosafety, bioethics and Intellectual Property Rights (IPR), Biotechnology entrepreneurship and startup opportunities, Applications of biotechnology in food, agriculture and pharmaceutical industries.

COURSE OUTCOMES:

1. Demonstrate understanding of gene cloning, vector design, and recombinant protein expression.
2. Apply molecular tools such as PCR, CRISPR, and hybridization techniques in genetic modification.
3. Evaluate applications of biotechnology in therapeutic development, crop improvement, and biofuels.
4. Analyze ethical, regulatory, and safety concerns associated with biotechnological products.

REFERENCES:

1. Crueger W, Crueger A. Biotechnology: A Textbook of Industrial Microbiology. 2nd ed. Sunderland: Sinauer Associates; 2000.
2. Stanbury PF, Whitaker A, Hall SJ. Principles of Fermentation Technology. 3rd ed. Oxford: Butterworth-Heinemann; 2017.
3. Shuler ML, Kargi F. Bioprocess Engineering: Basic Concepts. 3rd ed. Upper Saddle River (NJ): Prentice Hall; 2017.
4. Ratledge C, Kristiansen B, editors. Basic Biotechnology. 3rd ed. Cambridge: Cambridge University Press; 2006.
5. Primrose SB, Twyman RM. Principles of Gene Manipulation and Genomics. 8th ed. Oxford: Blackwell Publishing; 2013.
6. Brown TA. Gene Cloning and DNA Analysis: An Introduction. 8th ed. Hoboken (NJ): Wiley-Blackwell; 2020.
7. Glick BR, Pasternak JJ, Patten CL. Molecular Biotechnology: Principles and Applications of Recombinant DNA. 5th ed. Washington (DC): ASM Press; 2010.
8. Freshney RI. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 8th ed. Hoboken (NJ): Wiley-Blackwell; 2021.
9. Bhojwani SS, Dantu PK. Plant Tissue Culture: An Introductory Text. New Delhi: Springer India; 2013.
10. Walsh G. Biopharmaceuticals: Biochemistry and Biotechnology. 3rd ed. Chichester: John Wiley & Sons; 2018.
11. Singh BD. Biotechnology: Expanding Horizons. 5th ed. New Delhi: Kalyani Publishers; 2021.
12. Gupta PK. Elements of Biotechnology. 3rd ed. New Delhi: Rastogi Publications; 2019.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 5	PSO 1	PSO 2	PSO 6
CO 1	✓	✓			✓		
CO 2	✓	✓	✓		✓	✓	✓
CO 3	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓		✓	✓	✓	✓

BCS 304: BIOINFORMATICS AND BIOSTATISTICS: SOFTCORE

Lecture Hours: 39

Total Credits: 03

COURSE OBJECTIVES:

1. To introduce computational tools for analysis of biological data.
2. To teach database usage for nucleotide and protein sequences.
3. To understand experimental design and statistical analysis in research.
4. To develop skills for scientific writing and publication.

UNIT I

13 hrs.

Introduction to bioinformatics: scope, importance and applications. Biological databases: primary, secondary and composite databases; NCBI, GenBank, EMBL, DDBJ, UniProt and PDB. Sequence alignment methods: pairwise alignment, global and local alignment. BLAST and FASTA. Multiple sequence alignment and phylogenetic analysis. Genome sequencing projects, genome annotation and introduction to functional genomics.

UNIT II

13 hrs.

Introduction to next-generation sequencing (NGS) technologies and applications. Genome and transcriptome analysis. RNA-seq and variant analysis. Introduction to single-cell biology and multi-omics approaches. Proteomics and metabolomics databases and applications. Protein structure prediction and molecular visualization. Molecular docking and computer-aided drug discovery. Applications of bioinformatics in genomics, proteomics and personalized medicine.

UNIT II

13 hrs.

Measures of central tendency and dispersion: mean, median, mode, variance, standard deviation and standard error. Correlation and regression. Sampling methods. Probability and probability distributions (binomial, Poisson and normal). Tests of significance: t-test, chi-square test and analysis of variance (ANOVA).

Data visualization using line graphs, histograms, bar diagrams and pie charts. Introduction to statistical software and R-based data analysis. Artificial intelligence and machine learning applications in biological data analysis. Ethical aspects of biological data management.

COURSE OUTCOMES:

1. Utilize biological databases and sequence alignment tools effectively.
2. Analyze and interpret experimental data using statistical methods.
3. Design valid and reproducible experiments in biochemistry research.
4. Develop scientific reports, proposals, and manuscripts for publication.

REFERENCES:

1. Mount DW. *Bioinformatics: Sequence and Genome Analysis*. 2nd ed. Cold Spring Harbor Laboratory Press; 2004.
2. Lesk AM. *Introduction to Bioinformatics*. 5th ed. Oxford University Press; 2019.
3. Krane DE, Raymer ML. *Fundamental Concepts of Bioinformatics*. 1st ed. Pearson; 2002.
4. Rashidi HH, Buehler LK. *Bioinformatics Basics: Applications in Biological Science and Medicine*. 2nd ed. CRC Press; 2005.
5. Campbell AM, Heyer LJ. *Discovering Genomics, Proteomics, and Bioinformatics*. 2nd ed. Benjamin Cummings; 2007.
6. Baxevanis AD, Ouellette BFF. *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*. 3rd ed. Wiley-Interscience; 2005.
7. Baldi P, Brunak S. *Bioinformatics: The Machine Learning Approach*. 2nd ed. MIT Press; 2001.
8. Ewens WJ, Grant GR. *Statistical Methods in Bioinformatics*. 2nd ed. Springer; 2005.
9. Zar JH. *Biostatistical Analysis*. 5th ed. Pearson Education; 2010.
10. Sokal RR, Rohlf FJ. *Biometry: The Principles and Practice of Statistics in Biological Research*. 4th ed. W.H. Freeman; 2012.
11. Glantz SA. *Primer of Biostatistics*. 7th ed. McGraw-Hill; 2011.
12. Kothari CR. *Research Methodology: Methods and Techniques*. 2nd ed. New Age International; 2004.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 5	PSO 2	PSO 6	PSO 7	PSO 9
CO 1	✓	✓			✓		✓	
CO 2	✓	✓	✓		✓	✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓	✓

BCS 305: CANCER BIOLOGY: SOFTCORE

Lecture Hours: 39

Total Credits: 03

COURSE OBJECTIVES:

1. To study the hallmarks and molecular basis of cancer.
2. To understand oncogenes, tumor suppressors, and signaling pathways.
3. To explore mechanisms of metastasis and tumor progression.
4. To examine approaches in cancer diagnosis and therapy.

UNIT I

13 hrs.

Growth characteristics of cancer cells: Morphological and ultrastructural properties of cancer cells. Types of growth- hyperplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. Differences between benign and malignant tumors. Hall marks of cancer. Epidemiology of cancer. Aberrant metabolism during cancer development. Warburg effect. Paraneoplastic syndromes. Chemical carcinogenesis- stages in chemical carcinogenesis- Initiation, promotion and progression. Ames test. Radiation and Viral carcinogenesis. Free radicals, antioxidants in cancer. Cancer endocrinology.

UNIT II

13 hrs.

Cellular proto-oncogenes-oncogenes activation: Growth factors- EGF, TNF- α and TGF- β and growth factor receptors- Signal transduction in cancer -transcription factors- NFAT, NF-kB, SMAD and STAT in cancer. RAS signaling in cancer. Tumor suppressor genes p53, p21, Rb, BRCA1 and BRCA2. Telomeres and Immortality; cell- cell interactions, cell adhesion- invasion and metastasis- VEGF signaling, angiogenesis. Hypoxia; Epigenetics- Role of DNA methylation in gene silencing- epigenetic silencing; Apoptosis in cancer- cell death by apoptosis- role of caspases; Death signaling pathways- mitochondrial and death receptor pathways. Autophagy in cancer.

UNIT III

13 hrs.

Different types of diagnostic approach to detect cancer: Tumor markers, Strategies of cancer treatment- chemotherapy- gene therapy; Immunotherapy- Immune check point therapy and CART- Cell therapy; Radio therapy and Cancer vaccines. Resistance against anticancer drugs. Nutrition and cancer management. Phyto medicine in cancer. Cancer drug discovery: genomics and proteomics approach. Cancer stem cells.

COURSE OUTCOMES:

1. Describe genetic and biochemical mechanisms of oncogenesis.
2. Analyze signal transduction pathways involved in cancer development.
3. Explain tumor progression, angiogenesis, and metastasis.
4. Evaluate diagnostic methods and therapeutic strategies in oncology.

REFERENCES:

1. Weinberg RA. The Biology of Cancer. 2nd ed. Garland Science; 2013.
2. Pecorino L. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics. 4th ed. Oxford University Press; 2021.
3. King RJ, Robins MW. Cancer Biology. 4th ed. Pearson; 2006.
4. Franks LM, Teich NM. Introduction to the Cellular and Molecular Biology of Cancer. 4th ed. Oxford University Press; 1997.
5. Lodish H et al. Molecular Cell Biology. 8th ed. Freeman; 2016.
6. Cooper GM. The Cell: A Molecular Approach. 6th ed. ASM Press; 2013.
7. Kufe DW et al. Cancer Medicine. 8th ed. BC Decker; 2012.
8. Vogelstein B, Kinzler KW. The Genetic Basis of Human Cancer. 2nd ed. McGraw-Hill; 2002.
9. Ruddon RW. Cancer Biology. 4th ed. Oxford University Press; 2007.
10. Thompson CB. Apoptosis in Cancer Pathogenesis. Cell; 1995.
11. Hanahan D, Weinberg RA. Hallmarks of Cancer. Cell; 2000.
12. Sudhakar A. Cancer Biology. Alpha Science; 2009.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 4	PO 5	PSO 4	PSO 6	PSO 09
CO 1	✓	✓			✓	✓	
CO 2	✓	✓	✓		✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓

OPEN ELECTIVE FOR OTHER DISCIPLINES BCE 306: HEALTH AND DISEASE: SOFTCORE

Lecture Hours: 39

Total Credits: 03

COURSE OBJECTIVES:

1. To provide foundational knowledge on the definition, dimensions, and determinants of health and disease.
2. To classify and explain the causes, symptoms, prevention, and treatment of communicable, non-communicable, and lifestyle-related diseases.
3. To introduce genetic disorders and discuss their clinical features, diagnosis, and management.
4. To promote awareness about mental health, hygiene, infection control, and public health interventions.

UNIT I

13 hrs.

Introduction to health and diseases: WHO definition of health, Health and hygiene, General health care, Factors affecting health, Indices and evaluation of health, Disease patterns in developed and developing world; Classification of diseases - Endemic, Epidemic, Pandemic; Professional Health hazards. Disease condition: Acute disease, Chronic disease, Incurable disease, Terminal disease, Illness, disorders, Syndrome, Pre-disease. Treatment:

Psychotherapy, medications, surgery, medical devices, and self-care. Dimensions of Health: physical, mental, social, spiritual, emotional, vocational, political, cultural, socioeconomic, environmental, philosophical, educational, nutritive, curative and preventive.

UNIT II

13 hrs.

Communicable and life style diseases - Tuberculosis, Cholera, Typhoid, Conjunctivitis, Sexually Transmitted diseases (STD), Information, statistics, and treatment guidelines for STD, Prevention: Syphilis, Gonorrhea, AIDS etc. Non-communicable diseases- Malnutrition- Under nutrition, Over nutrition, Nutritional deficiencies; Anemia, Stroke, Rheumatic heart disease, Coronary heart disease, Cancer, blindness, accidents, mental illness, Iodine deficiency, Fluorosis, Epilepsy, Asthma. Genetic disorders- Down's syndrome, Klinefelter's syndrome, Turner's syndrome. Life style disorders- Obesity, Liver cirrhosis, Diabetes mellitus, Hypertension (Causative agents, symptoms, diagnosis, treatment, prognosis, prevention)

UNIT III

13 hrs.

Health promotion: Preventing drug abuse, Oral health promotion by tobacco control. Mental Hygiene and Mental Health - Concepts of mental hygiene and mental health Characteristics of mentally healthy person - Warning signs of poor mental health - Promotive and preventive mental health – strategies and services - Ego defense mechanisms and implications -Personal and social adjustments - Guidance and Counseling. Infection control - Nature of infection - Chain of infection transmission - Defenses against infection transmission.

COURSE OUTCOMES:

1. Students will be able to define health and disease and identify factors influencing health across global populations.
2. Students will classify diseases and explain the prevention, diagnosis, and treatment of communicable and non-communicable diseases.
3. Students will describe major genetic and lifestyle disorders and interpret their health impacts and control strategies.
4. Students will demonstrate awareness of mental health, hygiene practices, infection control, and public health promotion strategies.

REFERENCES:

1. Srilakshmi B. *Nutrition Science*. 4th ed. New Age International; 2010.
2. Swaminathan M. *Essentials of Food and Nutrition*. Vol. 1 & 2. Bangalore Printing; 2003.
3. Chatterjea MN, Shinde R. *Textbook of Medical Biochemistry*. 8th ed. Jaypee Brothers; 2012.
4. Murray RK et al. *Harper's Illustrated Biochemistry*. 31st ed. McGraw-Hill; 2018.
5. Guyton AC, Hall JE. *Textbook of Medical Physiology*. 13th ed. Elsevier; 2016.
6. Devlin TM. *Textbook of Biochemistry with Clinical Correlations*. 7th ed. Wiley; 2010.
- 7.Sizer FS, Whitney E. *Nutrition: Concepts and Controversies*. 15th ed. Cengage Learning; 2021.
8. WHO. *Global Status Report on Noncommunicable Diseases*. World Health Organization; 2014.

9. Ross AC et al. *Modern Nutrition in Health and Disease*. 11th ed. Lippincott Williams & Wilkins; 2012.
10. Brown JE. *Nutrition Through the Life Cycle*. 5th ed. Cengage Learning; 2014.
11. Bamji MS, Krishnaswamy K, Brahmam GNV. *Textbook of Human Nutrition*. 3rd ed. Oxford & IBH; 2009.
12. Insel P, Roth WT, McMahon K. *Nutrition*. 5th ed. Jones & Bartlett; 2011.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO5	PSO1	PSO 3	PSO 09
CO 1	✓				✓		✓
CO 2	✓	✓		✓		✓	
CO 3	✓	✓	✓	✓			
CO 4		✓		✓	✓		✓

BCP 307: PRACTICAL MOLECULAR BIOLOGY & IMMUNOLOGY: SOFT CORE

Practical: 6 Hours/week

Total Credits: 02

COURSE OBJECTIVES:

1. To understand molecular techniques in DNA and RNA analysis.
2. To practice immunological assays such as ELISA.
3. To learn protein-DNA interaction and gene expression analysis.
4. To gain experience in blotting and PCR techniques.

Experiments:

1. Isolation of DNA and RNA from plant and animal source, purity of DNA.
2. Isolation of plasmid
3. Spectroscopic determination of melting temperature (T_m) of calf thymus DNA.
4. Electrophoresis of DNA and RNA.
5. DNA size determination using molecular weight markers
6. PCR setup and cycling conditions
7. Antigen-antibody reactions (in vitro) Phagocytosis (in vitro)
8. Immunological diagnosis of pregnancy and infection
9. Radial immunoassay.
10. Ouchterlony double diffusion
11. Rocket immune-electrophoresis
12. Dot ELISA.
13. Blood group testing.
14. Separation of serum proteins by SDS-PAGE

COURSE OUTCOMES:

1. Isolate, quantify, and assess the purity and properties of DNA, RNA, and plasmids using standard molecular biology techniques.
2. Perform nucleic acid analysis using electrophoresis, molecular weight markers, and PCR-based methods.

3. Demonstrate and interpret antigen–antibody reactions using immunological assays and diagnostic techniques.
4. Apply immunological and biochemical methods such as ELISA, immunodiffusion, immunoelectrophoresis, blood grouping, and SDS-PAGE for analysis of biological samples.

REFERENCES:

1. Sambrook J, Russell DW. Molecular Cloning: A Laboratory Manual. 4th ed. Cold Spring Harbor (NY): Cold Spring Harbor Laboratory Press; 2012.
2. Green MR, Sambrook J. Molecular Cloning: A Laboratory Course Manual. Cold Spring Harbor (NY): Cold Spring Harbor Laboratory Press; 2019.
3. Wilson K, Walker J. Principles and Techniques of Biochemistry and Molecular Biology. 8th ed. Cambridge: Cambridge University Press; 2018.
4. Das HK. Textbook of Biotechnology. 5th ed. Hoboken (NJ): Wiley India Pvt. Ltd.; 2017.
5. Seidman LA, Moore CJ. Basic Laboratory Methods for Biotechnology: Textbook and Laboratory Reference. 3rd ed. Boston (MA): Pearson Education; 2015.

BCP 308: PRACTICAL INDUSTRIAL BIOTECHNOLOGY AND BIOPROCESS TECHNOLOGY: HARD CORE

Practical: 6 hours/week

Total Credits: 04

COURSE OBJECTIVES:

1. To provide practical training in recombinant DNA technology, microbial cultivation, and genetic engineering techniques.
2. To develop skills in the isolation, screening, and utilization of industrially important microorganisms for the production of commercially valuable biomolecules.
3. To impart hands-on experience in cell culture techniques, cell viability assessment, and separation of mammalian cells for biotechnological applications.
4. To familiarize students with advanced biotechnology techniques including DNA manipulation, primer design, enzyme immobilization, and DNA library construction.

Experiments:

1. Preparation of media, culturing of transgenic E. coli and Yeast.
2. Preparation of competent cells.
3. Restriction digestion of DNA.
4. Primer design and optimization
5. Isolation of industrially important microorganisms for citric acid/lactic acid production
6. Isolation of industrially important microorganisms for alpha amylase production.
7. Immobilization of enzymes and cells
8. Isolation of industrially important microorganisms for ethanol production and comparison of ethanol production using various Organic wastes /raw Material (Free cells/ immobilized cells).
9. Maintenance of cultures (normal and tumor cell lines)
10. Separation of peripheral blood mononuclear cells
11. Cell counting (haemocytometer)
12. Lymphocyte culture technique
13. Cell viability tests
14. Construction of DNA libraries

COURSE OUTCOMES:

1. Demonstrate proficiency in microbial culture techniques, preparation of competent cells, and maintenance of recombinant microorganisms.
2. Perform molecular biology procedures including restriction digestion, primer design, DNA manipulation, and construction of DNA libraries.
3. Isolate, screen, and evaluate industrially important microorganisms and apply immobilization techniques for enhanced bioprocess applications.
4. Apply mammalian cell culture techniques, cell counting, viability assessment, and lymphocyte culture methods in biotechnology and biomedical research.

REFERENCES:

1. Brown TA. Gene Cloning and DNA Analysis: An Introduction. 8th ed. Hoboken (NJ): Wiley-Blackwell; 2020.
2. Green MR, Sambrook J. Molecular Cloning: A Laboratory Manual. 4th ed. Cold Spring Harbor (NY): Cold Spring Harbor Laboratory Press; 2012.
3. Freshney RI. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 8th ed. Hoboken (NJ): Wiley-Blackwell; 2021.
4. Stanbury PF, Whitaker A, Hall SJ. Principles of Fermentation Technology. 3rd ed. Oxford: Butterworth-Heinemann; 2017.
5. Glick BR, Pasternak JJ, Patten CL. Molecular Biotechnology: Principles and Applications of Recombinant DNA. 6th ed. Washington (DC): ASM Press; 2010.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 5	PSO 1	PSO 3	PSO 09
CO 1	✓				✓		✓
CO 2	✓	✓		✓		✓	
CO 3	✓	✓	✓	✓			
CO 4		✓		✓	✓		✓

BCP 309: PRACTICAL BIOINFORMATICS AND BIOSTATISTICS: SOFT CORE**Practical: 6 Hours/Week****Total Credits: 02****COURSE OBJECTIVES:**

1. To provide practical training in the use of bioinformatics databases, sequence analysis tools, and protein structure prediction software.
2. To develop skills in computational analysis of biological data using bioinformatics and molecular modeling tools.
3. To impart knowledge of basic biostatistical methods for data analysis and interpretation in biological research.
4. To introduce R programming and data analysis approaches for handling and interpreting OMICS datasets.

Experiments:

1. Biological databases
2. BLAST
3. FASTA
4. RASMOL AND PYMOL AND PDB VIEWERS
5. Multiple sequence alignment – MEGA/Clustal Omega
6. Protein structure-function prediction using ExPASy ProtParam/ SOPMA, GOR4, or CFSSP/
7. SWISS-MODEL
8. Restriction mapping
9. Mean SEM,
10. Histogram
11. Student's t-test
12. ANOVA
13. Introduction to R Programming
14. RStudio-data analysis and interpretation of OMICS data

COURSE OUTCOMES:

1. Retrieve, analyze, and interpret biological information using databases and sequence analysis tools such as BLAST, FASTA, and Clustal Omega.
2. Apply bioinformatics software for protein structure visualization, prediction, homology modeling, and restriction mapping studies.
3. Perform statistical analyses using descriptive and inferential statistical methods including t-tests, ANOVA, and graphical data representation.
4. Utilize R and RStudio for data analysis, visualization, and interpretation of biological and OMICS datasets.

REFERENCES:

1. Lesk AM. Introduction to Bioinformatics. 5th ed. Oxford: Oxford University Press; 2019.
2. Mount DW. Bioinformatics: Sequence and Genome Analysis. 2nd ed. Cold Spring Harbor (NY): Cold Spring Harbor Laboratory Press; 2004.
3. Pevsner J. Bioinformatics and Functional Genomics. 4th ed. Hoboken (NJ): John Wiley & Sons; 2024.
4. Pagano M, Gauvreau K. Principles of Biostatistics. 2nd ed. Boca Raton (FL): CRC Press; 2018.
5. Kabacoff RI. R in Action: Data Analysis and Graphics with R. 3rd ed. Shelter Island (NY): Manning Publications; 2024.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 5	PSO 1	PSO 3	PSO 09
CO 1	✓				✓		✓
CO 2	✓	✓		✓		✓	
CO 3	✓	✓	✓	✓			
CO 4		✓		✓	✓		✓

FOURTH SEMESTER

BCH 401: PROJECT DISSERTATION: HARD CORE

Project work: 40 Hours/Week

Total Credits: 16

COURSE OBJECTIVES:

1. To provide students with hands-on research experience in Biochemistry and allied disciplines through independent project work.
2. To develop skills in experimental design, data collection, analysis, and interpretation using appropriate scientific methodologies.
3. To expose students to research, industrial, clinical, and professional environments and promote ethical scientific practices.
4. To enhance scientific communication skills through dissertation writing, presentation, and viva-voce examination.

Students shall undertake a four-month project work at reputed biochemical, pharmaceutical, biotechnology, or related industries, national/state research laboratories/academic institutions of national importance, or Biochemistry departments.

As part of the project, each student is required to carry out independent research work endorsed by authorized certification of the institution and submit a dissertation embodying the objectives, methodology, results, discussion, and conclusions of the study.

Project work shall be allotted in emerging and interdisciplinary areas of Biochemistry and allied sciences, including but not limited to Cancer Biology, Protein and Peptide Chemistry, Enzymology, Clinical Biochemistry, Nanotechnology, Inflammopharmacology, Phytopharmacology, Biomarkers, Toxicology, Molecular Biology, Bioinformatics, Industrial Biochemistry, and Biomedical Research. In addition to these areas, students may choose other relevant research topics in consultation with their guides.

COURSE OUTCOMES:

1. Design and execute an independent research project using appropriate biochemical and analytical techniques.
2. Apply scientific methods and modern tools to collect, analyze, and interpret experimental data.
3. Demonstrate professional ethics, teamwork, and problem-solving abilities in research and industrial settings.
4. Effectively communicate research findings through dissertation writing, oral presentation, and viva-voce examination.
- 5.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 5	PSO 1	PSO 2	PSO 6	PSO 7	PSO 8
CO 1	✓	✓			✓				
CO 2	✓	✓	✓		✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓		✓	✓	✓	✓	✓	✓

BCH 402: PROJECT VIVA-VOCE EXAMINATION: SOFT CORE

Total Credits: 02

COURSE OBJECTIVES:

1. To provide students with hands-on research experience in Biochemistry and allied disciplines through independent project work.
2. To develop skills in experimental design, data collection, analysis, and interpretation using appropriate scientific methodologies.
3. To expose students to research, industrial, clinical, and professional environments and promote ethical scientific practices.
4. To enhance scientific communication skills through dissertation writing, presentation, and viva-voce examination.

A student shall carry out project work for a period of four months in various chemical, biochemical, pharmaceutical, biotechnology, clinical, or allied industries/research institutions/biochemistry programme. During this period, the student is expected to gain hands-on training in industrial practices, laboratory techniques, instrumentation, quality control, research methodologies, data analysis, and professional ethics relevant to the field of Biochemistry and allied sciences.

The student should present the findings of the project work before an evaluation committee consisting of the internal guide and external examiner/supervisor for a *prima facie* viva voce examination.

COURSE OUTCOMES:

1. Design and execute an independent research project using appropriate biochemical and analytical techniques.
2. Apply scientific methods and modern tools to collect, analyze, and interpret experimental data.
3. Demonstrate professional ethics, teamwork, and problem-solving abilities in research and industrial settings.
4. Effectively communicate research findings through dissertation writing, oral presentation, and viva-voce examination.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO 5	PSO 1	PSO 2	PSO 6	PSO 7	PSO 8
CO 1	✓	✓			✓				
CO 2	✓	✓	✓		✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓		✓	✓	✓	✓	✓	✓

Model Question Paper

First Semester M.Sc. BIOCHEMISTRY Degree Theory Examination

Time: 3 Hours

Max. Marks:70

PART-A

1. Write short notes on any FIVE of the following: (2x5=10)

- a)
- b)
- c)
- d)
- e)
- f)
- g)

PART-B

Answer any FIVE questions from the following: (5x6=30)

- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.

PART-C

Answer any THREE questions from the following: (3x10=30)

- 9.
- 10.
- 11.
- 12.