



ಕ್ರಮಾಂಕ/No. : MU/ACC/CR.11/2025-26/A2

ಕುಲಸಚಿವರ ಕಛೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ - 574 199
Office of the Registrar
Mangalagangothri - 574 199
ದಿನಾಂಕ/Date: 31.07.2025

NOTIFICATION

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

Ref: Academic Council approval vide agenda No.: ಎಸಿಸಿ:ಶೈ.ಮ.ಸಾ.ಸ.1:1
(2025-26) dtd 18.07.2025.

The revised syllabus of M.Sc. in Biochemistry programme which has been approved by the Academic Council at its meeting held on 18.07.2025 is hereby notified for implementation with effect from the academic year 2025-26 and onwards.

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


REGISTRAR

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-ordin ator, 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 14 Hard Core** courses are included, comprising: **10 theory courses, 3 practical courses** (spanning Semesters I to III) **1 project work** (Semester IV). **These constitute a total of 56 credits.** The Programme offers **9 Soft Core courses**, which include: **6 theory-based courses and 3 practical-based courses.** 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, 2 Open Elective courses are offered in Semesters II and III, contributing **6 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.

Key Features:

1. **Choice-Based Learning:** Students can choose from a range of Soft-Core courses offered across all semesters, promoting academic flexibility and tailored learning experiences.
2. **Interdisciplinary Exposure:** Open Elective courses provide an opportunity for non-Biochemistry students to gain foundational knowledge in Biochemistry.
3. **Research Emphasis:** The mandatory project work in the final semester encourages research aptitude and practical application of biochemical concepts.

Placement Opportunities for M.Sc. Biochemistry

1. Research and Development (R&D)

- Pharmaceutical companies (e.g., Biocon, Dr. Reddy's, Cipla)
- Biotech firms working on drug discovery, protein engineering, or genetic tools
- Government R&D labs (e.g., CSIR, DBT, DRDO, ICMR, BARC)
- Contract Research Organizations (CROs) conducting clinical and preclinical studies

2. Clinical and Diagnostic Laboratories

- Clinical Biochemist in hospitals, pathology labs, or diagnostic centres
- Lab manager or quality analyst in NABL-accredited labs
- Medical coding or clinical data analyst in healthcare KPOs

3. Biotechnology & Life Sciences Industry

- Process development and production roles in biotech manufacturing
- QC/QA executive (quality control/quality assurance) in fermentation, food, and enzyme industries
- Product specialist or application scientist for life science instruments and reagents

4. Bioinformatics and Data Analysis

- Bioinformatics analyst in genomics, proteomics, or precision medicine companies
- Scientific data curator or database manager in research institutes or databases
- Statistical analyst for clinical trial or biomedical datasets

5. Academia and Higher Education

- Lecturer or Assistant Professor in colleges and Universities (after qualifying NET/SET)
- Ph.D. scholar or project fellow under funded projects (e.g., DST, UGC, DBT)
- Online content developer or science communicator in e-learning platforms

6. Food, Agriculture, and Nutrition Sectors

- Nutritional biochemist in food testing labs and nutrition companies
- R&D associate in nutraceuticals and functional food product development
- Biochemist in agri-biotech firms working on plant metabolism or biofertilizers

7. Government and Public Sector

- Scientific officer or lab technician in public health departments, forensic labs
- Exams like UPSC, CSIR-NET, ICMR-JRF for entry into research and administrative services
- Scientific assistant or analyst in FSSAI, IBPS-agriculture, or related agencies

8. Opportunities Abroad

- Higher studies (Ph.D./MS) with scholarships abroad in biomedical sciences
- Research internships and fellowships in international labs or biotech firms
- Jobs in regulatory affairs, toxicology, or pharmaco vigilance after additional certification

Eligibility Criteria for M.Sc. Biochemistry Admission

Candidates who have passed three year B.Sc. degree examination of Mangalore University or any other University considered as equivalent there to with Biochemistry, Chemistry, Life Sciences, Botany, Biotechnology, Zoology, Molecular Biology, Microbiology, Food Science and Nutrition, Pharmacology, Pharmaceutical chemistry, Biomedical Science, Home Science, Horticulture science, Fishery Science, Nursing, Naturopathy and Yogic Science (BNYS), Forensic Science, Forestry, Agricultural Sciences as optional/major/special subjects with minimum of 45% (40% for SC/ST/Category-I candidates) marks in aggregate excluding languages and group III subjects. Candidates who have studied open elective courses in I to IV semesters in above mentioned subjects are also eligible provided having 45% (40% for SC/ST/Category-I candidates) marks in degree programme. Candidates who have studied B.Voc (Pharmaceutical Chemistry)/BE (Biotechnology)/BMLT (Biochemistry/Microbiology) are also eligible provided having 45% (40% for SC/ST/Category-I candidates) marks in degree programme.

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. **Environmental and Nutritional Awareness:** The program instills knowledge of environmental biochemistry and the role of nutrition in health and disease, promoting sustainable development and wellness.
10. **Readinesses 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 PROGRAMME
(FOUR SEMESTERS)
M.Sc. BIOCHEMISTRY (CBCS)

Sl. No.	Semester	Hard core credits (HC)	Soft core credits(SC)	Open elective credits (OE)	Total Credits	Practical/ Project*	Theory
1.	I	16	6	-	22	1 (HC) 1 (SC)	3(HC) +1(SC)
2.	II	16	6	3	25	2 (HC)	2(HC)+2(SC)+ 1(OE)
3.	III	12	10	3	25	2 (SC)	3(HC)+1(SC) +1(OE)
4.	IV	12	6	-	18	1 (HC)	2(HC)+2(SC)
	Total	56	28	6	90	04 (HC)+03 (SC)=7	10 (HC)+06(SC) +02(OE)=18

M.Sc. BIOCHEMISTRY CBCS COURSES (ALL 4 SEMESTERS)
HARDCORE COURSES

Serial No.	Paper code	Title of the paper
1.	BCH 402	Chemistry of Biomolecules
2.	BCH 403	Biochemical Techniques
3.	BCP 408	Practical Bioanalytical Techniques
4.	BCH 409	Human Physiology
5.	BCH 451	Enzymology
6.	BCP 458	Practical Enzymology
7.	BCP 459	Practical Clinical Biochemistry
8.	BCH 460	Cell Biology and Microbiology
9.	BCH 501	Molecular Biology
10.	BCH 502	Immunobiology
11.	BCH 511	Metabolism-II
12.	BCPR/D 557	Project Work/ Dissertation
13.	BCH 558	Nutrition
14.	BCH 559	Biotechnology

SOFTCORE COURSES

Serial No.	Paper code	Title of the paper
1.	BCP 406	Practical Biochemical Methods
2.	BCP 407	Practical General Biochemistry
3.	BCS 410	Bioorganic & Biophysical Chemistry
4.	BCS 411	Bio-Inorganic Chemistry
5.	BCS 455	Metabolism of Fuel Molecules
6.	BCS 461	Clinical Biochemistry
7.	BCS 462	Cell Signaling
8.	BCS 463	Neurobiology
9.	BCP 509	Practical Molecular Biology & Immunology
10.	BCP 510	Practical Bioprocess Technology
11.	BCS 512	Plant Biochemistry
12.	BCS 513	Cancer Biology
13.	BCP 514	Practical Cell Biology and Microbiology
14.	BCP 515	Practical Genetic Engineering
15.	BCS 556	Nanotechnology
16.	BCS 560	Genetics
17.	BCS 561	Proteomics
18.	BCS 562	Bioinformatics, Biostatistics & Research Methodology

OPEN ELECTIVES COURSES

Serial No.	Paper code	Title of the paper
1.	BCE 464	Biochemistry in Daily Life
2.	BCE 508	Health and Disease

FIRST SEMESTER

Sl. No.	Paper Code	Title of the Paper	Instruction hours /week	Credits	Exam hours	Marks Exam + IA= Total	HC / SC
1.	BCH 402	Chemistry of Biomolecules	4	4	3	70+30=100	HC
2.	BCH 403	Biochemical Techniques	4	4	3	70+30=100	HC
3.	BCP 406*	Practical Biochemical Methods	8	3	4	70+30=100	SC
4.	BCP 407*	Practical General Biochemistry					
5.	BCP 408	Practical Bioanalytical Techniques	8	4	4	70+30=100	HC
6.	BCH 409	Human Physiology	4	4	3	70+30=100	HC
7.	BCS 410**	Bioorganic & Biophysical Chemistry	3	3	3	70+30=100	SC
8.	BCS 411**	Bioinorganic Chemistry					

Note: * Choice between, BCP 406 & BCP 407, **BCS 410 and BCS 411.

HC/SC: Hard Core/ Soft Core.

SECOND SEMESTER

Sl. No.	Paper Code	Title of the Paper	Instruction hours / week	Credits	Exam hours	Marks Exam + IA= Total	HC / SC
1.	BCH 451	Enzymology	4	4	3	70+30=100	HC
2.	BCS 455*	Metabolism of Fuel Molecules	3	3	3	70+30=100	SC
3.	BCP 458	Practical Enzymology	8	4	4	70+30=100	HC
4.	BCP 459	Practical Clinical Biochemistry	8	4	4	70+30=100	HC
5.	BCH 460	Cell Biology and Microbiology	4	4	3	70+30=100	HC
6.	BCS 461**	Clinical Biochemistry	3	3	3	70+30=100	HC
7.	BCS 462**	Cell signaling					

8.	BCS 463*	Neurobiology	3	3	3	70+30=100	SC
9.	BCE 464	Biochemistry in Daily Life	3	3	3	70+30=100	OE

Note: * There is a choice between BCS 455 & BCS 463, **BCS 461 and BCS 462.

BCE 464 is an open elective course for other disciplines.

HC/SC: Hard Core/ Soft Core.

THIRD SEMESTER

Sl. No.	Paper Code	Title of the Paper	Instruction hours /week	Credits	Exam hors	Marks Exam + IA = Total	HC / SC
1.	BCH 501	Molecular Biology	4	4	3	70+30=100	HC
2.	BCH 502	Immunobiology	4	4	3	70+30=100	HC
3.	BCE 508	Health and Disease	3	3	3	70+30=100	OE
4.	BCP 509*	Practical Molecular Biology & Immunology	8	4	4	70+30=100	SC
5.	BCP 510*	Practical Bioprocess Technology					
6.	BCH 511	Metabolism-II	4	4	3	70+30=100	HC
7.	BCS 512**	Plant Biochemistry	3	3	3	70+30=100	SC
8.	BCS 513**	Cancer Biology					
9.	BCP 514***	Practical Cell Biology and Microbiology	8	3	4	70+30=100	SC
10.	BCP 515***	Practical Genetic Engineering					

Note: *There is a choice between BCP 509 & BCP 510, **BCS 512 and BCS 513, *BCP 514 & BCP 515. BCE 508 is an open elective course for other disciplines.**

HC/SC: Hard Core/ Soft Core.

FOURTH SEMESTER

Sl. No.	Paper Code	Title of the Paper	Instruction hours /week	Exam hours	Credits	Marks Exam + IA = Total	HC / SC
1.	BCS 556*	Nanotechnology	3	3	3	70+30=100	SC
2.	BCPR/D 557**	Project Work/ Dissertation	8	-	4	70+30=100	HC
3.	BCH 558	Nutrition	4	3	4	70+30=100	HC
4.	BCH 559	Biotechnology	4	3	4	70+30=100	HC
5.	BCS 560***	Genetics	3	3	3	70+30=100	SC
6.	BCS 561***	Proteomics					
7.	BCS 562*	Bioinformatics, Biostatistics & Research Methodology	3	3	3	70+30=100	SC

Note: * There is a choice between BCS 556 & BCS 562, *BCS 560 & BCS 561.**

****BCPR/D 557 is compulsory to all the students. HC/SC:**

Hard Core/ Soft Core.

Total Credits of all the Semesters

First Semester	22
Second Semester	25
Third Semester	25
Fourth Semester	18
Total	90

Cores	Credits	%
Hard Core	56	62.22
Soft Core	28	31.11
Open Elective	06	6.67
Total	90	100.00

University Theory Question Paper Pattern

Sl. No.	Question type	Marks
1.	Answer any TEN out of 12 questions	2 x 10= 20
2.	Answer any FIVE questions out of seven	10 x 5 = 50
	Hard core: Two questions from each Unit and the remaining questions from any of the four units for short answers	
	Soft core: Three questions from each unit and the remaining questions from any of the three units for short answers.	

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

University Project work Evaluation pattern

Sl. No.	Details	Marks (70)
1.	Presentation	20
2.	Viva-Voce	15
3.	Report	35

Internal Assessment (Theory) Examination

Sl. No.	Description	Marks
1.	Test (Average of C1 and C2) (Tests to be conducted on 10 th and 14 th weeks after the start of a semester)	20
2.	Assignment	05
3.	Seminar	05
	Total	30

Internal Assessment (Practical) Examination

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

I SEMESTER

BCH 402: CHEMISTRY OF BIOMOLECULES: HARD CORE

Lecture hours: 48

Total Credits: 04

Course Objectives:

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

UNIT I

12 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. **Structural elucidation:** degradation, graded acid hydrolysis, periodate oxidation, degradation of oxo polysaccharides, methylation, acetylation, GC-MS.

UNIT II

12 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

12 hrs.

Secondary structure: Peptide bond – structure and conformation, Ramachandran plot. Secondary structure: α - helix and other types of helices, β – pleated sheet, 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

12 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. short hand 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 403: BIOCHEMICAL TECHNIQUES: HARD CORE

Lecture Hours: 48

Total Credits: 04

Course Objectives:

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

UNIT I

12 hrs.

Model systems: Animal and plant models, Investigation with microorganism and their mutant (auxotroph). Rat, Mice, Drosophila, Zebra fish, *Ceanorhabditis elegans*, and *Arabidopsis thaliana* as model organisms. **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

12 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

12 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 spectrometers in biochemical and biomedical sciences- Colorimeter, Fluorimetry, Turbidimetry, 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 Microscopy-Principles and application of light microscopy, fluorescence, Confocal microscopy, scanning and transmission electron microscopy, Cytophotometry and flow cytometry.

UNIT IV

12 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, Phosphorus-32, Sulfur-35, Iodine-131) 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.

References:

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.
3. Pattabhi V, Gautham N. *Biophysics*. Narosa Publishing House; 2002.
4. Plummer DT. *An Introduction to Practical Biochemistry*. 3rd ed. McGraw-Hill; 1988.
5. Freifelder D. *Physical Biochemistry*. 2nd ed. WH Freeman; 1982.
6. Karp G. *Cell and Molecular Biology: Concepts and Experiments*. 7th ed. Wiley; 2013.
7. Gupta PK. *Elements of Biotechnology*. Rastogi Publications; 2014.
8. Jain JL. *Fundamentals of Biochemistry*. S. Chand Publishing; 2016.
9. Sadasivam S, Manickam A. *Biochemical Methods*. New Age International; 2008.
10. Nigam A. *Lab Manual of Biochemistry*. Tata McGraw-Hill; 2007.
11. Segel IH. *Biochemical Calculations*. 2nd ed. Wiley; 1976.
12. Cooper TG. *Tools of Biochemistry*. Wiley-Interscience; 1977.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO4	PSO2	PSO 6
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	✓
CO 3	✓	✓	✓	✓	✓	
CO 4	✓		✓		✓	

BCP 406: PRACTICAL BIOCHEMICAL METHODS: SOFT CORE

Practical: 8 hours/Week

Total credits: 03

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. Extraction of carotenes from natural source and their estimation by UV-Vis spectroscopy
2. Extraction of Lycopenes from natural source and their estimation by UV-Vis spectroscopy
3. Extraction of Chlorophylls from natural source and their estimation by UV-Vis spectroscopy
4. Separation of protein by Ion exchange chromatography
5. Separation of protein by Gel filtration chromatography
6. Purification of immunoglobulin by Affinity chromatography
7. Estimation of Phospholipids
8. Extraction and estimation of Phosphatidylcholine from egg yolk
9. Determination of pKa of an acid
10. Estimation of calcium from natural source (Ragi)

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.
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	PO4	PSO1	PSO 6
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	
CO 3	✓	✓	✓		✓	✓
CO 4	✓	✓	✓	✓	✓	✓

BCP 407: PRACTICAL GENERAL BIOCHEMISTRY: SOFT CORE

Practical: 8 hours/week

Total credits: 03

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.
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	PO4	PSO1	PSO 6
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	
CO 3	✓	✓	✓		✓	✓
CO 4	✓	✓	✓	✓	✓	✓

BCP 408: PRACTICAL BIOANALYTICAL TECHNIQUES: HARD CORE

Practical: 8 hours/week

Total Credits: 04

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
14. Purification of proteins: Ammonium sulphate precipitation (salting out), Dialysis.
15. Separation and detection of proteins – Native PAGE, Denaturing PAGE.

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	PO4	PSO1	PSO 6
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	
CO 3	✓	✓	✓		✓	✓
CO 4	✓	✓	✓	✓	✓	✓

BCH 409: HUMAN PHYSIOLOGY: HARDCORE

Lecture Hours: 48

Total Credits: 04

Course Objectives:

1. Learn the structure and function of blood and components.
2. Understand hormone origin, function, and regulation.
3. Study the physiology of various organ systems in detail.
4. Gain insight into biochemical processes underlying human health.

UNIT I

12 hrs.

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

12 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, Myelin sheath: composition and function, Action potential, Gated and non-gated channels, Blood-brain barrier. Acetylcholine receptors, Nicotinic, muscarinic adrenergic receptors and other neurotransmitter receptors. Mechanism of synaptic transmission, receptor integrated ion channels and G- protein mediated ion channels.

UNIT III

12 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.

UNIT IV

12 hrs.

Hepatobiliary, gastrointestinal and Endocrine System: Functional anatomy of liver and biliary system, blood supply, hepatocytes, endothelial cell and Kupffer cell. Gallbladder, secretory and excretory function- composition, formation, and storage of bile. **Gastrointestinal System:** Anatomy of GI tract, digestion and absorption of carbohydrates, proteins and lipids. Mechanism of HCl production in the stomach. Regulation of GI Function.

Endocrine System: Endocrine organs in man. Structure and control of hypothalamus. Pituitary - anatomy and structure. Role of receptors in hormones. Hormones produced GRH, Somatostatin, TRH, CRH, GnRH. Hormones of anterior, posterior and median lobes. Thyroid, parathyroid, adrenal, Gonads -testes and ovaries. Menstrual cycle. Hypothalamus- Pituitary target organ axis and regulation by feedback mechanism. Peptide hormones.

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.
4. Vander AJ, Sherman JH, Luciano DS. *Human Physiology: The Mechanisms of Body Function*. 8th ed. McGraw-Hill; 2001.
5. Tortora GJ, Derrickson BH. *Principles of Anatomy and Physiology*. 13th ed. Wiley; 2012.
6. Fox SI. *Human Physiology*. 13th ed. McGraw-Hill; 2015.
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.
10. Boron WF, Boulpaep EL. *Medical Physiology*. 3rd ed. Elsevier; 2017.
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	PO5	PSO4	PSO10
CO 1	✓	✓	✓		✓	✓
CO 2	✓	✓			✓	
CO 3	✓	✓		✓	✓	✓
CO 4		✓		✓		✓

BCS 410: BIOORGANIC AND BIOPHYSICAL CHEMISTRY: SOFT CORE

Lecture hours: 36

Total credits: 03

Course Objectives:

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

UNIT I

12 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

12 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, dia-stereomers, 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

12 hrs.

Mechanism of Bio-organic reactions: Introduction, Homo and heterolytic cleavage, structure and reactivity of carbocation (C^+), carbanion (C^-) and carbon free radical ($C\cdot$) characteristic aspects of ionic, radical and concerted reactions, substitution, addition, elimination and rearrangements. Energy profiles of reactions, transition state theory, Reactions SN_1 , SN_2 , SN_1 neighboring group participation. Elimination reaction, Electrophilic addition to $C=O$, aldol condensation, Michael addition. **Heterocyclic systems:** Occurrence in biological systems, structure and properties of indole, thiazole, imidazole, pyrimidine, purine, quinine 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 SN_1/SN_2 and other reaction mechanisms in biomolecular transformations.
4. Recognize biologically important heterocyclic compounds and their functions

References:

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.
5. Tinoco I, Sauer K, Wang JC, Puglisi JD, Harbison GS, Rovnyak D. *Physical Chemistry: Principles and Applications in Biological Sciences*. 5th ed. Pearson; 2013.
6. Cantor CR, Schimmel PR. *Biophysical Chemistry Part I–III*. W.H. Freeman; 1980.
7. Mathews CK, van Holde KE, Appling DR, Anthony-Cahill SJ. *Biochemistry*. 4th ed. Pearson Education; 2013.
8. Morrison RT, Boyd RN. *Organic Chemistry*. 6th ed. Prentice Hall; 2004.
9. Voet D, Voet JG. *Biochemistry*. 4th ed. Wiley; 2011.
10. Lehninger AL, Nelson DL, Cox MM. *Lehninger Principles of Biochemistry*. 7th ed. Freeman; 2017.
11. Timberlake KC. *Chemistry: An Introduction to General, Organic and Biological Chemistry*. 7th ed. Benjamin Cummings; 1999.
12. Wilson K, Walker JM. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th ed. Cambridge Univ Press; 2010.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO4	PSO1	PSO2
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	✓
CO 3	✓	✓	✓		✓	✓
CO 4	✓			✓	✓	

BCS 411: BIO-INORGANIC CHEMISTRY: SOFT CORE

Lecture hours: 36

Total credits: 03

Course Objectives:

1. Understand chemical bonding, VSEPR theory, and solid-state structures.
2. Learn metal-ligand bonding, crystal field theory, and its applications.
3. Explore organometallic and bioinorganic systems such as cytochromes and hemoglobin.
4. Study the basics of nuclear chemistry and radioactivity in biology.

UNIT I

12 hrs.

Chemical Bonding- VSEPR model, shapes of molecules- ClF_3 , ICl_4^- , TeF_5^- , I_3^- , TeCl_6^{2-} ; Bent rules and energetics of hybridization; electro negativity Pauling, Allred-Rochow and Mulliken, electronegativity and partial ionic character; Bonds Multicenter, Synergic and Agostic bonding. Lattice energy: Born-Landé equation, Kapustinskii equation; Fajan's rules- polarizability and partial covalent character, radius-ratio rules-limiting radius ratios of trigonal, tetrahedral, octahedral and cubic. **Structures of solids**- NaCl , CsCl , ZnS (zinc blend and wurtzite), rutile (TiO_2), perovskite (CaTiO_3), fluorite and anti fluorite. Zintl ions, Molecular orbital theory: formation of sigma, pi and delta bonds, LCAO and MO diagrams of heteronuclear diatomic (CO , NO , HF and ICI) and triatomic molecules (CO_2 and NO_2).

UNIT II

12 hrs.

Metal- ligand bonding- Coordination numbers 3 to 8. Crystal field theory, salient features, spectrochemical series, splitting of d-orbitals in tetrahedral, square planar, trigonal bipyramidal, square-pyramidal and octahedral geometry, applications of CFT- colors of transition metal complexes, magnetic properties of octahedral complex, Jahn Teller distortion, CFSE and their uses, factors affecting CFSE, limitations of CFT, experimental evidences for metal-ligand covalent bonding in complexes, nephelauxetic effect, Ligand Field Theory, MO theory: tetrahedral and octahedral complexes (including π -bonding), angular overlap model. Stereochemical non-rigidity and its detection. Ligand replacement reactions and electron transfer reactions of organometallic moieties of biological macromolecules (cytochromes, chlorophyll and hemoglobin).

UNIT III

12 hrs.

Metal clusters- factors favouring M-M bond, classification, synthesis, structure and bonding in $[\text{Re}_2\text{Cl}_8]^{2-}$. Metal carbonyl clusters- LNCC's and HNCC's. Electron counting in carbonyl clusters, Wades-Mingos and Lauher rules. Nuclear Chemistry-The atomic nucleus-elementary particles, quarks, classification of nuclides based on Z and N values, nuclear stability, nuclear potential, binding energy. Nuclear t_2 Models: Shell model-salient features, forms of the nuclear potential, filling of orbitals, nuclear configuration, Liquid drop model. Radioactivity, radioactive decay kinetics, parent-daughter decay-growth relationship-secular and transient equilibria, theories of α , β^- , β^+ and 1 -decay, internal conversion, Auger effect.

Course Outcomes:

1. Analyze coordination complexes and predict geometry and magnetic properties.
2. Apply crystal field and molecular orbital theories to bioinorganic molecules.
3. Describe metal-carbonyl clusters and electron counting rules.
4. Explain nuclear stability, decay kinetics, and biological applications of isotopes

References:

1. Cotton FA, Wilkinson G, Gaus PL. *Advanced Inorganic Chemistry*. 6th ed. Wiley; 1999.
2. Greenwood NN, Earnshaw A. *Chemistry of the Elements*. 2nd ed. Butterworth-Heinemann; 1997.
3. Huheey JE, Keiter EA, Keiter RL. *Inorganic Chemistry: Principles of Structure and Reactivity*. 4th ed. Pearson Education; 1993.
4. Shriver DF, Atkins PW, Langford CH. *Inorganic Chemistry*. 5th ed. Oxford University Press; 2010.
5. Miessler GL, Fischer PJ, Tarr DA. *Inorganic Chemistry*. 5th ed. Pearson; 2013.
6. Lippard SJ, Berg JM. *Principles of Bioinorganic Chemistry*. University Science Books; 1994.
7. Bertini I, Gray HB, Lippard SJ, Valentine JS. *Bioinorganic Chemistry*. University Science Books; 1994.
8. Dileep RY. *Bioinorganic Chemistry*. Discovery Publishing House; 2007.
9. Eichhorn GL. *Inorganic Biochemistry Vol. I & II*. Elsevier; 1973.
10. Lever ABP. *Inorganic Electronic Spectroscopy*. 2nd ed. Elsevier; 1984.
11. Carlin RL. *Magnetochemistry*. Springer Verlag; 1986.
12. Sathyanarayana DN. *Electronic Absorption Spectroscopy and Related Techniques*. University Press; 2001.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO4	PSO1	PSO2
CO 1	✓	✓			✓	
CO 2	✓	✓			✓	✓
CO 3	✓	✓			✓	
CO 4	✓		✓	✓		✓

II SEMESTER

BCH 451: ENZYMOLOGY: HARD CORE

Lecture Hours: 48

Total Credits: 04

Course Objectives:

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

UNIT I

12 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

12 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

12 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

12 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.
3. Copeland RA. *Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis*. 2nd ed. Wiley-VCH; 2000.
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.
9. Murray RK et al. *Harper's Illustrated Biochemistry*. 31st ed. McGraw-Hill; 2018.
10. Rawn JD. *Biochemistry*. Neil Patterson Publishers; 1989.
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	PO4	PSO1	PSO2
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	✓
CO 3	✓	✓	✓		✓	✓
CO 4	✓	✓		✓	✓	✓

BCS 455: METABOLISM OF FUEL MOLEULES: SOFT CORE

Lecture Hours: 36

Total Credits: 03

Course Objectives

1. Understand bioenergetics and thermodynamics in metabolism.
2. Study carbohydrate catabolism and anabolism.
3. Explore lipid biosynthesis and degradation pathways.
4. Learn integration and regulation of metabolic pathways.

UNIT I

12 hrs.

Metabolism of carbohydrates: Catabolism, anabolism, catabolic, anabolic and amphibolic pathways. Glycolysis, energetics, regulation. Pathways of utilization of pyruvate, lactate, ethanol, gluconeogenesis, regulation, citric acid cycle, its regulation, energetics, anapleurosis, glyoxylate cycle, HMP pathway, Enter – Doudoroff, Glucuronate and Glyoxylate pathway, Cori cycle, Futile cycles and anaplerotic reactions. Interconversion of hexoses. Biosynthesis of sucrose. Glycogen and starch degradation, synthesis and regulation, glycogen storage disorders. Regulation of blood glucose level, hypoglycemia and hyperglycemia. Pentosuria, fructose and lactose intolerance, fructosuria, galactosemia.

UNIT II

12 hrs.

Lipid metabolism- Degradation of triacylglycerols and phospholipids- lipase, hormone sensitive lipase phospholipases. Fatty acid degradation -Beta oxidation, Knoop's experiment, saturated and unsaturated FA, Regulation, α and ω - oxidation, Energetics, Biosynthesis of FA-FA synthetase complex, chain elongation and desaturation. Pathways in animals, conversion of linoleate to arachidonate (scheme only). Cholesterol Biosynthesis and Dehydration, regulation, Phospholipid Biosynthesis- De novo pathway and inter conversion, biosynthesis of sphingolipids ether lipids and glycolipids. Degradation and biosynthesis of gangliosides and cerebroside disorders. Tay Sach's disease, Nieman-Pick disease. Fabry's disease. Biosynthesis of prostaglandins, thromboxanes, leukotrienes. Integration of carbohydrate and lipid metabolism, glucose paradox.

UNIT III

12 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 metabolic disorders and their biochemical basis

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.
4. Zubay GL. *Biochemistry*. 4th ed. WCB; 1998.
5. Rawn JD. *Biochemistry*. Neil Patterson Publishers; 1989.
6. Stryer L. *Biochemistry*. 5th ed. Freeman; 2002.
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	PO5	PSO1	PSO 4
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	
CO 3	✓	✓	✓		✓	
CO 4	✓	✓		✓	✓	✓

BCP 458: PRACTICAL ENZYMOLOGY: HARD CORE

Practical: 8 hours/week:

Total Credits: 04

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

2. Purification by ammonium sulphate fractionation and enzyme characterization

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	PO4	PSO2	PSO 6
CO 1	✓	✓	✓		✓	✓
CO 2	✓	✓	✓		✓	✓
CO 3	✓	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓

BCP 459: PRACTICAL CLINICAL BIOCHEMISTRY: HARD CORE

Practical: 8 hours/week

Total Credits: 04

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.

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	PO4	PSO1	PSO 2	PSO 6
CO 1	✓	✓	✓		✓		
CO 2	✓	✓	✓		✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	
CO 4	✓	✓	✓	✓	✓	✓	✓

BCH 460: CELL BIOLOGY AND MICROBIOLOGY: HARD CORE

Lecture hours: 48

Total Credits: 04

Course Objectives:

1. Study cell structure, organelles, and cell division.
2. Understand membrane dynamics and transport mechanisms.
3. Learn signaling molecules and hormone action.
4. Gain microbiology basics including structure, classification, and techniques.

UNIT I

12 hrs.

Cell structure and function: ECM, cytoskeletal elements-microtubules, microfilaments and intermediate filaments. Cell motility-mechanism and significance, cell-cell and cell-matrix interactions. Adhesion molecules-Integrins and selectins and their interaction. Structural organization and function of intracellular organelles: Cell wall, cell membrane, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast. Cell division, cell cycle phases and regulation: Role of cyclins and cyclin-dependent kinases (CDKs), Mitosis and meiosis.

UNIT II

12 hrs.

Membrane biochemistry: Physicochemical properties of biological membranes; compositions. Models of membrane. Membrane asymmetry; lipids, proteins and carbohydrates and their lateral diffusion. Membrane domains; caveolae, rafts, membrane lipid and protein turnover, intracellular targeting of proteins. Membrane transport: Simple diffusion, facilitated diffusion and active transport. Glucose transporters, Ca²⁺ ATPase, Na⁺ -K⁺

ATPase (Structure and mechanism of action). Overview and classification of AAA -ATPases, roles in cellular process and drug resistance. Endocytosis, receptor mediated endocytosis, exocytosis, ion channels; gated and non-gated, aquaporin channel.

UNIT III

12 hrs.

Cell signaling – types- Autocrine, paracrine, juxtacrine and endocrine signaling. Mechanism of peptide hormone action: General mechanisms of cell signaling by hydrophilic factors, transmembrane receptors, G protein coupled receptors, receptor tyrosine kinase. Second messengers: IP₃, DAG, cAMP, protein kinases. Nitric oxide signaling; generation and action. Growth factors: Structure, mechanism of action and receptors of EGF, NGF and Insulin receptor. Receptor down regulation, desensitization and up regulation. Mechanism of action of steroid hormone: Conversion of cholesterol to steroid hormone. Steroid receptors. Chemistry and action of prostaglandins, prostacyclins and thromboxanes, eicosanoid receptors. Newly discovered hormones. Insect hormones: Structure and function of moulting hormone, juvenile hormones, Pheromones. Application of insect hormones, plant hormones.

UNIT IV

12 hrs.

Microbiology- Introduction to Microbiology – Scope and history of Microbiology Microbial Taxonomy - Definition and systematics, Nomenclatural rules and identification. Haeckel's three kingdom classification. nutritional classification of bacteria - Phototroph, Chemotroph, Autotroph (lithotroph), Heterotroph (organotroph), Photoautotroph, Photoheterotroph, Chemoautotroph, Chemoheterotroph, Control of microbes- Sterilization and disinfection techniques, Physical- dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter, Chemical methods. Biology of bacteria - cell structure, size, shape, arrangement membrane, cell wall, cytoplasmic inclusions, mesosomes, flagella and motility, slime, capsule, pili, chemotaxis, endospore. Pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture).

Course Outcome:

1. Explain structural and functional features of organelles and the cytoskeleton.
2. Understand biochemical basis of membrane transport and signaling.
3. Describe cell cycle regulation and hormone mechanisms.
4. Apply microbiological knowledge in culturing and identifying microbes

References:

1. Alberts B et al. *Molecular Biology of the Cell*. 6th ed. Garland Science; 2014.
2. Lodish H et al. *Molecular Cell Biology*. 8th ed. W.H. Freeman; 2016.
3. Cooper GM, Hausman RE. *The Cell: A Molecular Approach*. 6th ed. ASM Press; 2013.
4. Karp G. *Cell and Molecular Biology: Concepts and Experiments*. 7th ed. Wiley; 2013.
5. De Robertis EDP, De Robertis EMF. *Cell and Molecular Biology*. 8th ed. Lippincott; 2001.
6. Moat AG, Foster JW, Spector MP. *Microbial Physiology*. 4th ed. Wiley-Liss; 2002.

7. Prescott LM, Harley JP, Klein DA. *Microbiology*. 9th ed. McGraw-Hill; 2013.
8. Madigan MT, Bender KS, Buckley DH, Sattley WM, Stahl DA. *Brock Biology of Microorganisms*. 16th ed. Pearson; 2019.
9. Pelczar MJ, Chan ECS, Krieg NR. *Microbiology: Concepts and Applications*. 1st ed. McGraw-Hill; 1993.
10. Tortora GJ, Funke BR, Case CL. *Microbiology: An Introduction*. 12th ed. Pearson; 2016.
11. Madigan MT, Martinko JM. *Biology of Microorganisms*. 14th ed. Pearson; 2015.
12. Slonczewski JL, Foster JW. *Microbiology: An Evolving Science*. 4th ed. W.W. Norton & Company; 2017.

Course Articulation Matrix Mapping

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

BCS 461: CLINICAL BIOCHEMISTRY: SOFT CORE

Lecture Hours: 36

Total Credits: 03

Course Objectives:

1. Understand enzyme use in disease diagnosis.
2. Study disorders related to hemoglobin, liver, and kidney.
3. Analyze endocrine, GIT, and metabolic dysfunctions.
4. Learn biochemical tests for various disease states.

UNIT I

12 hrs.

Diagnostic enzymes and hematological 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, Porphyrias. 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

12 hrs.

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, Chron's disease. **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(Thyroid). Infertility tests. Laboratory diagnosis. **Cancer**- Apoptosis, Oncogenesis, Necrosis, Angiogenesis, Carcinogens, mechanisms of cancer developments, diagnosis.

UNIT III

12 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, xanthinuria. **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.
5. Bishop ML, Fody EP, Schoeff LE. *Clinical Chemistry: Principles, Techniques, and Correlations*. 7th ed. Lippincott; 2017.
6. Chatterjea MN, Shinde R. *Textbook of Medical Biochemistry*. 8th ed. Jaypee Publishers; 2012.
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	PO5	PSO3	PSO 4
CO 1	✓	✓		✓	✓	✓
CO 2	✓	✓			✓	✓
CO 3	✓	✓	✓		✓	✓
CO 4	✓	✓	✓	✓	✓	✓

BCS 462: CELL SIGNALING: SOFTCORE

Lecture hours: 36

Total credits: 03

Course Objectives:

1. Introduce principles of cellular signaling and communication.
2. Study receptor types and second messenger systems.
3. Understand multicellularity and extracellular matrix signaling.
4. Compare and analyze major signal transduction pathways.

UNIT I

12 hrs.

Introduction and components of biosignaling: Definition of Cell Signaling, general principles of cell signaling and communication; various forms of communication between cells; signaling process and its stages – Signal recognition, transduction and cellular effect; **Types of cell signaling** – Autocrine signaling, Direct contact signaling, Paracrine signaling, Synaptic signaling, Endocrine(Distance) signaling. First messengers, glands and types of secretions, Ligands, Agonists, Antagonists, Receptors for first messengers, Second messengers, soluble second messengers, Membrane bound second messengers. Receptor down regulation, Receptor up regulation.

UNIT II

12 hrs.

Multicellularity: Role of Extracellular matrix - hyaluronan and proteoglycan. Matrix proteins and their receptors, adhesive proteins and cell junctions in multicellularity. Structure and function of plant cell wall. The importance of the matrix in signal transduction: Cell surface receptors as reception of extra-cellular signals, Amplification of signal during transmission - a quantitative study, Tyrosine kinase and tyrosine phosphatase, Cell membrane components and adapter proteins required for signal transmission, Upstream and downstream signal transduction without cell surface receptor activation, G-protein coupled signaling; the secondary messengers in signal transduction pathways cAMP, Ca²⁺, Reactive Oxygen Species

and Hypoxia Signalling, Apoptosis Signaling Transduction Pathway, PI3K/AKT Cell Survival Pathway.

UNIT III

12 hrs.

Various signal transduction pathways from cell surface to nucleus: MAP kinase pathway, SAP/JNK pathway, p38 pathway, ERK pathway, NFkB pathway, Cell survival pathway, Wnt signaling pathway, Jak/Stat pathway, Signaling, EGFR, VEGF And their Smad pathway, TGF Signalling, Cytoskeleton And Cell Signalling, Carbohydrate Recognition Signaling, MMPs And Cell Signalling, Cross talk among cell surface receptors, Cross talks among cytoplasmic components, Translocation of signal components during signal transmission, From cytoplasm to cell membrane, NF- Signaling from cytoplasm to nucleus, Cell cycle and its Signalling.

Course Outcomes:

1. Describe components of key signaling pathways (e.g., MAPK, PI3K-AKT).
2. Explain receptor functions and cross-talk among pathways.
3. Evaluate how signaling regulates cell cycle, survival, and death.
4. Interpret the biological relevance of signal amplification and regulation

References:

1. Alberts B et al. *Molecular Biology of the Cell*. 6th ed. Garland Science; 2014.
2. Lodish H et al. *Molecular Cell Biology*. 8th ed. Freeman; 2016.
3. Cooper GM. *The Cell: A Molecular Approach*. 6th ed. ASM Press; 2013.
4. Karp G. *Cell and Molecular Biology*. 7th ed. Wiley; 2013.
5. Hunter T. *Cell Signaling*. Cold Spring Harbor Laboratory Press; 2012.
6. Pawson T, Scott JD. *Signaling Through Scaffold, Anchoring, and Adaptor Proteins*. Academic Press; 2000.
7. Alberts B et al. *Essential Cell Biology*. 4th ed. Garland Science; 2014.
8. Harnett MM, Garside P. *Cell Signalling*. 1st ed. Oxford University Press; 2006.
9. Bray D. *Cell Movements: From Molecules to Motility*. 2nd ed. Garland Science; 2000.
10. Thomas G. *Signal Transduction*. 1st ed. Academic Press; 2001.
11. Hancock J. *Cell Signalling*. 4th ed. Oxford University Press; 2017.
12. Helgason CD, Miller CL. *Cellular Signal Processing*. Springer Protocols; 2010.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO5	PSO2	PSO 6
CO 1	✓	✓			✓	
CO 2	✓	✓	✓		✓	✓
CO 3	✓	✓	✓		✓	✓
CO 4	✓	✓		✓	✓	✓

BCS 463: NEUROBIOLOGY: SOFTCORE

Lecture hours: 36

Total credits: 03

Course objective:

1. To introduce students to the field of neurobiology.
2. To study the neuron structure, action potentials, and sensory systems,
3. To distinguishing between normal and pathological states, with emphasis on neurodegenerative, vascular, and neoplastic changes.

UNIT I

12 hrs.

Brain Anatomy Different Lobes/ Cortex Brain Organization – CNS, PNS, ANS Structure of Cerebellum and Basal Ganglia, Histology of Brain Sections (Coronal/sagittal) – Normal vs. Diseased, Neuro-developmental Biology (Briefly), Blood Brain Barrier. Cell Biology Neurons and Glial Cells, Detection of different neuronal cells (by IHC/ICC), Techniques and tools applicable in neuroscience: MRI, PET, Fluorescence microscopy, FACS, Electron Microscopy, Patch Clamp, Brain cells and their functions, blood brain barrier .

UNIT II

12 hrs.

Neuronal Transmission- Electrical Impulse – Action Potential, Excitatory and Inhibitory Postsynaptic Potentials (EPSP and IPSP), Chemical Impulse, Synapse , Neurotransmitters and their metabolism, Different Pathways (Dopaminergic, Adrenergic, Serotonergic, etc.) Examples of malfunctions of pathways Neuronal study in Cell/Organ. Isolation and culturing of primary neurons and means of manipulation, Culturing and methods of differentiation of cultured neuronal cells, Organotypic brain cultures.

UNIT III

12 hrs.

Sensation and Sensory Processing: The Somatic Sensory System-Touch and Proprioception, Pain, Vision – The Eye and Central Visual Pathways , The Auditory System , Olfactory System Gustatory System, Neuropathology Clinical, Cellular and Molecular Mechanisms of the Neurological Diseases: Alzheimer's Disease, Parkinson's Disease, Huntington Disease, Dystonia, Wilson Disease, Epilepsy, Autism, Multiple Sclerosis, Amyotrophic Lateral Sclerosis (ALS), attention deficit hyperactivity disorder (ADHD), Schizophrenia, Depression, Dementia, Cerebro-vascular disease (Stroke)

Course Outcomes:

1. Describe structure and function of neurons and glial cells.
2. Understand neurotransmitters and synaptic transmission.
3. Analyze sensory and motor pathways in the nervous system.
4. Discuss neurological disorders at the molecular level.

References:

1. Kandel ER, Schwartz JH, Jessell TM. *Principles of Neural Science*. 5th ed. McGraw-Hill; 2013.
2. Zigmond MJ, Coyle JT, Rowland LP. *Neurobiology of Brain Disorders*. Elsevier; 2014.
3. Sanes DH, Reh TA, Harris WA. *Development of the Nervous System*. 3rd ed. Academic Press; 2011.
4. Champney TH. *Essential Clinical Neuroanatomy*. Wiley-Blackwell; 2015.
5. Bear MF, Connors BW, Paradiso MA. *Neuroscience: Exploring the Brain*. 4th ed. Wolters Kluwer; 2015.
6. Nicholls JG, Martin AR, Fuchs PA. *From Neuron to Brain*. 5th ed. Sinauer Associates; 2012.
7. Purves D et al. *Neuroscience*. 6th ed. Oxford University Press; 2017.
8. Siegel A, Sapru HN. *Essential Neuroscience*. 2nd ed. Lippincott; 2010.
9. Shepherd GM. *Neurobiology*. 3rd ed. Oxford University Press; 1994.
10. Whitaker M. *Molecular and Cellular Biology of the Neuron*. Oxford University Press; 2000.
11. Brady ST, Siegel GJ, Albers RW. *Basic Neurochemistry*. 8th ed. Academic Press; 2011.
12. Snell RS. *Clinical Neuroanatomy*. 7th ed. Lippincott; 2010.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 4	PO5	PSO2	PSO 5
CO 1	✓	✓			✓	
CO 2	✓	✓			✓	✓
CO 3	✓	✓	✓		✓	✓
CO 4	✓	✓	✓	✓	✓	✓

(OPEN ELECTIVE FOR OTHER DISCIPLINES)

BCE 464: BIOCHEMISTRY IN DAILY LIFE

Lecture Hours: 36

Total Credits: 03

Course Objectives:

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

UNIT I

12hrs.

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

12hrs.

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, fad diets, Keto, Paleo, and Atkin's diet. 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

12hrs.

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.
4. Ansel HC, Lachman L. *Textbook of Cosmetic Formulations*. CBS Publishers; 2005.
5. Whitney EN, Rolfes SR. *Understanding Nutrition*. 15th ed. Cengage Learning; 2018.
- 6.Sizer FS, Whitney E. *Nutrition: Concepts and Controversies*. 15th ed. Cengage; 2021.
7. Voet D, Voet JG. *Principles of Biochemistry*. 4th ed. Wiley; 2011.
8. Brown A. *The Science of Beauty: The Complete Guide to Skin Care and Cosmetic Chemistry*. CreateSpace; 2010.
9. Bhatia BS, Arora R. *Food Adulteration and Food Safety*. Kalyani Publishers; 2015.
10. Choudhary RK. *Consumer Awareness and Protection*. S. Chand; 2012.
11. Potter NN, Hotchkiss JH. *Food Science*. 5th ed. Springer; 1998.
12. 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	PO5	PS01	PS0 8	PS09	PS010
CO 1		✓		✓	✓		✓	
CO 2		✓	✓	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓		✓	
CO 4	✓	✓	✓	✓	✓	✓	✓	✓

III SEMESTER

BCH 501: MOLECULAR BIOLOGY: HARD CORE

Lecture hours: 48

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

12hrs.

Replication and regulation of gene expression- Historical perspective. Central dogma of molecular biology. Replication of DNA semi conservative nature- Messelson and Stahl experiment. Mechanism of replication, the replicons, origin, primosome and replisomes, properties of prokaryotic and eukaryotic DNA polymerases, synthesis of leading and lagging strands, difference between prokaryotic and eukaryotic replication.- direction of replication discontinuous replication-Okazaki fragments, Trombone model. DNA polymerase I, II and III, DNA ligase and topoisomerases, Fidelity of replication. Replication in viruses- ϕ X174, single stranded DNA virus, rolling circle model. Replication of mitochondrial DNA. Regulation of gene expression, super coiling, DNA methylation. Role of nucleosome structure in eukaryotic gene expression, histone code hypothesis.

UNIT II

12hrs.

Transcription- RNA biosynthesis in prokaryotes and eukaryotes; initiation, elongation and termination. RNA dependent RNA synthesis-RNA replicase of QB virus. Processing of eukaryotic RNA cap addition, poly A tail addition, RNA editing, Processing of tRNA and rRNA transcripts. Regulation at the level of transcription: Operon model; Lac operon, structure and regulation. Galactose operon; role of two promoters. Arabinose operon; positive control. Tryptophan operon, attenuation control. Transcription factors, TF II, NF-kB.

UNIT III

12 hrs.

Translation- Genetic code, triplet codon, universal features of the genetic code, assignment of codon, studies of Khorana, Nirenberg, triplet binding techniques, degeneracy, Wobble hypothesis, 3D structure of prokaryotic and eukaryotic ribosome, Protein synthesis- initiation, elongation and termination in prokaryotes and eukaryotes. Inhibitors of translation. Regulation at the level of translation: Secondary structure in the 5' and 3' untranslated region; regulation of ferritin and transferrin m-RNA. Inteins, GCN4 gene regulation.

UNIT IV

12 hrs.

Post translational modification of proteins-signal cleavage, disulphide bond formation, O and N- glycosylation, folding of nascent protein, the role of chaperones, attachment of glucose anchor, and other modifications. Regulation at the level of post translational modification: proteins stability, N-end rule, PEST and other sequences, ubiquitin mediated degradation. Regulation of genes during development (Eg. Genes involved in the development of 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. Pearson; 2013.
2. Alberts B et al. *Molecular Biology of the Cell*. 6th ed. Garland Science; 2014.
3. Lodish H et al. *Molecular Cell Biology*. 8th ed. Freeman; 2016.
4. Krebs JE, Goldstein ES, Kilpatrick ST. *Lewin's Genes XII*. 12th ed. Jones & Bartlett; 2017.
5. Brown TA. *Genomes*. 3rd ed. Garland Science; 2006.
6. Cooper GM, Hausman RE. *The Cell: A Molecular Approach*. 6th ed. ASM Press; 2013.
7. Tropp BE. *Molecular Biology: Genes to Proteins*. 4th ed. Jones & Bartlett; 2012.
8. Malacinski GM. *Essentials of Molecular Biology*. 4th ed. Jones & Bartlett; 2002.
9. Primrose SB, Twyman RM. *Principles of Gene Manipulation and Genomics*. 7th ed. Wiley-Blackwell; 2006.
10. Griffiths AJF, Wessler SR, Carroll SB, Doebley J. *Introduction to Genetic Analysis*. 11th ed. Freeman; 2015.
11. Snustad DP, Simmons MJ. *Principles of Genetics*. 6th ed. Wiley; 2015.
12. Nicholl DSA. *An Introduction to Genetic Engineering*. 3rd ed. Cambridge University Press; 2008.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	P04	PSO1	PSO 2	PSO 6
CO 1	✓	✓			✓	✓	
CO 2	✓	✓	✓		✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓

BCH 502: IMMUNOBIOLOGY: HARDCORE

Lecture hours: 48

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

12 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

12 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

12 hrs.

MHC molecules and transplantation: Role of MHC in immune response and transplantation. Non-specific Defense 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 of graft and host tissue. Tumor immunology-tumor associated antigens, factors favoring tumor growth, immune surveillance. Tumor necrosis factors α and β .

Unit IV

12 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. Defense system in plants: Host parasite interaction and defense system in plants.

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.
5. Roitt IM, Brostoff J, Male DK. *Immunology*. 8th ed. Mosby; 2001.
6. Delves PJ, Martin SJ, Burton DR, Roitt IM. *Roitt's Essential Immunology*. 13th ed. Wiley-Blackwell; 2016.
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	PO5	PSO2	PSO 4	PSO 5	PSO 6
CO 1	✓	✓			✓		✓	
CO 2	✓	✓	✓		✓	✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓	✓

OPEN ELECTIVE FOR OTHER DISCIPLINES

BCE 508: HEALTH AND DISEASE

Lecture hours: 36

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

12 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, Illness and wellness.

UNIT II

12 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 (Alcoholic and nonalcoholic fatty liver disease), Diabetes mellitus, Hypertension (Causative agents, symptoms, diagnosis, treatment, prognosis, prevention).

UNIT III

12 hrs.

Health promotion: Preventing drug abuse, Oral health promotion by tobacco control. Cannabis. 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 10
CO 1	✓				✓		✓
CO 2	✓	✓		✓		✓	
CO 3	✓	✓	✓	✓			
CO 4		✓		✓	✓		✓

BCP 509: PRACTICAL MOLECULAR BIOLOGY & IMMUNOLOGY: SOFTCORE

Practical: 8 hours/week

Total Credits: 04

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. Preparation of media, culturing of transgenic *E. coli* and Yeast. Preparation of competent cells.
2. Isolation of DNA and RNA from plant and animal source, purity of DNA.

3. Spectroscopic determination of melting temperature (T_m) of calf thymus DNA.
4. Electrophoresis of DNA and RNA.
5. Restriction digestion of DNA.
6. Radial immune assay.
7. Ouchterlony double diffusion
8. Rocket immune- electrophoresis
9. Dot ELISA.
10. Blood group testing.
11. Separation of serum proteins by electrophoresis.
12. Isolation of plasmid.

Course Outcomes:

1. Isolate and quantify nucleic acids using spectrophotometry and electrophoresis.
2. Perform immunodetection techniques like Western blot and ELISA.
3. Amplify DNA using PCR and analyze products through gel electrophoresis.
4. Evaluate antigen-antibody interactions through lab-based techniques.

.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
10. Gene Cloning Laboratory Manual 4th Edn. Michael R. Green and Joseph Sambrook, CSHL Press (2014).
11. Current Protocols in Molecular Biology; S Gallagher, Wiley Interscience (2008).

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO4	PSO1	PSO 2	PSO 6
CO 1	✓	✓	✓		✓		
CO 2	✓	✓	✓		✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	
CO 4	✓	✓	✓	✓	✓	✓	✓

BCP 510: PRACTICAL BIOPROCESS TECHNOLOGY: SOFT CORE

Practical: 8 hours/week

Total Credits: 04

Course objectives:

- To study industrially important organisms
- To understand the improvement of microorganisms to increase byproduct
- To study the industrially important enzymes from microorganisms
- To study the production of commercial products from microorganisms

Experiments

1. Isolation of industrially important microorganisms for citric acid production and improvement of strain for increase yield by mutation.
2. Isolation of industrially important microorganisms for Lactic acid production and improvement of strain for increase yield by mutation.
3. Isolation of industrially important microorganisms for alpha amylase production and improvement of strain for increase yield by mutation.
4. Isolation of industrially important microorganisms for ethanol production and comparison of ethanol production using various Organic wastes /raw Material (Free cells/ immobilized cells).
5. Isolation of industrially important microorganisms for production of glutamic acid.
6. Isolation of industrially important microorganisms for production of antibiotics.

Course outcome:

- Students gain the knowledge of industrially and economically important microorganisms and their products.
- Students gain the knowledge of producing cost effective products from cheaper resources.

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
10. Principles of Fermentation Technology, Peter F Stanbury, Allan Whitaker, Stephen J Hall,
11. Industrial Microbiology by L.E.J.R. Casida, New Age International publishers, Delhi.

BCH 511: METABOLISM-II: HARDCORE

Lecture hours: 48

Total Credits: 04

Course Objectives

1. To explore nitrogen metabolism and amino acid pathways.
2. To study urea cycle, neurotransmitters, and metabolic regulation.
3. To examine biosynthesis and degradation of amino acids.
4. To understand heme and nucleotide metabolism.

UNIT I

12 hrs.

Overview of Nitrogen metabolism: Introduction, Assimilation of ammonia, formation of amino acid amides by glutamine synthetase and its regulation. **Amino acid metabolism:** General metabolic reaction of amino acids–transamination, pseudo-transamination, glucose – alanine cycle, oxidative deamination (glutamate dehydrogenase), minor pathways of amino acid degradation – trans- deamination, amino acid oxidase, and non – oxidative deamination (α -deaminase, dehydratase, asparaginase and glutaminase). **Urea cycle**– regulation. 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 norepinephrine).

UNIT II

12 hrs.

Degradation of the individual amino acids: Amino acids forming from pyruvate (alanine, glycine, threonine, serine, cystine and cysteine), oxaloacetate (aspartic acid and asparagine), α - ketoglutarate (glutamic acid, glutamine, arginine, histidine and proline), succinyl CoA (valine, isoleucine and methionine), acetoacetate and/or acetyl CoA (leucine and lysine), pyruvate, formaldehyde, acetoacetate and/or acetyl CoA (tryptophan) and fumarate, acetoacetate and/or acetyl CoA (phenyl alanine and tyrosine). **Heme Metabolism:** Biosynthesis and degradation of porphyrin and their regulation.

UNIT III

12hrs.

Biosynthesis of the individual amino acids: Biosynthesis of non-essential amino acids from pyruvate (alanine), intermediates of glycolysis (serine) and TCA cycle (aspartic acid, asparagine, glutamic acid and glutamine), essential amino acid (tyrosine), non-essential amino acid (glycine, proline and arginine), and essential & non-essential amino acid (cysteine). Biosynthesis of essential amino acids from aspartate family of amino acids (threonine, lysine and methionine), pyruvate family of amino acids (valine and leucine), pyruvate and α -ketobutyrate family of amino acid (isoleucine), aromatic family of amino acids (phenylalanine, tyrosine and tryptophan) and histidine. Regulation of amino acid biosynthesis by sequential & concerted feedback inhibition.

UNIT IV

12hrs.

Nucleotide Metabolism: Biosynthesis of purine and pyrimidine nucleotides and their interconversion, regulation of biosynthesis. Other pathways of purine nucleotide formation. Biosynthesis of deoxyribonucleotides and coenzymes nucleotides. Chemical inhibition of the biosynthesis of nucleic acid precursors. Degradation of purine and pyrimidines.

Course Outcomes:

1. Understand nitrogen assimilation and amino acid metabolic reactions.
2. Analyze inherited amino acid metabolism disorders.
3. Explain heme metabolism and associated diseases like porphyria.
4. Evaluate purine/pyrimidine metabolism and disorders such as gout

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.
4. Zubay GL. *Biochemistry*. 4th ed. WCB; 1998.
5. Murray RK et al. *Harper's Illustrated Biochemistry*. 31st ed. McGraw-Hill; 2018.
6. Devlin TM. *Textbook of Biochemistry with Clinical Correlations*. 7th ed. Wiley-Liss; 2010.
7. Mathews CK, van Holde KE, Appling DR, Anthony-Cahill SJ. *Biochemistry*. 4th ed. Pearson; 2013.
8. Conn EE, Stumpf PK. *Outlines of Biochemistry*. 5th ed. Wiley; 2009.
9. Campbell MK, Farrell SO. *Biochemistry*. 9th ed. Cengage Learning; 2018.
10. Rawn JD. *Biochemistry*. Neil Patterson Publishers; 1989.
11. Smith EL, Hill RL, Lehman IR. *Principles of Biochemistry: Mammalian Biochemistry*. 7th ed. McGraw-Hill; 1983.
12. Stryer L. *Biochemistry*. 5th ed. Freeman; 2002.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO5	PSO1	PSO 4	PSO 6
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CO 1	✓	✓			✓		
CO 2	✓	✓	✓		✓		
CO 3	✓	✓	✓		✓	✓	
CO 4	✓	✓		✓	✓	✓	✓

BCS 512: PLANT BIOCHEMISTRY: SOFTCORE

Lecture Hours: 36

Total Credits: 03

Course Objectives:

1. To study plant metabolic processes and cell structure.
2. To analyze plant respiration and photosynthesis pathways.
3. To explore secondary metabolites and stress responses.
4. To understand nitrogen metabolism and host-parasite interactions.

UNIT I

12 hrs.

Plant cell biology: Overview of plant structure, major tissues in plant, structure and components of a plant cell, plant cell membrane and constituents, transport systems across cell membrane, genome organization in plant (nucleus, plastids and mitochondrial). **Solute transport and photo assimilate translocation:** Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem. Transpiration, mechanisms of loading and unloading of photo assimilation. **Respiration:** Plant Glycolysis- cytosolic and Plastidic process; plant mitochondrial electron transport and regulation.

UNIT II

12 hrs.

Photosynthesis and plant secondary metabolites: Photosynthetic apparatus in plants, photo systems I and II, light harvesting antenna complex. Electron flow and phosphorylation; cyclic and noncyclic, oxygen evolution, Calvencycle, C3, C4, and CAM cycle. Photo respiration, regulation of photosynthesis, RUBISCO. **Plant hormones:** Biosynthesis, storage, breakdown and transport. Physiological effects and mechanisms of action of auxins, gibberlins, cytokinins, ethylene, abscisic acid. **Plant defense and secondary metabolites-** Terpenes, phenols, flavonoids and nitrogenous compounds and their roles in plant physiology. Methods in phytochemicals: extraction, fractionation and characterization.

UNIT III

12 hrs.

Stress biology and host parasite interaction: Nitrogen metabolism- Importance of nitrogen in biological systems, nitrogen cycle. Nitrogen fixation; symbiotic and non-symbiotic, nitrogenase complex, energetic and regulation. Formation of root nodules in legumes. Assimilation of nitrate and ammonium ion.

Sulfur assimilation. **Stress physiology:** Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress. **Host-parasite interaction:** Recognition and entry processes of different pathogens like bacteria, Viruses, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen induced diseases in plants, cell-cell fusion in both normal and abnormal cells.

Course Outcomes:

1. Understand plant physiology including nutrient uptake and translocation.
2. Analyze photosynthetic mechanisms like C3, C4, and CAM cycles.
3. Recognize roles of secondary metabolites and phytohormones.
4. Apply knowledge of plant defense and stress physiology

References:

1. Buchanan BB, Gruissem W, Jones RL. *Biochemistry and Molecular Biology of Plants*. 2nd ed. Wiley Blackwell; 2015.
2. Heldt HW, Piechulla B. *Plant Biochemistry*. 4th ed. Academic Press; 2021.
3. Lea PJ, Leegood RC. *Plant Biochemistry and Molecular Biology*. 2nd ed. Wiley; 1999.
4. Dey PM, Harborne JB. *Plant Biochemistry*. 1st ed. Academic Press; 1997.
5. Taiz L, Zeiger E, Moller IM, Murphy A. *Plant Physiology and Development*. 6th ed. Sinauer Associates; 2015.
6. Hopkins WG, Hüner NPA. *Introduction to Plant Physiology*. 4th ed. Wiley; 2008.
7. Dennis DT, Turpin DH, Lefebvre DD, Layzell DB. *Plant Metabolism*. 2nd ed. Longman; 1997.
8. Goodwin TW, Mercer EI. *Introduction to Plant Biochemistry*. 2nd ed. Pergamon Press; 1983.
9. Salisbury FB, Ross CW. *Plant Physiology*. 4th ed. Brooks/Cole; 1991.
10. Sinha RK. *Modern Plant Physiology*. 1st ed. Narosa Publishing House; 2004.
11. Jain VK. *Fundamentals of Plant Physiology*. 16th ed. S. Chand; 2016.
12. Vance CP, Kirk TK. *Plant Metabolism: An Overview*. Springer; 2002.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO5	PSO3	PSO 5	PSO 6
CO 1	✓	✓			✓	✓	
CO 2	✓	✓	✓		✓	✓	
CO 3	✓	✓	✓		✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓

Lecture hours: 36

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

12 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

12 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- κ B, 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

12 hrs.

Different types of diagnostic approach to detect cancer: Tumor markers, Strategies of cancer treatment- chemotherapy- gene therapy; Immunotherapy- Immune checkpoint 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	P05	PS04	PSO 6	PSO 10
CO 1	✓	✓			✓	✓	
CO 2	✓	✓	✓		✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓

BCP 514: PRACTICAL CELL BIOLOGY AND MICROBIOLOGY: SOFT CORE

Practical: 8 Hours/Week

Total Credits: 03

Course Objectives:

1. To demonstrate cytological techniques such as Barr body identification and study of mitosis and meiosis using plant tissues.
2. To develop proficiency in isolating cell organelles like nucleus, mitochondria, and chloroplasts through standard biochemical protocols.
3. To train students in microbial cultivation, identification, and differentiation using various staining and culture techniques.
4. To expose students to real-world laboratory practices through microbial sampling and institutional/industrial visits.

Experiments:

1. Mounting of Barr bodies
2. Study of mitosis using onion root tips
3. Study of meiosis

4. Isolation of nucleus
5. Isolation of mitochondria
6. Isolation of chloroplast
7. To cultivate and characterize microbial cultures.
8. Staining techniques (a) Simple staining (b) Gram staining (c) Endospore staining (d) Capsule staining (e) AFB staining (f) Negative staining
9. Isolation of air/ water microflora
10. Visit to Industry/Institution/Clinical Laboratory.

Course Outcomes:

1. Students will be able to identify and interpret stages of mitosis, meiosis, and detect Barr bodies using cytological methods.
2. Students will demonstrate the ability to isolate and characterize cell organelles such as the nucleus, mitochondria, and chloroplast.
3. Students will cultivate, isolate, and differentiate microorganisms using staining and microbiological techniques.
4. Students will apply microbiological sampling methods and relate theoretical knowledge to practical settings through institutional or industrial exposure.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO4	PSO1	PSO 2	PSO 6
CO 1	✓	✓	✓		✓		
CO 2	✓	✓	✓		✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	
CO 4	✓	✓	✓	✓	✓	✓	✓

BCP 515: PRACTICAL GENETIC ENGINEERING: SOFT CORE

Practical: 8 Hours/Week

Total Credits: 03

Course Objectives:

1. To train students in the extraction, purification, and quality assessment of DNA and RNA from various biological sources.
2. To develop technical skills in PCR, primer design, and gel electrophoresis for nucleic acid analysis.
3. To enable accurate determination of DNA fragment size and visualization using standard molecular biology techniques.
4. To introduce students to basic bioinformatics tools for sequence and structural analysis of nucleic acids and proteins.

Experiments:

1. DNA extraction from different sources (e.g., bacteria, plant, animal).
2. RNA extraction and purification methods.
3. Quality assessment and quantification of nucleic acids (spectrophotometry, gel electrophoresis).
4. Primer design and optimization
5. PCR setup and cycling conditions
6. Agarose gel electrophoresis for PCR product analysis
7. Agarose gel electrophoresis for DNA fragment separation and analysis
8. DNA size determination using molecular weight markers
9. DNA band visualization techniques (e.g., ethidium bromide staining, DNA intercalating dyes)
10. Introduction to bioinformatics databases and tools, Sequence analysis (e.g., BLAST, multiple sequence alignment).
11. Prediction of protein secondary structure and function.

Course Outcomes:

1. Students will extract and evaluate DNA and RNA from different biological samples using standard protocols.
2. Students will design primers, set up PCR reactions, and analyze amplification products using agarose gel electrophoresis.
3. Students will assess nucleic acid quality and size using spectrophotometry and molecular weight markers.
4. Students will utilize bioinformatics tools for sequence alignment, structure prediction, and functional annotation.

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*
4. Distributors *Manual of Biochemistry*. New Delhi: Tata McGraw-Hill Education; 2007.
5. Wilson K, Walker JM. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th ed. Cambridge: Cambridge University Press; 2010.
6. Segel IH. *Biochemical Calculations*. 2nd ed. New York: John Wiley & Sons; 1976.
7. .Genetic Engineering: Principles and Methods (2019) 3rd ed., Fowler, MR, CABI, ISBN: 978- 1789240605.
8. Introduction to Genetic Analysis (2020) 12th ed., Griffiths, AJF, Wessler, SR, Carroll, SB, and Doebley, J, W.H. Freeman, ISBN: 978-1319149609.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO5	PSO 2	PSO 6	PSO 7
CO 1	✓		✓		✓	✓	
CO 2	✓	✓	✓		✓		
CO 3	✓	✓			✓		
CO 4	✓	✓		✓		✓	✓

IV SEMESTER

BCH 556: NANOTECHNOLOGY: SOFT CORE

Lecture hours: 36

Total Credits: 03

Course Objectives:

1. To introduce basic concepts and tools of nanoscience.
2. To explore nanomaterials and their synthesis techniques.
3. To understand applications of nanotechnology in biotechnology and medicine.
4. To assess safety, ethics, and regulations in nanotechnology.

Unit I

12 hrs.

Biological nanoparticles and their applications: Introduction to biological nanoparticles and their applications: Exosomes, lipoproteins, ferritin, magnetite viruses. Biological nanomotors and machines, mechanisms of biological machines, protein assemblies: muscle myosin, kinesin, nerve, ATPase, bacteriorhodopsin, haemoglobin dynein, cilia. Bacterial flagella: structure and function; nanomotor. Ion channels: nanopores of high specificity. Bioinspired nanomaterials: DNA and peptide based. Interaction between biomolecules and nanoparticle surfaces.

Unit II

12 hrs.

Biosynthesis of nanoparticles: Biological synthesis of nanoparticles using bacteria, fungi, plants, purified enzymes and biological templates, Slayer. Silver nanoparticles, gold nanoparticles, cerium oxide nanoparticles, titanium oxide and zinc oxide nanoparticles. Application of inorganic nanoparticles.

Unit III

12 hrs.

Biosensor and nanobiosensor: Biosensor and nanobiosensor basic concepts, characterization, perception, Enzyme-metal NP hybrids for bio-sensing and for the generation of nanostructures, Biomolecule-semiconductor NPs for biosensing, Different types of nanobiosensors; Nanobiosensors for medical diagnostics. Nanoprobes for analytical applications. Nanotechnology and its application in food industry: Nanotechnology and food packaging, natural biopolymers, advantages of nanomaterials in food packaging applications,

nanosensors, outstanding issues, risks and regulations, public perception. Nanotechnology in Agriculture, Precision farming, Smart delivery system, Insecticides using nanotechnology, Potential of nanofertilizers.

Course Outcomes:

1. Describe nanomaterial synthesis and characterization techniques.
2. Apply nanotechnology in targeted drug delivery and diagnostics.
3. Evaluate the advantages and limitations of nanobiotechnology in healthcare.
4. Demonstrate awareness of biosafety and ethical issues in nanotech applications.

References:

1. Ratner MA, Ratner D. *Nanotechnology: A Gentle Introduction to the Next Big Idea*. Pearson; 2003.
2. Bhushan B. *Springer Handbook of Nanotechnology*. 4th ed. Springer; 2017.
3. Niemeyer CM, Mirkin CA. *Nanobiotechnology: Concepts, Applications and Perspectives*. Wiley-VCH; 2004.
4. Goodsell DS. *Bionanotechnology: Lessons from Nature*. Wiley-Liss; 2004.
5. Poole CP, Owens FJ. *Introduction to Nanotechnology*. Wiley-Interscience; 2003.
6. Sahoo SK, Labhasetwar V. *Nanotechniques for Biomedical Applications*. Wiley; 2007.
7. Roszek B, de Jong WH, Geertsma RE. *Nanotechnology in Medical Applications*. RIVM Report; 2005.
8. Roco MC, Mirkin CA, Hersam MC. *Nanotechnology Research Directions for Societal Needs in 2020*. Springer; 2011.
9. Hornyak GL, Dutta J, Tibbals HF, Rao A. *Introduction to Nanoscience and Nanotechnology*. CRC Press; 2008.
10. Kulkarni SK. *Nanotechnology: Principles and Practices*. 3rd ed. Capital Publishing; 2014.
11. Jain KK. *Nanomedicine: Technologies and Applications*. Humana Press; 2008.
12. Cao G. *Nanostructures and Nanomaterials: Synthesis, Properties and Applications*. Imperial College Press; 2004.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO5	PSO2	PSO 6	PSO 9
CO 1	✓	✓			✓		
CO 2	✓	✓	✓		✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓

BCPR/D 557: PROJECT WORK/DISSERTATION: HARD CORE

Project work: 08 hours/week

Total Credits: 04

Course Objectives:

1. To enable students to undertake independent research in biochemistry.
2. To design and execute experiments based on hypothesis-driven research.
3. To develop analytical, writing, and presentation skills.
4. To foster scientific thinking, literature review, and ethical research practices.

Project work will be allotted to the students on defined research work such as Cancer biology, protein and peptide chemistry, enzymology, clinical biochemistry, nanotechnology, inflammopharmacology, Phytopharmacology, biomarkers, toxicology etc. In addition to these topics, students can select any other topics in consultation with their respective guides. Students have to present and defend their project work.

Course Outcomes:

1. Plan and carry out a research project including data collection and analysis.
2. Present research findings in written dissertation and oral presentation formats.
3. Use appropriate statistical tools to interpret data.
4. Demonstrate the ability to critically evaluate scientific literature and draw conclusions.

Course Articulation Matrix Mapping

CO	P01	P02	P03	P04	P05	PS01	PS0 2	PS06	PS07	PS08	PS010
CO 1	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO 2	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO 3	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

BCH 558: NUTRITION: HARD CORE

Lecture Hours: 48 hours

Total Credits: 04

Course Objectives:

1. To study the biochemical basis of human nutrition and dietary requirements.
2. To understand the metabolism and physiological roles of macro and micronutrients.
3. To learn the biochemical assessment of nutritional status.
4. To explore the role of nutrition in health, disease, and therapeutic contexts.

UNIT- I

12 hrs.

Basic Concepts in Nutrition: Composition of human body. Energy contents of foods. Measurement of energy expenditure: Direct and Indirect calorimetry. Physiological fuel value, daily requirement of energy, high and low calorie diets. Definition of BMR and SDA and factors affecting these. Thermogenic effects of foods. Energy requirements of men and women and factors affecting energy requirements. **Carbohydrates:** Dietary requirements and sources of available and unavailable carbohydrates. Physicochemical properties and physiological actions of unavailable carbohydrates (dietary fiber). Simple and complex carbohydrates. Artificial sweeteners.

UNIT- II

12 hrs.

Proteins & Lipids: Protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance. Essential amino and nutritional classification of proteins, Cereal proteins and their limiting amino acids. Supplementary value of proteins, Protein requirement at different stages of development. Protein Energy Malnutrition (PEM): Etiology, clinical features, Kwashiorkor and Marasmus, Nitrogen balance, Malnutrition, protein calorific value. Starvation: Protein metabolism in prolonged fasting. Protein sparing treatments during fasting. Basic concepts of high protein, low caloric weight reduction diets. **Lipids:** Sources, invisible fat, essential fatty acids, PUFA and their physiological functions. Properties and composition of plasma lipoproteins. Dietary needs of lipids. Obesity: Definition and classification. Genetic and environmental factors leading to obesity. Role of leptin in regulation of body mass.

UNIT III

12 hrs.

Vitamins Fat soluble and water-soluble vitamins, pro-vitamins, antivitamins, dietary sources, structure, biochemical functions, daily requirements and Deficiency symptoms Dietary sources, and specific deficiency diseases associated with fat – and water- soluble vitamins. Hypervitaminosis symptoms of fat-soluble vitamins. Nutritional requirements during pregnancy, lactation and growth of infants and children. Vitamin-like compounds, hypervitaminosis. Minerals: Nutritional significance of dietary calcium, phosphorus,

magnesium, iron, iodine, zinc and copper. Vitamin like compounds, **Food Drug Interaction:** Pharmacological aspects of food-drug interaction, risk factors.

UNIT IV

12 hrs.

Role of diet and nutrition in the prevention and treatment of disease: Dental caries, fluorosis, renal failure, hyperlipidemia, atherosclerosis, and rheumatic disorders, inherited metabolic disorders: Phenyl ketonuria, Maple syrup disease, homocystinuria, galactosemia, gout, diabetes insipidus and diabetes mellitus. Anti-nutrients: Naturally occurring food-borne toxicants: Protease inhibitors, Hemagglutinins, Hepatotoxins, Allergens, Oxalates, Toxins from mushrooms, animal food stuffs and sea food, fad diets, healthy diets.

Course Outcomes:

1. Students will be able to describe the metabolism and nutritional functions of carbohydrates, proteins, fats, vitamins, and minerals.
2. Analyze the nutritional requirements for different physiological states (e.g., pregnancy, aging, athletic performance).
3. Interpret biochemical and clinical markers of nutritional deficiencies and disorders.
4. Recommend appropriate dietary adjustments for the prevention and management of metabolic diseases.

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 & Publishing Co.; 2003.
3. Ross AC et al. *Modern Nutrition in Health and Disease*. 11th ed. Lippincott Williams & Wilkins; 2012.
4. Bamji MS, Krishnaswamy K, Brahmam GNV. *Textbook of Human Nutrition*. 3rd ed. Oxford & IBH Publishing; 2009.
5. Insel P, Turner RE, Ross D. *Nutrition*. 5th ed. Jones & Bartlett; 2011.
6. Whitney E, Rolfes SR. *Understanding Nutrition*. 15th ed. Cengage Learning; 2018.
7. Gopalan C et al. *Nutritive Value of Indian Foods*. NIN, ICMR; 2016.
8. Mahan LK, Escott-Stump S, Raymond JL. *Krause's Food & the Nutrition Care Process*. 14th ed. Elsevier; 2017.
9. Gibney MJ et al. *Introduction to Human Nutrition*. 2nd ed. Wiley-Blackwell; 2009.
10. Shils ME, Shike M, Ross AC, Caballero B, Cousins RJ. *Modern Nutrition in Health and Disease*. 10th ed. Lippincott; 2005.
11. Berdanier CD. *Advanced Nutrition: Macronutrients, Micronutrients, and Metabolism*. CRC Press; 2007.
12. Geissler C, Powers H. *Human Nutrition*. 12th ed. Oxford University Press; 2017.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 4	PO5	PSO3	PSO 4	PSO 10
CO 1	✓	✓		✓	✓	✓	
CO 2	✓	✓	✓	✓	✓	✓	✓
CO 3	✓	✓	✓		✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓

BCH 559 –BIOTECHNOLOGY: HARDCORE

Lecture Hours: 48 hours

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

12 hrs.

History, definition, aims and objectives of recombinant DNA technology, **Tools in Genetic Engineering:** Polymerases, Ligase, Kinases and Phosphatases, Restriction endonucleases; type I, II and III, specificity, sticky ends and blunt ends, iso-schizomers. Adapters, linkers, homopolymer tailing.

Basics of DNA cloning: Cloning into different vectors – **plasmids** (pBR322, pUC18), **phages** (λ phage, M13, SV40), Shuttle vectors; hybrid vectors **and**, artificial Chromosomes **BACs and YACs**, Plant transformation vectors (T DNA and viral vectors), expression vectors and Cloning hosts (E. coli, Saccharomyces, Plant and animals cells), DNA libraries (Genomic DNA, cDNA and expression libraries).

Transformation: Micro injection, electroporation, lipofection, calcium phosphate method, protoplast fusion and biolistic methods. **Screening methods** – Direct and Indirect screening insertional inactivation of marker gene, replica plating, visual screening, **Screening using probes;** construction of gene probes, hybridization and labelling, colony, plaque hybridization, antibody screening.

UNIT II

12 hrs.

Techniques-Polymerase Chain Reaction (PCR): Concept of PCR, Various kinds of PCR, Real Time PCR, RAPD fingerprinting, Ligation Chain Reaction, Applications of PCR. **Genome sequencing:** DNA sequencing by Sanger's method, Whole genome shotgun sequencing, Sequencing by Oligonucleotide Ligation and Detection (SOLiD). **Blotting techniques-** dot blot,

slot blot, southern and northern blot, western blot, DNA foot print assay, DNA finger print assay, gel retardation assay, nuclease protection assay, RFLP, RAPD, Microarray.

UNIT III

12 hrs.

Applications: Gene editing (CRISPR-CAS 9), Gene therapy, **applications in agriculture and medicine.** GM foods, GM crops for nutritional quality and quantity; negative impact of genetic engineering, gene knock out, transgenic animals, Production of human recombinant hormones (insulin, somatotropin), recombinant vaccines. **Biosafety and Bioethics.**

UNIT IV

12 hrs.

Cell culture techniques: Introduction to plant tissue culture and animal cell culture, Different constituents of culture medium, types of media. Preparation of primary culture; disaggregation of tissue and primary cultures, cell doubling time. **Cell lines:** Characteristics and routine maintenance, cell separation techniques. Measurement of viability and cytotoxicity. Scaling-up of animal cell culture; bioreactors used in animal cell culture and their applications. **Industrial applications:** Fermenter-stirred fermenter, micro-carrier, encapsulation, hollow fiber chambers, packed glass bead reactors. Cell immobilization techniques. Plant cell culture: plant tissue culture media, Micro propagation, callus culture, haploid production, somatic embryogenesis, somatic hybridization, cybridization and somaclonal variation. Production of disease-free plants.

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. Brown TA. *Gene Cloning and DNA Analysis: An Introduction*. 7th ed. Wiley-Blackwell; 2016.
2. Primrose SB, Twyman RM. *Principles of Gene Manipulation and Genomics*. 7th ed. Wiley-Blackwell; 2006.
3. Glick BR, Pasternak JJ. *Molecular Biotechnology: Principles and Applications of Recombinant DNA*. 4th ed. ASM Press; 2010.
4. Dubey RC. *A Textbook of Biotechnology*. 6th ed. S. Chand; 2021.
5. Old RW, Primrose SB. *Principles of Gene Manipulation*. 6th ed. Wiley-Blackwell; 2004.
6. Watson JD et al. *Recombinant DNA: Genes and Genomes – A Short Course*. 3rd ed. Freeman; 2007.

7. Singh BD. *Biotechnology: Expanding Horizons*. 2nd ed. Kalyani Publishers; 2011.
8. Satyanarayana U. *Biotechnology*. 1st ed. Elsevier; 2008.
9. Nicholl DSA. *An Introduction to Genetic Engineering*. 3rd ed. Cambridge University Press; 2008.
10. Walker JM, Rapley R. *Molecular Biology and Biotechnology*. 5th ed. Royal Society of Chemistry; 2009.
11. Gupta PK. *Elements of Biotechnology*. Rastogi Publications; 2014.
12. Channarayappa. *Molecular Biotechnology: Principles and Practices*. Universities Press; 2006.

Course Articulation Matrix Mapping

CO	PO 1	PO 2	PO 3	PO5	PSO1	PSO 2	PSO 6
CO 1	✓	✓			✓		
CO 2	✓	✓	✓		✓	✓	✓
CO 3	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓		✓	✓	✓	✓

BCS 560: GENETICS: SOFT CORE

Lecture hours: 36

Total Credits: 03

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

12 hrs.

Basic Principles of Mendelism- Laws of Inheritance, dominance, codominance, epistasis, (eg., Comb shape in chicken) Pleiotropism. Cytoplasmic inheritances (eg. Male sterility in plants, Shell Coiling). **Gene Linkage and Chromosome-** Linkage and recombination of genes in a chromosome. Crossing over gene mapping with three - point test cross. X-linked inheritance. Polygenic inheritance, mitochondrial inheritance, Y-chromosome inheritance.

UNIT II

12 hrs.

Organization of Genes in Prokaryotic and Eukaryotic genes-Genome size and evolutionary complexity, C-value paradox, structure of bacterial chromosome, structure and organization of eukaryotic chromosome, nucleosome organization, arrangement of chromatin fibers in a chromosome, Polytene chromosomes, Centromere and telomere structure, Karyotype, Epigenetic modifications on chromatin.

UNIT III

12 hrs.

Mutations and Repair mechanisms- Mutations-nature of Mutations, spontaneous and induced mutation, conditional, lethal (eg. Temperature sensitive) mutation. Biochemical basis of mutation. Point mutation, base substitution mutation, missense, nonsense and silent mutation. Mutation rates. Chemical mutagens, radiation induced mutation, reverse mutations and suppressor mutations- intergenic and intragenic suppression, reversion as a means of detecting mutagens- Ames's test. Repair Mechanism- Reciprocal recombination, site specific recombination, *E.coli* rec system. Holliday model of recombination. Chromosomal Basis of Human Diseases- Extra or missing chromosome, abnormality in chromosome structure – deletion duplication, inversion, translocation.

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	PO5	PSO1	PSO 2	PSO 6
CO 1	✓	✓			✓		
CO 2	✓	✓	✓		✓	✓	✓
CO 3	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓		✓	✓	✓	✓

BCS 561: PROTEOMICS: SOFT CORE

Lecture hours: 36

Total Credits: 03

Course Objectives:

1. To study the structure, function, and expression of proteins.
2. To introduce key technologies used in proteomics.
3. To understand mass spectrometry and bioinformatics in protein analysis.
4. To explore applications of proteomics in disease biomarker discovery.

UNIT I

12 hrs.

Human genome-Genomes to Proteomes- HUPO –Human Proteome Project, Branches of proteomics, Protein structure-function relationship – Disulfide bonds, Post translational modifications, Glycosylation, Phosphorylation, other modifications, Applications - methods for detection of protein- protein interactions - Yeast 1 and 2 hybrid systems – Phage display – Surface Plasmon Resonance (SPR) - Fluorescence Resonance Energy Transfer (FRET).

UNIT II

12 hrs.

1D and 2-D gel electrophoresis – Mass Spectrometry – Principles - MALDITOF – RP chromatography /Tandem mass spectrometry – Protein sequence analysis -Peptide mass finger printing- N-terminal determination methods- Protein modification – Protein microarrays – Tissue microarray– Infra red Protein array with Quantitative Readout (IPAQ) -- Algorithms for proteomics – OMSSA - SEQUEST - MASCOT.

UNIT III

12 hrs.

Expression Systems –, *E. coli*, Yeast, *Pichia pastoris*, Baculovirus - introduction, detection and purification of expressed transgenes - antibody capture – antibody generation and Engineering – Protein/peptide chemical synthesis --Protein-polynucleotide interactions, Reconstitution of proteins in lipid vesicles, - Liposomes- Peptide and protein drugs. **Protein Biomarker Discovery and Validation** - low abundance and hydrophobic proteins. High through put techniques to identify protein molecules in sample Body fluid profiles, blood disease profiles, diabetes profiles stroke and myocardial infarction, Alzheimer, Proteomics in Biotechnology.

Course Outcomes:

1. Explain the methodologies of 2D-GE, MALDI-TOF, LC-MS/MS in proteomic analysis.
2. Interpret protein interaction networks and post-translational modifications.
3. Apply proteomic data for biomarker identification in disease.
4. Integrate proteomic techniques with systems biology approaches.

References :

1. Liebler DC. *Introduction to Proteomics: Tools for the New Biology*. Humana Press; 2002.
2. Twyman RM. *Principles of Proteomics*. 2nd ed. Garland Science; 2014.
3. Pennington SR, Dunn MJ. *Proteomics: From Protein Sequence to Function*. Viva Books; 2004.
4. Reinders J, Sickmann A. *Proteomics: Methods and Protocols*. 2nd ed. Humana Press; 2011.
5. Daniel C. *Proteomics for Biological Discovery*. Wiley; 2005.
6. Westermeier R, Naven T. *Proteomics in Practice*. 2nd ed. Wiley-VCH; 2008.
7. Rabilloud T. *Two-Dimensional Gel Electrophoresis and Immunoblotting for Proteomics*. Humana Press; 2008.
8. Simpson RJ. *Proteins and Proteomics: A Laboratory Manual*. Cold Spring Harbor Laboratory Press; 2002.
9. Lottspeich F, Engels JW. *Bioanalytics: Analytical Methods and Concepts in Biochemistry and Molecular Biology*. Wiley-VCH; 2018.
10. Wilkins MR et al. *Proteome Research: New Frontiers in Functional Genomics*. Springer; 1997.
11. Chitteti BR, Agarwal S. *Proteomics: Methods and Protocols*. Springer; 2011.
12. Palzkill T. *Proteomics*. Elsevier Academic Press; 2006.

Course Articulation Matrix Mapping

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

BCS 562: BIOINFORMATICS, BIOSTATISTICS & RESEARCH METHODOLOGY: SOFT CORE

Lecture Hours: 36

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

14 hrs.

Introduction to Bioinformatics: History, Scope and Importance, Aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities - introduction to NCBI data model - Overview of file formats for biological sequences: FASTA, GenBank, EMBL, GFF, PDB Databases -Tools and their uses Primary sequence databases-GenBank, EMBL, DDBJ - Composite sequence databases- UniProt, PIR-PSD - Secondary databases- PROSITE, Pfam, PRINTS, Nucleic acid sequence databases- RefSeq, Swiss-Prot, Protein sequence databases-Structural databases-PDB, SCOP, CATH-- Protein structure visualization tools (RasMol, Swiss PDB Viewer). **Sequence Alignment Methods:** Sequence analysis of Biological data - Significance of Sequence alignment – Pair wise sequence alignment methods - Use of Scoring matrices and Gap penalties in sequence alignments - Multiple sequence alignment methods – Tools and application of multiple sequence alignment. Proteomics and Genomics. Genome projects: *E.coli*, *D.melanogaster*, *A. thaliana* and mouse. **The human genome project:** goals, mapping strategies, markers, sequencing technologies, potential benefits and risks, ethical, legal and social issues(ELSI).

Unit II

12 hrs.

Introduction to Biostatistics: Measures of central value (Grouped and ungrouped data) - Mean, mode and median; Statistics of Dispersion; Coefficient of variation; standard deviation, standard error Concepts of moments, skewness and kurtosis; Simple correlation and regression; Concept of sampling and sampling methods. Probability and Probability distributions (binomial, poisson and normal); Tests of statistical significance (t -Test, Chi-square test); Analysis of variance. Representation of statistical data line graph, histogram, bar diagram, pie chart, scatter diagram.

Unit III

10 hrs.

Introduction to Research Methodology: Definition, scope, and importance of research in science, Types of research: Basic, applied, translational, interdisciplinary, Research Design and Methodology-Experimental vs. observational studies, Qualitative and quantitative research, Data collection methods: Primary and secondary sources, Literature Review and Reference Management-Importance of literature survey, Sources of scientific literature (PubMed, Scopus, Google Scholar), Uses of AI in Scientific research, Ethics in Research - Scientific misconduct: Plagiarism, data fabrication, falsification, Scientific Communication and Academic Writing-Preparing research proposals, thesis/dissertation format. Oral and poster presentation essentials.

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	PO5	PS02	PS0 6	PS0 7	PS09
CO 1	✓	✓			✓		✓	
CO 2	✓	✓	✓		✓	✓	✓	
CO 3	✓	✓	✓	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓	✓
