

SENGUNTHAR ARTS AND SCIENCE COLLEGE

(Autonomous)

(Affiliated to Periyar University, Salem and Approved by AICTE, NewDelhi)

**An ISO 9001:2015 Certified Institution. Recognised under section 2(f)
and 12(B) of the UGC Act, 1956 and Accredited by NAAC with A⁺**

TIRUCHENGODE-637205, NAMAKKAL DT., TAMILNADU

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SYLLABUS

M.Sc.,BIOCHEMISTRY

(CBCS-LOCF)

(With effect from the Academic Year 2024-25 onwards)

CDC – COORDINATOR

BOS – CHAIRMAN

PRINCIPAL i/c

CORRESPONDENT

INTRODUCTION

Biochemistry is a fundamental science between the exact sciences like physics, chemistry, computer science, and the biological sciences. It deals with the molecular structures and functions of living organisms in a wider sense, molecular biology, cell biology and biotechnology. To give students a solid foundation in biology and chemistry and to develop analytical and critical-thinking skills that allow independent exploration of biological phenomena through the scientific method. To introduce students to modern methods of biochemical experimentation within the disciplines of biology, chemistry and biotechnology and to provide students with practical skills in the areas of Biochemistry and Molecular Biology. To train students on relevant and recent advances in Biochemistry and Molecular Biology. Oncology, Clinical Chemistry and Cancer Research heavily depend on Biochemistry. The Biochemistry Programme has pursued its curriculum and research agenda in recognition of the role of Biochemistry in contributing to both basic life sciences and applied research in industries.

AIM

The syllabus of this program is aimed at preparing the students with the latest developments and put them on the right track to fulfill the present requirements.

ELIGIBILITY FOR ADMISSION

A candidate who has passed B.Sc., degree in Biochemistry, Chemistry, Microbiology, Botany, Zoology, Genetics or equivalent B.Sc., Examination in Bachelor in Medical / Clinical Laboratory Technology Course or some other B.Sc., board equivalence submitted by the respective University may be accepted by the syndicate as equivalent there to with Biochemistry shall be eligible for admission into M.Sc., course in Biochemistry.

PROGRAMME OUTCOMES

LEARNING OUTCOMES - BASED CURRICULUM FRAME WORK FOR UNDER GRADUATE	
Programme	M.Sc., BIOCHEMISTRY
Programme Code	24PBC
Duration	Two Years
Programme Outcomes (POs)	PO1. To make students understand the importance of biochemistry as a subject that deals with life processes, as well as the concepts, theories and experimental approaches followed in biochemistry, in order to pursue a research career, either in an industry or academic setting. PO2. To develop analytical and problem - solving skills PO3. To create an awareness among the students on the inter connection between the inter disciplinary areas of biochemistry. PO4. To give the necessary practical skills required for biochemical techniques and analysis. PO5. To develop a communication and writing skills in students. PO6. To develop leadership and team work skills PO7. To emphasize the importance of good academic and work ethics and their social implications. PO8. To emphasize the importance of continuous learning and to promote lifelong learning and career development. PO9. To teach students how to retrieve information from a variety of sources, including libraries, databases and the internet. PO10. To teach students to identify, design and execute are search problem, Analyze and interpret data and learn time and resource management.

Programme Specific Outcomes (PSOs)

Programme Specific Outcomes (PSOs)	PSO1. Understand the principles and methods of various techniques in Biochemistry, Immunology, Microbiology, Enzymekinetics and Molecular CellBiology. Based on their understanding the students May would be able to design and execute experiments during their final Semester project, and further research programs. PSO2. In sight on the structure - function relationship of biomolecules, Their synthesis and break down, there gulation of these pathways, and their importance in terms of clinicalcorrelation. Students will also acquire knowledge of the principles of nutritional biochemistry and Also understand diseases and their prevention. PSO3. To understand theconcepts of cellular signal transduction Pathways and the association of a berrant signal processes with various diseases. Acquirein sight into the immune system and its responses, and Use this knowledge in the processes of immunization, vaccine development, transplantation and organ rejection. PSO4. To visualize and appreciate the central dogma of molecular biology, regulation of gene expression, molecular techniques used in rDNA technology, gene knock-out and knock-in techniques. PSO5. To create awareness in students about the importance of good Laboratory practices and the importance of ethical and social Responsibilities of a researcher. Teach them how to review literature And the art of designing and executing experiments independently and Also work as a part of a team.
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	Pos										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Level of Correlation between POs and PSOs (Suggested by UGC as per Six Sigma Tool– CauseandEffectMatrix); 1–Low, 2–Medium, 3–High, 0 No Correlation

S.No	Course Category	Course code	Title of the course	Hrs/Week		Credit Points	Max Marks		
				L	T/P		CIA	ESE	Total
SEMESTER-I									
1	Core-I	24S1PBC01	Basics of Biochemistry	6	-	4	25	75	100
2	Core-II	24S1PBC02	Biochemical and MolecularBiology Techniques	6	-	4	25	75	100
3	Core-III	24S1PBC03	Physiology andCell Biology	6	-	4	25	75	100
4	CorePractical-I	24S1PBCP01	Practical-ILabcourse on Biomolecules and Biochemical Techniques	-	6	4	40	60	100
5	Elective-I	24S1PBCE01	Microbiologyand Immunology	3	-	3	25	75	100
		24S1PBCE02	Immunology and ImmunoTechnology						
6	Elective-II	24S1PBCS01	SoftSkill-Tissue culturetechniques	3	-	3	25	75	100
		24S1PBCS02	SoftSkill-Scientific writingskills and Presentation						
Total				24	06	22	165	435	600

S.No	Course Category	Course code	Title of the course	Hrs/Week		Credit Points	Max Marks		
				L	T/P		CIA	ESE	Total
SEMESTER-II									
1	Core-I	24S2PBC04	Enzymology	5	-	4	25	75	100
2	Core-II	24S2PBC05	CellularMetabolism	5	-	4	25	75	100
3	Core-III	24S2PBC06	ClinicalBiochemistry	5	-	4	25	75	100
4	CorePractical-II	24S2PBCP02	Practical-II Lab course on Enzymology, MicrobiologyandCell Biology	-	5	4	40	60	100
5	Elective-III	24S2PBCE03	Energyanddrug Metabolism	3	-	3	25	75	100
		24S2PBCE04	Biomedical Instrumentation						
6	Elective-IV	24S2PBCE05	Nutritional Biochemistry	3	-	3	25	75	100
		24S2PBCE05	Biochemistryin humanhealth						
7	NME-I	24S2PBCN01	ClinicalNutrition	2	-	2	25	75	100
8		24S2PHR01	HumanRights	2	-	1	25	75	100
Total				25	05	25	215	585	800

S.No	Course Category	Course code	Title of the course	Hrs/Week		Credit Points	Max Marks		
				L	T/P		CIA	ESE	Total
SEMESTER–III									
1	Core-VII	24S3PBC07	Industrial Microbiology	5	-	4	25	75	100
2	Core-VIII	24S3PBC08	Molecular Biology	5	-	4	25	75	100
3	Core-IX	24S3PBC09	Gene Editing, Cell And Gene therapy	6	-	4	25	75	100
4	Core Practical-III	24S3PBCE03	Practical III Lab course on Clinical Biochemistry	-	6	4	40	60	100
5	Elective–V	24S3PBCE07	Biostatistics and Data Science	3	-	3	25	75	100
		24S3PBCE08	Research Methodology						
		24S3PBCE09	Recombinant DNA technology						
6	Elective–VI	24S3PBCE10	Molecular basis of diseases and therapeutic strategies	3	-	3	25	75	100
		24S3PBCE11	Clinical Laboratory Techniques						
		24S3PBCE12	Concepts in Neurochemistry						
7	NME-II	24S3PBCN02	Human Physiology and Nutrition	2	-	2	25	75	100
		24S3PBCIT1	*Internship	-	-	2			
Total				24	06	26	190	510	700

S.No	Course Category	Course code	Title of the course	Hrs/Week		Credit Points	Max Marks		
				L	T/P		CIA	ESE	Total
SEMESTER–IV									
1	Core-X	24S4PBC10	Pharmaceutical Biochemistry	6	-	4	25	75	100
2	Core-XI	24S4PBC11	Biochemical Toxicology	6	-	4	25	75	100
3	Core-XII	24S4PBCPR1	Project and viva	12	-	4	25	75	100
4	Elective–VII	24S4PBCE13	Bio safety, lab safety and IPR	3	-	3	25	75	100
		24S4PBCE14	Cancer Biology						
		24S4PBCE15	Nanotechnology in Health science						
5	Elective–VIII	24S4PBCE16	Developmental Biology	3	-	3	25	75	100
		24S4PBCE17	Plant Biochemistry						
		24S4PBCE18	Ecology and environmental biology						
6	Extension Activity	24S4PEX01	Industrial Visit Pharma or Food Processing	-	-	1			
Total				30	-	19	125	375	500

FIRST YEAR -SEMESTER I
CORE I–BASICS OF BIOCHEMISTRY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S1PBC01	Core – I	Theory	Y	-	-	6	4

Learning Objectives

- ❖ Students will be introduced to the structure of biomolecules.
- ❖ The significance of carbohydrates in biological processes will be understood.
- ❖ The structure, properties and biological significance of lipids in the biological system will be studied
- ❖ Students will learn about the concepts of protein structure and their significance in biological processes and creatively comprehend the role of membrane components with their biological significance.
- ❖ Students will gain knowledge about the structures and functional roles of nucleic acids in the biological system

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Explain the chemical structure and functions of carbohydrates.	PO1,PO2
CO2	Using the knowledge of lipid structure and function, Explain how it plays a role in Signaling pathways	PO3,PO4
CO3	Analyse the various levels of structural organization of Proteins and the role of proteins in biological system	PO4,PO7
CO4	Apply the knowledge of proteins in cell-cell interactions.	PO2,PO4,
CO5	Applying the knowledge of nucleic acids sequencing in Research and diagnosis	PO1,PO2& PO4

CORE I–BASICS OF BIOCHEMISTRY

UNIT	DETAILS	No.of Hours
I	Chemistry of Carbohydrates Carbohydrates: Classification, Physicochemical properties; Chemistry, Biological roles and Structural elucidation of polysaccharides - homo and heteropolysaccharides. Glycoproteins – proteoglycans. O-Linked and N-linked glycoproteins. Biological significance of glycan. Blood group polysaccharides and Bacterial cell wall polysaccharides (peptidoglycans, teichoic acid) and plant cell wall carbohydrates. Model Preparation: Biomolecules working model	18
II	Lipids – Classification of lipids, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, glycolipids, sphingolipids – Biological importance. Chemistry and Properties of Sterols and Steroids – Bile acids and Bile salts; Salient features of Bacterial and Plant lipids. Eicosanoids – classification, structure and functions of prostaglandins, thromboxanes, leukotrienes. Lipoproteins – Classification, structure, transport (endogenous and exogenous pathway) and their biological significance.	18
III	Overview of Amino acids – classification, structure and properties of amino acids, biological role. Non Protein amino acids and their biological significance. Proteins – classification based on composition, structure and functions. Primary, secondary, super secondary (motifs) (Helix-turn-helix, helix-loop-helix, Beta-alpha-beta motif, Rosemann Rossmann fold, Greek key), tertiary and quaternary structure of proteins. Structural characteristics of collagen and hemoglobin. Pauling and Corey model for fibrous proteins. Determination of amino acid sequence, Forces involved in stabilization of protein structure. Ramachandran plot. PPT Presentation: Protein structure	18
IV	Membrane Proteins – Types and their significance. Cytoskeleton proteins – actin, tubulin, intermediate filaments. Biological role of cytoskeletal proteins. Membrane structure – fluid mosaic model. Molecular chaperons – Hsp70 and 90 – biological role.	18
V	Nucleic acids – types and forms (A, B, C and Z) of DNA. Watson-Crick model – Primary, secondary and tertiary structures of DNA. Triple helix and quadruplex DNA. Mitochondrial and chloroplast DNA. DNA supercoiling (calculation of Writhe, linking and twist number). Determination of nucleic acid sequences by Maxam Gilbert and Sanger's methods. Forces stabilizing nucleic acid structure. DNA bending: The Wedge model and Junction model, Protein induced bending. Properties of DNA and RNA. C-value, C-value paradox, Cot curve. Structure and role of nucleotides in cellular communications. Major and minor classes of RNA, their structure and biological functions. PPT Presentation: DNA Watson and Crick Model (Animation)	18

	Self-Study -Classification of Sugars Nutritional classification of fatty acids	
	TOTAL	90
* Note: Model Preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only.		

Text Books

- ❖ David L. Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed)W.H.Freeman.
- ❖ Satyanarayan, U(2014) Biochemistry(4thed), ArunabhaSen Books&Allied(P)Ltd,Kolkata.

Reference Books

- ❖ Voet.D& Voet.J.G (2010) Biochemistry,(4thed), JohnWiley & Sons,Inc.
- ❖ MetzlerD.E(2003).The chemical reactions of living cells (2nded),Academic Press.
- ❖ ZubayG.L(1999)Biochemistry,(4thed),McGrew-Hill.
- ❖ LubertStryer(2010)Biochemistry,(7thed),W.H.Freeman

Web Resources

- ❖ [https://bio.libretexts.org/Bookshelves/Biochemistry/Book%3A_Biochemistry_Online_\(Jakubowski\)](https://bio.libretexts.org/Bookshelves/Biochemistry/Book%3A_Biochemistry_Online_(Jakubowski))
- ❖ <https://www.thermofisher.com/in/en/home/life-science/protein-biology/protein-biology-learning-center/protein-biology-resource-library/pierce-protein-methods/protein- glycosylation.html>
- ❖ <https://ocw.mit.edu/courses/biology/7-88j-protein-folding-and-human-disease-spring-2015/study-materials/>
- ❖ <https://www.open.edu/openlearn/science-maths-technology/science/biology/nucleic-acids-and-chromatin/content-section- 3.4.2>
- ❖ <https://www.genome.gov/genetics-glossary/Cell-Membrane>
- ❖ <https://nptel.ac.in/content/storage2/courses/102103012/pdf/mod3.pdf>

Mapping with Programme Outcomes:3 Strong,2–Medium,1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	3	2	2	2	3	2	2
CO2	3	2	1	3	2	2	2	3	2	2
CO3	3	2	2	3	3	2	1	3	2	2
CO4	3	2	2	3	2	2	2	3	2	2
CO5	3	3	2	3	1	2	2	3	2	2

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3	3	3	3	3

Course Coordinator

BOS Chairman

SEMESTER I

CORE II– BIOCHEMICAL AND MOLECULAR BIOLOGY TECHNIQUES

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S1PBC02	Core-II	Theory	Y	-	-	6	4

Learning Objectives

- ❖ To understand the various techniques used in biochemical investigation and microscopy.
- ❖ To explain chromatographic techniques and their applications.
- ❖ To explain electrophoretic techniques.
- ❖ To comprehend the spectroscopic techniques and demonstrate their applications in biochemical investigations.
- ❖ To acquire knowledge of radiolabeling techniques and centrifugation.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Attain good knowledge in modern used in biochemical investigation and microscopy and apply the experimental protocols to plan and carry out simple investigations in Biological research.	PO1,PO7
CO2	Demonstrate knowledge to implement the theoretical basis of Chromatography in upcoming practical course work.	PO2,PO7
CO3	Demonstrate knowledge to implement the theoretical basis of electrophoretic techniques in research work.	PO2,PO7
CO4	Tackle more advanced and specialized spectroscopic techniques that are pertinent to research.	PO1,PO2,PO7
CO5	Tackle more advanced and specialized radio isotope and centrifugation techniques that are pertinent to research work.	PO1,PO2,PO7

CORE II– BIOCHEMICAL AND MOLECULAR BIOLOGY TECHNIQUES

UNIT	DETAILS	No.of Hours
I	General approaches to biochemical investigation, cell culture techniques and microscopic techniques. Organ and tissue slice technique, tissue homogenization techniques, cell sorting, and cell counting. Tissue culture techniques. Cryopreservation, Biosensors- principle and applications. Principle, working and applications of light microscope, dark field, phase contrast and fluorescent microscope. Electron microscope- Principle, instrumentation of TEM and SEM, Specimen preparation and applications- shadow casting, negative staining and freeze fracturing.	18
II	Chromatographic Techniques: Basic principles of chromatography- adsorption and partition techniques. Chiral Chromatography and counter current Chromatography. Adsorption Chromatography – Hydroxy apatite chromatography and hydrophobic interaction Chromatography. Affinity chromatography. Gas liquid chromatography- principle, instrumentation, column development, detectors and applications. Low pressure column chromatography – principle, instrumentation, column packing, detection, quantification and column efficiency, High pressure liquid chromatography- principle, instrumentation, delivery pump, sample injection unit, column packing, development, detection and application. Reverse HPLC, capillary electro chromatography and perfusion chromatography. Report writing on chromatographic Techniques.	18
III	Electrophoretic Techniques: General principles of electrophoresis, supporting medium, factors affecting electrophoresis, Isoelectric focusing-principle, ampholyte, development of pH gradient and application. PAGE-gel casting-horizontal, vertical, slab gels, sample application, detection-staining using CBB, silver, fluorescent stains. SDS PAGE-principle and application in molecular weight determination principle of disc gel electrophoresis, 2D PAGE. Electrophoresis of nucleic acids-agarose gel electrophoresis of DNA, pulsed field gel electrophoresis- principle, apparatus, application. Electrophoresis of RNA, curve. Microchip electrophoresis and 2D electrophoresis, Capillary electrophoresis. Report writing on Electrophoretic Techniques.	18
IV	Spectroscopic techniques: Basic laws of light absorption- principle, instrumentation and applications of UV-Visible, IR, ESR, NMR, Mass spectroscopy and Raman spectroscopy. Turbidimetry, Nephelometry and Flame photometry. Luminometry (Luciferase system, chemiluminescence). X - ray diffraction. Atomic absorption spectroscopy- principle and applications - Determination of trace elements.	18

V	Radiolabeling Techniques and Centrifugation: Nature of radioactivity-detection and measurement of radioactivity, methods based upon ionization (GM counter), excitation (scintillation counter), Gamma counter and autoradiography and applications of radioactive isotopes, biological hazards of radiation and safety measures in handling radioactive isotopes. Basic principles of Centrifugation. Preparative ultracentrifugation - Differential centrifugation, Density gradient centrifugation. Analytical ultracentrifugation - Molecular weight determination. PPT Presentation: Biological hazards of radiation and safety measures	18
	Self-Study 1. Types of rotors 2. Colorimetry—principle and applications	
	TOTAL	90
*Note: Report writing & PPT Presentation, related to the above topics are considered to be Internal Exam Only.		

Text Books

- ❖ Robyt JF (2015) Biochemical techniques: Theory and Practice (1st ed), CBS Publishers & Distributors
- ❖ Rodney F. Boyer (2012), Biochemistry Laboratory: Modern Theory and techniques, (2nd ed), Prentice Hall
- ❖ Kaloch Rajan (2011), Analytical techniques in Biochemistry and Molecular Biology, Springer

Reference Books

- ❖ Keith Wilson, John Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology (7th ed) Cambridge University Press
- ❖ David Sheehan (2009), Physical Biochemistry: Principles and Applications (2nd ed), Wiley-Blackwell
- ❖ David M. Freifelder (1982) Physical Biochemistry: Applications to Biochemistry and Molecular Biology, W.H. Freeman
- ❖ Segell H. (1976) Biochemical Calculations (2nd ed), John Wiley and Sons

Web Resources

- ❖ <https://www.kau.edu.sa/Files/0017514/Subjects/principals%20and%20techniques%20of%20biochemistry%20and%20molecular%20biology%207th%20ed>

Mapping with Programme Outcomes:3 Strong,2–Medium,1 –Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	3	3	1	1	3	3	2
CO2	3	2	2	3	2	1	3	3	3	1
CO3	3	2	1	3	2	3	3	3	2	1
CO4	3	3	1	3	3	3	3	3	2	2
CO5	3	3	2	3	2	3	3	3	2	2

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weightedpercentage ofCourse ContributiontoPOs	3	3	3	3	3

Course Coordinator

BOS Chairman

SEMESTER I

CORE III – PHYSIOLOGY AND CELL BIOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S1PBC03	Core-III	Theory	Y	-	-	6	4

Learning Objectives

- ❖ To understand the functions and activities of organs, tissues or cells and of physical and chemical phenomena involved in the human body.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Specifically understand the biological and chemical processes within a human cell.	PO1,PO2,PO7, PO10
CO2	Identify and prevent disease.	PO1,PO2, PO4,PO7
CO3	Understand defects indigestion, nutritional deficiencies and intolerances, and gastrointestinal pathologies.	PO1,PO2,PO4, PO7,PO10
CO4	Identify general characteristics in individuals with imbalances of acid- base, fluid and electrolytes.	PO1,PO2, PO4,PO7,PO10
CO5	Process the mechanism: the transmission of biochemical information between cell membrane and nucleus.	PO1,PO2,PO7

CORE III – PHYSIOLOGY AND CELL BIOLOGY

UNIT	DETAILS	No. of Hours
I	Historical aspects- Cell Theory. Major classes of cell junctions-anchoring, tight and gap junctions. Major families of cell adhesion molecules (CAMs)- cadherins, integrins. Types of tissues. Epithelium- organization and types. The basement membrane. Cell cycle- mitosis and meiosis, their regulations, control of cell cycle. Cell death mechanisms- an overview-apoptosis, necrosis. PPT Presentation: Cell cycle (Animation)	18
II	Reproductive system- sexual differentiation and development; sperm transport, sperm capacitation, and Acrosome reaction. Clinical relevance of female reproductive physiology- menstrual cycle, pregnancy, lactation and menopause. Fertilization and infertility issues.	18
III	Digestive system – structure and functions of different components of digestive system, digestion and absorption of carbohydrates, lipids and proteins, role of bile salts in digestion and absorption, mechanism of HCl formation in stomach, role of various enzymes and hormones involved in digestive system. Respiratory system – Gas exchange and acid-base homeostasis. Mechanism of the movement of O₂ and CO₂ through lungs, arterial and venous circulation. Bohr effect, oxygen and carbon dioxide binding hemoglobin. Surfactant nature and function. Model Preparation: Digestive system & Respiratory system	18
IV	Sensory transduction, Nerve impulse transmission- nerve cells, synapses, reflex arc structure, resting membrane potential, Nernst equation, action potential, voltage gated ion-channels, impulse transmission, neurotransmission, neurotransmitter receptors, synaptosomes. Rod and cone cells in the retina, changes in the visual cycle, photochemical reaction and regulation of rhodopsin. Defect in normal vision. Chemistry of muscle contraction – actin and myosin filaments, theories involved in muscle contraction, mechanism of muscle contraction, energy sources for muscle contraction.	18
V	Hormones – Classification, Biosynthesis, circulation in blood, modification and degradation. Mechanism of hormone action, Hormones of Hypothalamus, pituitary, Pancreatic, thyroid & parathyroid, GI tract, adrenal and gonadal hormones. Synthesis, secretion, physiological actions and feedback regulation of synthesis. PPT presentation: Pathophysiology of Hormones	18
	Self-Study Variation in cell differentiation and progression, Lesch-Nyhan syndrome, orotic aciduria and GERD.	

	TOTAL	90
* Note: Model Preparation and PPT Presentation, related to the above topics are considered to be Internal Exam Only.		

Text Books

- ❖ Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed). John Wiley & Sons, Inc.
- ❖ Bruce Alberts and Dennis Bray (2013), Essential Cell Biology, (4th ed), Garland Science.
- ❖ De Robertis, E.D.P. and De Robertis, E.M.F. (2010). Cell and Molecular Biology. (8th ed). Lippincott Williams and Wilkins, Philadelphia.

Reference Books

- ❖ Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. (5th ed). Sunderland, Mass. Sinauer Associates, Inc.
- ❖ Wayne M. Baker (2008) the World of the Cell. (7th ed). Pearson Benjamin Cummings Publishing, San Francisco. Cell Biology
- ❖ John E. Hall (2010). Guyton and Hall Textbook of Medical Physiology (12th ed), Saunders
- ❖ Harrison's Endocrinology by J. Larry Jameson Series: Harrison's Specialty, 19th Edition Publisher: McGraw-Hill, Year: 2016.

Web Resources

- ❖ <https://www.genome.gov/genetics-glossary/Cell-Cycle>
- ❖ <https://my.clevelandclinic.org/health/diseases/16083-infertility-causes>
- ❖ <https://www.webmd.com/heartburn-gerd/reflux-disease>
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5760509/>

Mapping with Programme Outcomes :3 Strong, 2–Medium, 1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	3	3	3	2	3	3	3
CO2	3	3	3	3	3	2	1	2	3	3
CO3	3	2	2	3	2	2	2	2	1	2
CO4	3	2	2	2	2	2	2	3	3	3
CO5	3	1	3	3	2	1	1	3	3	3

Mapping With Programme Specific Outcomes

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course Coordinator

BOS Chairman

SEMESTER I
CORE PRACTICAL I
LAB COURSE ON BIOMOLECULES AND BIOCHEMICAL TECHNIQUES

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S1PBCP01	CorePractical-I	Practical		-	Y	5	4

Learning Objectives

- ❖ To instill skill in students enabling them to apprehend the wider knowledge about principles and techniques to be employed for the biomolecules under investigation.
- ❖ To inculcate the knowledge of various isolation and purification techniques of macromolecules like DNA, RNA, Glycogen and Starch,
- ❖ To perform colorimetric estimations to quantify important metabolites like lactate and tryptophan and minerals like calcium and iron from various sources.
- ❖ To achieve training in subcellular fractionation and to identify them by markers and training in various chromatographic techniques.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	The student will be able to acquire knowledge and skill in the techniques used in the isolation, purification and estimation of different biomolecules that are widely employed in research.	PO1,PO2,PO4
CO2	The students will get acquainted with Principle, Instrumentation and method of Performing UV absorption studies of DNA, Protein and interpreting the alteration occurred during the process of denaturation.	PO1,PO2,PO4
CO3	The student will be fine-tuned in handling the instruments like colorimeter, spectrophotometer and will be able to estimate the biomolecules and minerals from the given samples.	PO1,PO2,PO4
CO4	The student, in addition to acquiring skill in performing various biochemical techniques, can also learn to detect the presence of phytochemicals and quantify them in the plant sample.	PO1,PO2, PO4,PO10
CO5	The students will develop skill in analytical techniques like subcellular fractionation, Paper, Column and Thin Layer Chromatography, and the group experiments will enable them to build learning skills like team work, problem solving, and communication ability.	PO1,PO2, PO3,PO4, PO10

CORE PRACTICAL I
LAB COURSE ON BIOMOLECULES AND BIOCHEMICAL TECHNIQUES

UNIT	DETAILS	No.of Hours
I	Biochemical studies and estimation of macromolecules 1.Isolation and estimation of glycogen from liver. 2.Isolation and estimation of DNA from animal tissue. 3.Isolation and estimation of RNA from yeast. 1.Purification of Polysaccharides – Starch and assessment of its purity.	15
II	UV absorption 1.Denaturation of DNA and absorption studies at 260 nm. 1.Denaturation of Protein and absorption studies at 280 nm	15
III	Colorimetric estimations 1.Estimation of Pyruvate. 1.Estimation of tryptophan.	15
IV	Estimation of minerals 1.Estimation of calcium. 1.Estimation of iron.	10
IV	Estimation of minerals 2.Estimation of calcium. 1.Estimation of iron.	10
VI	Group Experiments 1.Fractionation of sub-cellular organelles by differential centrifugation-Mitochondria and nucleus 2.Identification of these separated sub-cellular fractions using marker enzymes (any one) 3.Separation of identification of lipids by thin layer chromatography.. 4.Separation of plant pigments from leaves by column chromatography 5.Identification of Sugars by Paper Chromatography 6.Identification of Amino acids by Paper Chromatography	10
	Self-Study 1. Laboratory Safety Rules, Requirements and Regulations. 2.Preparation of standard solutions and reagent	
	TOTAL	75

Text Books

- ❖ Prof.Sarin A.Chavhan,Prof.SushilkumarA.Shinde (2019)A Guide to ChromatographyTechniques Edition:1
- ❖ Jayaraman, J(2011),laboratoryManualinBiochemistry,Newagepublishers

Reference Books

- ❖ DavidPlummer(2001)AnIntroductiontoPracticalBiochemistry(3rded) McGrawHillEducation (India) Private Ltd
- ❖ VarleyH (2006)PracticalClinicalBiochemistry(6thed),CBSPublishers
- ❖ O. Debiyi and F. A. Sofowora, (1978)—Phytochemical screening of medical plants,||Iloyidia, vol. 3, pp. 234–246,
- ❖ Analytical techniques in Biochemistry and Molecular Biology; katoch, Rajan.Springer(2011)

Web Resources

- ❖ https://www.researchgate.net/publication/313745155_Practical_Biochemistry_A_Student_Companion
- ❖ <https://doi.org/10.1186/s13020-018-0177-x>
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5368116/>
- ❖ <https://www.life.illinois.edu/biochem/455/Lab%20exercises/2Photometry/spectrophotometry.pdf>
- ❖ <https://ijpsr.com/bft-article/determination-of-total-flavonoid-and-phenol-content-in-mimusops-elengi-linn/?view=fulltext>
- ❖ <https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry.pdf>

Mapping with Programme Outcomes :3 Strong, 2 –Medium, 1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	1	3	2	3
CO2	3	3	3	3	2	3	1	3	2	3
CO3	3	3	3	3	2	3	2	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Mapping With Programme Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course Coordinator

BOS Chairman

SEMESTER I

CORE ELECTIVE -I MICROBIOLOGY AND IMMUNOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S1PBCE01	CoreElective-I	Theory	Y	-	-	3	3

Learning Objectives

- ❖ To appreciate the classification of microorganisms based on their structure, size and shape with an insight into the ancient scriptures about microbes.
- ❖ To understand the role of microorganisms in environment and also to learn the culture conditions.
- ❖ To recognize the possible contamination of foods by microorganisms, to learn about counteracting preservative measures and to know about probiotic nature of microorganisms.
- ❖ To gain knowledge on pathogenic mediation by microorganisms and preventive measures as well.
- ❖ To comprehend the features of antimicrobial agents, their mechanism of action along with the side effects and also to explore natural remedial measures against microbes.
- ❖ To be able to exploit the various features of microorganisms for the beneficial industrial production.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To classify (by both ancient and modern modes) different types of microorganisms and explain life cycle of the microbes	PO1,PO2, PO7
CO2	To recognize the microorganisms involved in decay of foods and will be able to apply various counter acting measures. The students also will be able to relate the role of certain beneficial microbes in day-to- day's food consumption.	PO,PO2, PO4
CO3	To understand the common pathogenic bacterial and fungi that cause toxic effects and also will be able to employ curative measures.	PO1,PO2
CO4	To analyse various features of wide variety of anti microbial agents along with their mode of action, in addition, being able to apprehend the valuable potentials of traditional and easily Available herbs.	PO2,PO7, PO10
CO5	To apply knowledge gained in production of industrially important products as both pharmaceutical and nutraceutical.	PO2,PO4, PO7

SEMESTER I

CORE ELECTIVE -I MICROBIOLOGY AND IMMUNOLOGY

UNIT	DETLs	No.of Hours
I	Taxonomical classification – bacteria, viruses, algae, fungi and protozoa. Distribution and role of microorganisms in soil, water and air. Charaka's classification of microbes. Life cycle of viruses - lytic cycle and lysogenic cycle. Types of culture media, isolation of pure culture, growth curve and the measurement of microbial growth. Model Preparation: Life cycle of viruses	09
II	Contamination and spoilage of foods – cereals, fruits, vegetables, meat, fish, poultry, eggs, milk. General principles of traditional and modern methods of food preservation – Removal or inactivation of microorganisms, boiling, steaming, curing, pasteurization, cold processing, freeze drying, irradiation, vacuum packing. Microbes involved in preparation of fermented foods – cheese, yoghurt, curd, pickles, rice pan cake, appam, ragi porridge and bread. Report on Field visit to food industry	09
III	Food poisoning- bacterial food poisoning, <i>Salmonella</i>, <i>Clostridium botulinum</i> (botulism), <i>Staphylococcus aureus</i>, fungal food poisoning – aflatoxin. Pathogenic microorganisms, <i>E. coli</i>, <i>Pseudomonas</i>, <i>POlebsilla</i>, <i>Streptococcus</i>, <i>Haemophilus</i>, & <i>Mycobacterium</i>, causes, control, prevention, cure and safety. Food microbiological screening- Realtime PCR, ELISA, Aerobic and anaerobic Plate Count, dye reduction method, anaerobic lactic acid bacteria, anaerobic spore formers, Hazard analysis critical control point (HACCP)	09
IV	Antimicrobial chemotherapy, General characteristics of antimicrobial agents. Mechanism of action – sulfonamides, sulphones and PAS. Penicillin, streptomycin-spectra of activity, mode of administration, mode of action, adverse effects and sensitivity test., Antiviral and antiretroviral agents, Antiviral RNA interference, natural intervention. Natural immune modulators routinely used in Indian medical philosophy.	09
V	Immune system- Types of immunity, Cells of the immune system – neutrophils, eosinophils, basophils, mast cells, monocytes, macrophages, dendritic cells, natural killer cells, and lymphocytes (B cells and T cells). Lymphoid organs- Primary and Secondary organs; structure and functions. Antigens: definition, properties- antigenicity and immunogenicity, antigenic determinants and haptens. Immunoglobulins : Structure, classes, properties and functions of antibodies. Antigen – antibody interactions – molecular mechanism of binding. Affinity, avidity, valency, cross reactivity and multivalent binding. Complement Activation: Classical and Alternative pathway. Transplantation immunology-graft rejection and HLA antigens. PPT Presentation : Transplantation immunology (Animation)	09

	Self- study Microbial infections and gut micro biome with relevance to <i>tridoshas</i>	
	Microbial population and pH variations in different dairy products.	
	TOTAL	45
*Note: Model Preparation, Report Writing on Field Visit and PPT Presentation related to the above topics are considered to be Internal Exam Only.		

Text Books

- ❖ Judy Owen, Jenni Puntkuby (2013), Immunology (Kindt, Kuby Immunology) (7th ed) W. H. Freeman & Co
- ❖ Brooks GF and Carroll KC (2013) Jawetz Melnick & Adelbergs Medical Microbiology, (26th ed) McGraw Hill Education
- ❖ Greenwood D (2012), Medical Microbiology, Elsevier Health

Reference Books

- ❖ Michael J. Pelczar Jr. (2001) Microbiology (5th ed), McGraw Hill Education (India) Private Limited
- ❖ Frazier WC, Westhoff DC, Vanitha NM (2010) Food Microbiology (5th ed), McGraw Hill Education (India) Private Limited
- ❖ Willey J and Sherwood L (2011), Prescott's Microbiology (8th ed) McGraw Hill Education (India)
- ❖ Ananthanarayanan, Paniker and Arti kapil (2013) Textbook of Microbiology (9th ed) Orient Black Swan

Web Resources

- ❖ <https://www.ijam.co.in/index.php/ijam/article/view/1326> (Krumi (Microorganisms) in Ayurveda- a critical review)
- ❖ <https://www.frontiersin.org/articles/10.3389/fphar.2020.578970/full#h9>

Mapping with Programme Outcomes :3 Strong, 2–Medium, 1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	3	3	3	2	3	3	3
CO2	3	3	3	3	3	2	1	2	3	3
CO3	3	2	2	3	2	2	2	2	1	2
CO4	3	2	2	2	2	2	2	3	3	3
CO5	3	1	3	3	2	1	1	3	3	3

Mapping With Programme Specific Outcomes

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3	3	3	3	3

Course Coordinator

BOS Chairman

SEMESTER I

CORE ELECTIVE -I- IMMUNOLOGY AND IMMUNO TECHNOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S1PBCE02	Core Elective-I	Theory	Y	-	-	3	3

Learning Objectives

- ❖ To study the immune responses of human body against antigen, immunological techniques and vaccine synthesis.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Understand basics of immune system and about the cells and organs of immune system.	PO1,PO2,PO7, PO10
CO2	Antigen and Antibody structure and properties and obtain the knowledge about the hybridoma technology	PO2,PO3, PO4,PO7
CO3	Familiarize with complement system, autoimmunity and immune deficiency disorders	PO1,PO2, PO3,PO4, PO7
CO4	Knowledge about the immunization and hypersensitivity reactions.	PO1,PO2, PO3,PO4, PO7
CO5	To Comprehend the antigen and antibody reactions and immunological techniques.	PO1,PO2,PO7

CORE ELECTIVE I

IMMUNOLOGY AND IMMUNO TECHNOLOGY

UNIT	DETAILS	No.of Hours
I	Overview of Immune System: History of immunology- Cells and Organs of the immune system-primary and secondary lymphoid organs. Development of T cells and B cells in the primary and secondary lymphoid organs – Positive and Negative selection. Stem cells– sources, types, properties & applications. Antigens– types, properties that influence antigenicity & immunogenicity, epitopes, cross reactions. Haptens and mitogens. Adjuvants-types and properties. Antibodies–structure, types of immunoglobulins-structure, properties and functions, immunoglobulin superfamily. Complement cascades-components, mechanism of Classical, Alternative and other pathways, biological consequences of complement cascades and their fragments. PPT Presentation : Lymphoid organs	09
II	Types of immunities –Innate and Acquired. Immune response-Humoral and Cellular immune responses-their characteristics & effector mechanisms. Regulation of immune response. Immune response to infections-bacterial, viral, fungal and others. Immunodeficiency diseases-primary and secondary. Immuno genetics-antibody diversity-theories of antibody formation, organization of immunoglobulin gene and their expression, class switching. Major Histocompatibility Complex- organization, structure and function of MHC and HLA genes and non-MHC molecules. Gene products. Role in antigen processing and presentation.	09
III	Hypersensitivity and Autoimmunity: Hypersensitivity–classification, causes, mechanism, clinical manifestations, diagnosis and treatment of Types I–V hypersensitivities. Autoimmunity-classification, role of MHC, TH cells and TCR in autoimmunity, spectrum of autoimmune diseases, overlap, pathogenesis, diagnosis and treatment of autoimmune diseases. Immunological tolerance.	09
IV	Transplantation Immunology: Immunology of Allogeneic Transplantation, Types of Graft Rejection, Specific Immunosuppressive Agents, Immunology of Xenogeneic Transplantation, Transplantation- types of grafts, principles involved and mechanism of transplantation of various organs, immunosuppressive therapy, Graft Versus Host Disease. Role of MHC in transplantation, disease susceptibility and resistance and genetic control of primary histocompatibility PPT Presentation : Graft Rejection	09
V	Immunotechniques: Antigen-antibody interactions-Precipitation techniques. Agglutination techniques, ABO blood grouping & Rh typing. Tagged assays-RIA, ELISA, immune fluorescence, Immune blotting, immune electron microscopy. Isolation of pure	09

	antibodies, Assays for complement, FACS, Flow cytometry. Antibody engineering – Hybridoma technology- polyclonal and monoclonal antibody production and their applications. Recombinant antibody production. Vaccine production- types of vaccines, principles of vaccine production, production of conventional and modern vaccines, new vaccine strategies and vaccines under development. Vaccination strategies, immunization schedules. Report Writing on Immunotechniques.	
	Self-Study 1. Laboratory Safety Rules, Requirements and Regulations. 2. Preparation of standard solutions and reagent	
	TOTAL	45
*Note: Report writing and PPT Presentation related to the above topics are considered to be Internal Exam Only.		

Text Books

- ❖ Kuby Immunology. W.H. Freeman & Co. Fourth edition, 2005.
- ❖ Cellular and molecular immunology, by Abul Abbas, Andrew Lichtman, and Jordan Pober. W.B. Saunders.

Reference Books

- ❖ Immunobiology – the immune system in health and disease, by Charles Janeway, Jr. and Paul Travers. Garland Publishing, Inc.
- ❖ Immunology by Ivan Roitt, Jonathan Brostoff, and David Male. Mosby, London. 6th edition, 2001.
- ❖ Clark WR, The experimental foundations of modern immunology. John Wiley and Sons Inc. New York. 1991.
- ❖ Noel R. Rose, Herman Friedman, John L. Fahey. Manual of Clinical Laboratory Immunology. ASM. 3rd ed., 1986.

Web Resources

- ❖ <https://www.ijam.co.in/index.php/ijam/article/view/1326>(krumi(Microorganisms) in Ayurveda- a critical review)
- ❖ <https://www.frontiersin.org/articles/10.3389/fphar.2020.578970/full#h9>
- ❖ <https://www.frontiersin.org/articles/10.3389/fmicb.2018.02151/full>
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7559905/>

Mapping with Programme Outcomes :3 Strong, 2–Medium, 1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	2	0	0	2	3	2	2
CO2	0	0	0	3	0	0	2	2	2	0
CO3	0	0	0	3	0	0	3	3	2	2
CO4	0	0	0	3	0	0	3	2	2	0
CO5	0	0	0	3	0	0	3	2	2	0

Mapping with Programme:Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator

BOS Chairman

**ELECTIVE –II SOFT SKILL
TISSUE CULTURE TECHNIQUES**

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S1PBCS01	Elective-II Soft Skill	Theory	Y	-	-	3	3

Learning Objectives

- ❖ Students will gain knowledge about plant and Animal tissue culture, transgenic plants, Nitrogen fixation, significance of viral vectors and the concepts of animal biotechnology. They will acquire the skill to set up tissue culture laboratory.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	Programme Outcomes
CO1	To understand the basics of cell culture medium	PO1,PO2, PO7,PO10
CO2	To know the types of cell culture	PO2,PO3, PO4,PO7
CO3	To understand the basics of genetic engineering	PO1,PO2, PO3,PO4,PO7
CO4	To be aware of plant tissue techniques	PO1,PO2, PO3,PO4,PO7
CO5	To understand the functions of viral vectors	PO1,PO2,PO5

ELECTIVE –II SOFT SKILL
TISSUE CULTURE TECHNIQUES

UNIT	DETAILS	No.of Hours
I	Animal cell culture–History and development, Pluripotency, Media, balanced salt solutions, Physical, chemical and metabolic functions of constituents of culture media, Role of carbon dioxide, Serum, growth factors and amino acids in media. Serum containing and serum free media. Constitution of media for cell line. Essential equipments required for animal cell culture	09
II	Types of cell culture- Primary, Secondary, Organ culture and cell lines. Role of feeder layers in cell culture, Cell separation techniques, cell synchronization, Cell counting methods, cryopreservation, Cell banking procedures.	09
III	Transfection of cells in culture- Animal viral vectors for transfection, Physical methods of transfection, HAT selection, selectable markers. Micro manipulation of cells, Gene targeting, gene silencing and Gene knockout and their applications. Cell culture as a source of valuable products–Transgenic Animals PPT Presentation: Gene knockout and their applications.	09
IV	Media composition (MS media) – Micropropagation techniques – direct and indirect organogenesis–somatic variation–somatic embryogenesis–haploid and triploid–Protoplast isolation, fusion and culture – hybrid and cybrid production, Synthetic seed production. Advantages and disadvantages of micro propagation. Secondary metabolite production. Report on Different Media Preparation	09
V	Agrobacterium and crown gall tumors – Mechanism of T-DNA transfer to plants, Ti and Ri Plasmid vectors and their utility–Plant viral vectors. Use of plant viruses as episomal expression vectors. Symbiotic nitrogen fixation in Rhizobia, nif gene. Transgenic plant. PPT Presentation : Hybridization (Animation)	09
	TOTAL	45
Note: Report writing and PPT Presentation related to the above topics are considered to be Internal Exam Only.		

Text Books

- ❖ Glick, B.R. and Pasternak. 2002. Molecular Biotechnology: Principle and application of recombinant DNA.
- ❖ Ramasamy, P. 2002. Trends in Biotechnology, University of Madras Publications, Pearl Press Reading.

Reference Books

- ❖ Trivedi, P.C. 2000. Applied Biotechnology: Recent Advances. PANIMA Publishing corporation.
- ❖ Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw-Hill.
- ❖ Chawla, H.S.,—Introduction to Plant Biotechnology, 3rd Edition, Science Publishers, 2009.
- ❖ R. Ian Freshney, Culture of Animal cells—A Manual of Basic Technique Fourth Edition, WILEY LISS & Publications.

Mapping with Programme Outcomes :3 Strong, 2–Medium, 1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	2	3	3	3	3
CO2	3	3	3	1	2	2	3	3	3	3
CO3	3	2	2	2	3	2	3	3	3	2
CO4	3	2	2	1	3	1	3	3	3	2
CO5	3	3	3	1	3	2	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course Coordinator

BOS Chairman

SEMESTER I

ELECTIVE –II SOFT SKILL

SCIENTIFIC WRITING SKILL AND PRESENTATION

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S1PBCS02	Elective-II Softskill	Theory	Y	-	-	3	3

Learning Objectives

- ❖ Students will learn how to overcome writing barriers and develop a writing schedule.
- ❖ Students will learn how to better organize the results of their experiments into effective tables and figures.
- ❖ Students will improve their writing skills so that manuscript preparation becomes more efficient and productive.
- ❖ Students will learn how to successfully navigate a manuscript through the entire manuscript preparation, revision, review and publishing process.
- ❖ Students will successfully communicate their research findings to the scientific community through publication in peer-reviewed, scientific journals.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	Programme Outcomes
CO1	Write effective and well-organized research papers that are supported by information from several different, credible sources.	PO1, PO2, PO7, PO10
CO2	Develop advanced scientific writing skills to write research articles, reviews, thesis, and proposals and to make oral, poster or power point presentations.	PO2, PO3, PO4, PO7
CO3	Document sources correctly and incorporate information from sources while following the principles of academic honesty.	PO1, PO2, PO3, PO4, PO7
CO4	Evaluate the credibility of research sources, especially the online resources.	PO1, PO2, PO3, PO4, PO7
CO5	Understand the best practices of scientific writing by adhering to research ethics and by avoiding plagiarism	PO1, PO2, PO7

**ELECTIVE –II SOFT SKILL
SCIENTIFIC WRITING SKILL AND PRESENTATION**

UNIT	DETAILS	No.of Hours
I	Introduction to scientific writing Elements of a scientific paper: Abstract, introduction, materials & methods, results, discussion, conclusion, and references. Preparing figures and figure legends, citations. Appropriate use of colour and font size. Proofreading of a manuscript, understanding the symbols.	09
II	Advanced Scientific Writing The art of writing: Basic principles, Creative writing skills. The organization of content: Structure and flow of ideas. Writing thesis and dissertation, Writing clinical study reports. Processing data & application of statistics Displaying data: Text, table, graph and defining terms and abbreviations.	09
III	Structures of writing Sentences, Paragraphs, Parts of a paragraph, Writing laboratory records, journal articles, Text Books, research reports, reviews, scientific papers, Types of journals, Journal impact factor. Other forms of professional writing: composing professional emails and letters for various purposes; preparing an effective resume. Report on Field Visit to the Library	09
IV	Oral communication: Presentation skills: Oral presentation, Poster Preparation and presentation, an introductory idea about use of photoshop and coral making power point presentation. Simplicity of presentation material Animation Effects, Graphic Representation. PPT Presentation: Simplicity of presentation material Animation effect.	09
V	Plagiarism Referencing software: Mendeley, Endnote. Plagiarism: Definition, Common types of plagiarism, Intentional and Unintentional plagiarism, Detection of plagiarism by anti-plagiarism tools (Turnitin, DupliChecker, Viper, and plagiarismX checker), Penalties for plagiarism, Avoiding plagiarism.	09
	Self- study: Each student has to choose a scientific article and present it	
	TOTAL	45
*Note: Report Writing on Field Visit and PPT presentation related to the above topics are considered to be Internal Exam Only.		

Text Books

- ❖ JR, Matthews, RW, Matthews. 2014. Successful Scientific Writing. A step-by-step guide for the Biological and Medical Sciences. Fourth Edition.
- ❖ Cambridge University Press, Cambridge, UK. ISBN 978-1-107-69193-3.
- ❖ Thomas, C George. 2019. Research Methodology and Scientific Writing 2nd edition.

Reference Books

- ❖ Davis, Martha. 1997. Scientific Papers and Presentations. San Diego: Academic Press
- ❖ RA, Day, 1998. How To Write and Publish a Scientific Paper, 5th Edition, Oryx Press. ISBN-13: 978-1573561655 ISBN-10: 1573561657.
- ❖ AH, Hofman, 2010. Scientific Writing and Communication: Papers, Proposals, and Presentations. Oxford University Press, New York, NY. 682 pp.

Mapping with Programme Outcomes :3 Strong, 2–Medium, 1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	3	3	3	2	3	3
CO2	3	2	3	3	2	3	3	2	2	2
CO3	3	2	1	3	2	2	3	3	2	3
CO4	2	2	3	3	1	1	3	2	3	2
CO5	3	3	2	3	3	2	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3	3	3	3	3

Course Coordinator

BOS Chairman

SEMESTER II CORE IV – ENZYMOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S2PBC04	Core IV	Theory	Y	-	-	5	4

Learning Objectives

- ❖ Students will be introduced to the theory and practice of enzymology.
- ❖ Mechanisms of catalysis and factors affecting catalysis will be understood.
- ❖ The kinetics of enzyme- catalysed reactions in the absence and presence of inhibitors will be studied, and the options for applying enzymes and their inhibitors in medicine will be analysed.
- ❖ Students will learn about the applications of enzymes in research, medicine, and industry, which will prepare them for careers in industrial and biomedical research.
- ❖ The control of metabolic pathways and cellular responses through enzyme regulation will be emphasized.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	programmer Outcomes
CO1	Describe the catalytic mechanisms employed by enzymes.	PO1,PO2, PO7
CO2	Choose and use the appropriate methods to isolate and purify enzymes and check the purity of the enzyme.	PO1,PO2, PO3,PO4, PO7
CO3	Analyze enzyme kinetic data graphically, calculate kinetic parameters, determine the mechanism of inhibition by a drug/chemical, and analyze options for applying enzymes and their inhibitors in medicine.	PO1,PO2, PO3,PO4
CO4	Explain allosteric and cooperativity and differentiate Michaelis-Menten kinetics from sigmoidal kinetics. The role played by enzymes in the regulation of vital cellular processes will be appreciated.	PO1,PO2, PO7,PO10
CO5	Highlight the use of enzymes in industries and biomedicine.	PO1,PO2, PO3

CORE IV– ENZYMOLOGY

UNIT	DETAILS	No. of Hours
I	Introduction to enzymes and features of catalysis: A short history of the discovery of enzymes and how they became powerful biochemical tools. Holoenzyme, apoenzyme, cofactors, coenzyme, prosthetic groups, Classification and Nomenclature, Specificity of enzyme action-group specificity, absolute specificity, substrate specificity, stereochemical specificity. Active site, Identification of amino acids at the active site-trapping of ES complex, identification using chemical modification of amino acid side chains and by site-directed mutagenesis. Turnover number of enzymes. Mechanisms of enzyme catalysis: acid-base catalysis, covalent catalysis, electrostatic catalysis, metal ion catalysis, proximity and orientation effects, Low barrier H-bonds, Structural flexibility Mechanism of action of chymotrypsin. Modern concepts of evaluation of catalysis. PPT Presentation: Mechanisms of enzyme catalysis	15
II	Enzyme techniques: Isolation and purification of enzymes – Importance of enzyme purification, methods of purification – choice of source, extraction, fractionation methods – based on size or mass (centrifugation, gel filtration); based on polarity (ion-exchange chromatography, electrophoresis, isoelectric focusing, hydrophobic interaction chromatography); based on solubility (change in pH, change in ionic strength); based on specific binding sites (affinity chromatography), choice of methods, Criteria of purity of enzymes. Enzyme units – katal, IU. Affinity labelling. Measurement of enzyme activity – discontinuous, continuous, coupled assays; stopped flow method and its applications. Isoenzymes and their separation by electrophoresis with special	15
III	Enzyme kinetics I: Thermodynamics of enzyme action, Activation energy, transition-state theory, steady-state kinetics & pre-steady-state kinetics. Single substrate enzyme catalysed reactions – assumptions, Michaelis-Menten and Briggs-Haldane kinetics, derivation of Michaelis-Menten equation. Double reciprocal (Lineweaver-Burk) and single reciprocal (Eadie-Hofstee) linear plots, their advantages and limitations. Analysis of kinetic data – determination of K_m, V_{max}, k_{cat}, and their physiological significance, Importance of k_{cat}/K_m. Enzyme inhibition: Irreversible inhibition. Reversible inhibition – Competitive, uncompetitive, noncompetitive, mixed and substrate inhibition. Michaelis-Menten equation in the presence of competitive, uncompetitive and non-competitive inhibitors. Graphical analysis – Diagnostic plots for the determination of inhibition type. Therapeutic use of enzyme inhibitors – Aspirin, statins (irreversible inhibitors), Methotrexate (competitive inhibitor), Etoposide (non-competitive inhibitor), captopril (uncompetitive inhibitor). Demonstration: Using Microsoft Excel to Plot and Analyse Kinetic Data.	15

IV	Enzyme kinetics II: Allosteric enzymes: Cooperativity, MWC and KNF models of allosteric enzymes, Sigmoidal kinetics taking AT Case as an example. Regulation of amount and catalytic activity by – extracellular signal, transcription, stability of mRNA, rate of translation and degradation, compartmentation, pH, temperature, substrate concentration, allosteric effectors, covalent modification. Regulation of glycogen synthase and glycogen phosphorylase. Feedback inhibition – sequential, concerted, cumulative, enzyme multiplicity with examples. Bi-substrate reactions: Single Displacement Reactions (SDR) (Ordered and Random Bi-Bi mechanisms), Double Displacement Reactions (DDR) (Ping-Pong mechanism), Examples, Cleland's representation of BI substrate reactions.	15
V	Enzyme technology: Immobilization of enzymes – methods – Reversible immobilization (Adsorption, Affinity binding), Irreversible immobilization (Covalent coupling, Entrapment and Microencapsulation, Crosslinking), Advantages and Disadvantages of each method, Properties of immobilized enzymes. Designer enzymes – ribozymes and deoxyribozymes, abzymes, synzymes. Enzymes as therapeutic agents – therapeutic use of asparaginase and streptokinase. Application of enzymes in industry – Industrial application of rennin, lipases, lactases, invertase, pectinases, papain. Antioxidant enzymes. PPT Presentation: Designer Enzymes (Animation)	15
	Self - study: 1.Mechanistic enzymology in drug discovery 2.Enzyme Biosensors for Biomedical Applications	
	TOTAL	75

Note: PPT Presentation related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ Leininger Principles of Biochemistry, 8th edition, 2021, Nelson DL and Cox MM; W.H. Freeman & Co., New York.
- ❖ Biochemistry, Berg JM, Stryer L, Gatto G, 8th ed., 2015; W.H. Freeman & Co., New York.

Reference Book

- ❖ Voet's Biochemistry, Adapted ed., 2011, Voet D and Voet JG; Wiley, India.
- ❖ Enzyme Kinetics and Mechanism, Cook PF, Cleland W; 2007; Garland Science, London.

Web Resources

- ❖ <https://ocw.mit.edu/high-school/biology/exam-prep/chemistry-of-life/enzymes/>
- ❖ https://onlinecourses.swayam2.ac.in/cec20_bt20/preview
- ❖ <https://mooc.es/course/enzymology/>
- ❖ <https://dth.ac.in/medical/courses/biochemistry/block-1/1/index.php>
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4934206/>

Mapping with Programme Outcomes: 3 Strong, 2–Medium, 1– Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	1	2	3	1	3	3	2
CO2	3	3	3	3	2	2	1	3	3	3
CO3	3	3	3	3	2	2	2	3	3	3
CO4	3	3	3	3	2	2	2	3	3	3
CO5	3	3	3	3	2	1	2	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator

BOS Chairman

SEMESTER II
CORE V – CELLULAR METABOLISM

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S2PBC05	Core-V	Theory	Y	-	-	5	4

Learning Objectives

- ❖ Familiarize on blood glucose homeostasis.
- ❖ Provide an insight into the metabolic pathway of glycogen, glycoprotein, mucopolysaccharide and peptidoglycan with clinical correlation wherever required.
- ❖ Inculcate knowledge on nucleotide metabolism and disorders associated with it.
- ❖ Provide a platform to understand the versatile role of PLP in amino acid degradation, formation of specialized products and disorders associated with ammonia detoxification.
- ❖ Educate on home and sulphur metabolism with associated clinical manifestation.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	Programme Outcomes
CO1	Appreciate the modes of synthesis and degradation of glucose and will be able to justify the pros and cons of maintaining the blood sugar level.	PO1,PO2, PO7
CO2	Gain knowledge on polysaccharide metabolism and glycogen storage disease.	PO1,PO2, PO7
CO3	Acquaint with the making and breaking of nucleotides.	PO1,PO2, PO4
CO4	Differentiate the diverse reactions a particular amino acid can experience.	PO1,PO2, PO3,
CO5	Correlate the disturbance of metabolic reactions to clinical manifestations with reference to heme and Sulphur metabolism.	PO1,PO2, PO4,PO7

CORE V – CELLULAR METABOLISM

UNIT	DETAILS	No. of Hours
I	Glycolysis – aerobic and anaerobic, inhibitors, and regulation. Feeder pathway – entry of hexoses into glycolysis, Galactosemia, fructofuranan, Pyruvate dehydrogenase complex – mechanism and regulation. Glyoxalase cycle and its regulation. Gluconeogenesis – source, key enzymes, reaction sequence and its regulation. Blood glucose homeostasis and the role of hormones. Pentose phosphate pathway – significance and its regulation. Glucuronate pathway. Metabolism of glycogen and its regulation. Biosynthesis of N-linked and O-linked glycoproteins and mucopolysaccharides.	15
II	Oxidation of fatty acids – oxidation of saturated and unsaturated fatty acids (α , β & ω oxidation). Oxidation of fatty acids with odd and even numbered carbon atoms. Regulation of β -oxidation. Ketogenesis and its regulation. Biosynthesis of fatty acid – saturated and unsaturated, chain elongation, regulation. Biosynthesis of prostaglandins, thromboxane's and leukotrienes and hydroxyeicosanoic acids. Biosynthesis and degradation of triacylglycerol, phosphoglycerol lipids – lecithin, cephalin, plasmalogens and phosphatidylinositol. Sphingolipid – sphingomyelin, cerebroside, sulfatides, and gangliosides. Cholesterol biosynthesis and its regulation. Lipoprotein metabolism – chylomicrons, VLDL, HDL and LDL. Report Writing on Estimation of VLDL, HDL and LDL	15
III	Metabolism of nucleotides – <i>De novo</i> synthesis and salvage pathways of purine and pyrimidine nucleotides. Regulation and inhibitors of nucleotide biosynthesis. Role of ribonucleotide reductase and its regulation. Degradation of purine and pyrimidine nucleotides. Disorders in purine and pyrimidine metabolism..	15
IV	Biosynthesis of non-essential amino acids – Role and biological significance of glutamate dehydrogenase, glutamine synthetase, lysine, proline and phenylalanine hydroxylase. Interconversion of amino acids – proline to glutamate, methionine to cysteine, serine to glycine. Biosynthesis of spermine and spermidine. Degradation of amino acids – glucogenic and ketogenic amino acids. Formation of acetate from leucine and aromatic amino acid, pyruvate from cysteine, threonine and hydroxyproline, α -ketoglutarate from histidine and proline, succinate from methionine, threonine, valine and isoleucine, oxaloacetate from aspartate, glycine and serine. PPT Presentation: Biosynthesis of non-essential amino acids.	15
V	Biosynthesis and degradation of home. Oxidation and reduction of inorganic sulphur compounds by microbes and plants. Sulpha transferases and their biological role – rhodanese's, sulphatases, 3-mercaptopyruvate sulphur transferases. Oxidation of cysteine to sulphate and interconversion of sulphur compounds.	15
	TOTAL	75

Note: Report writing and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ David L. Nelson and Michael M. Cox (2012), Leininger Principles of Biochemistry (6th ed.), W.H. Freeman.
- ❖ Voet D. and Voet J.G. (2010), Biochemistry (4th ed.), John Wiley & Sons, Inc.

Reference Book

- ❖ Metzler D.E. (2003). The Chemical Reactions of Living Cells (2nd ed.), Academic Press.
- ❖ Zubayr G.L. (1999). Biochemistry (4th ed.), McGraw-Hill.
- ❖ Textbook of Biochemistry with Clinical Correlations, 7th Edition, Thomas M. Devlin (Editor), Wiley.
- ❖ Human Biochemistry – James M. Orten & Otto W. Nehan, 10th ed., The C.V. Mosby Company.

Web Resources

- ❖ <https://www.embopress.org/doi/full/10.1038/msb.2013.19>
- ❖ <https://people.wou.edu/~guralnl/450Glycogen%20metabolism.pdf>
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3243375/>
- ❖ https://www.researchgate.net/publication/334458898_Urea_Cycle
- ❖ https://www.researchgate.net/publication/51233381_Heme_biosynthesis_and_its_regulation_
- ❖ https://www.researchgate.net/publication/349746691_Microbial_Sulfur_Metabolism_and_Environmental_Implications

Mapping with Programme Outcomes:3 Strong,2–Medium,1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	2	3	3	3	2
CO2	3	2	3	3	3	2	3	3	3	2
CO3	3	2	3	3	3	2	3	3	3	3
CO4	3	2	3	2	3	2	3	3	3	2
CO5	3	2	3	3	3	2	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Course Coordinator

BOS Chairman

SEMESTER II
CORE VI – CLINICAL BIOCHEMISTRY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S2PBC06	Core –VI	Theory	Y	-	-	5	4

Learning Objectives

- ❖ To understand the need and methods of various biological sample collection.
- ❖ To explicitly understand the etiopathogenesis, symptoms and complications of metabolic and hormonal disorders and the relevant diagnostic markers.
- ❖ To emphasize the diagnostic significance of serum enzymes in different pathologies and other laboratory investigations of diagnostic importance so as to differentiate normal from disease.
- ❖ To conceive the role of inherited genes in inborn errors of metabolism and methodologies pertaining to in utero diagnosis and post-natal screening.
- ❖ To get updated about electrolyte and hormonal imbalances and the biochemical tests to diagnose them.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	Programme Outcomes
CO1	To appreciate the biological significance of sample collection and awareness of the diagnostic/screening tests to detect common non-communicable diseases so as to understand the role of laboratory investigations for biochemical parameters and understand the disorders associated with blood cells.	PO1,PO2, PO7
CO2	To understand the etiology of metabolic diseases like diabetes and atherosclerosis and avoid such lifestyle disorders by healthy eating and correlate the symptoms with underlying pathology based on diagnostic and prognostic markers.	PO1,PO2, PO7
CO3	To understand the diagnostic application of serum/plasma enzymes to correlate their levels with the organ pathologies associated with specific diseases.	PO1,PO2, PO4
CO4	To appreciate the role of pre- and post-natal diagnosis leading to healthy progeny.	PO1,PO2, PO3,
CO5	To link the serum hormone levels and clinical symptoms with underlying hormonal disturbances. To review the onward transmission of signal via downstream signalling molecules from cell surface to the nucleus by different pathways by comparing and contrasting them and critically evaluate the network between them resulting in the biological outcome.	PO1,PO2, PO4,PO7

CORE VI – CLINICAL BIOCHEMISTRY

UNIT	DETAIL S	No. of Hours
I	Biochemical investigations in diagnosis, prognosis, monitoring, screening: Specimen collection – blood (primary/secondary specimen), urine, feces and CSF. Preservation of biological specimens – blood, urine, feces, CSF and amniotic fluid. Biological reference ranges. Disorders of blood cells: Hemolytic, iron deficiency and aplastic anemia and diagnosis, sickle cell anemia, thalassemia, HbA1C variants. Porphyrrias, thrombocytopenia, causes of leucopenia, leukemia and leucocytosis. Disorders of blood clotting mechanism – Von Willebrand's disease, Hemophilia A, B and C, diagnostic tests for clotting disorders, D-dimer and its clinical significance. Laboratory Diagnosis of Haemoglobinopathies. Report on Field Visit to Clinical Laboratory	15
II	Diabetes mellitus: pathology and complications: Acute changes; Chronic complications: Diabetic nephropathy, neuropathy, retinopathy and Diabetic foot ulcers, Random/Fasting/PP glucose testing, Impaired glucose tolerance (IGT), Impaired fasting glucose (IFG), Diagnosis by GTT, Pre-diabetes, Gestational DM, Glycosylated Haemoglobin (HbA1c); Glycated albumin. Hypoglycaemia and critical alert value for glucose. Markers of complications of Diabetes mellitus: Metabolic syndrome, Lipid profile & lipoproteinemia, Atherosclerosis, Diabetic nephropathy, Microalbuminuria, eGFR. Point of care testing for glucose (Glucometers) and continuous glucose monitoring (CGM): principle and its use. Major groups of anti-diabetic drugs. Diet and lifestyle modifications.	15
III	Diagnostic Enzymology: Clinically Important Enzymes and Isoenzymes as diagnostic markers: Clinical significance of AST, ALT, ALP, ACP, CPO, γ-GT, amylase, pseudocholinesterase and their pattern in Myocardial infarction; Liver disease, Bone disease, Muscle disease, Cancer (tumor markers), GI tract (pancreatitis); Enzymes as therapeutic agents. Pre- and post-natal testing: Amniocentesis, prenatal detection of inborn errors of metabolism in developing fetus – Autosomal recessive mode of inheritance – cystic fibrosis, X-linked recessive inheritance – Duchenne muscular dystrophy. Newborn screening (NBS) for Inborn errors of metabolism, Tandem mass spectrometry application in NBS.	15
IV	Liver function tests: Liver function test panel, Fatty liver. Plasma protein changes in liver diseases. Hepatitis A, B and C. Cirrhosis and fibrosis. Portal hypertension and hepatic coma. Gall stones. Acute phase proteins – CRP, Haptoglobins, α-fetoprotein, ferritin and their clinical significance. Interpreting serum protein electrophoresis. Inflammatory markers (cytokines such as TNF-alpha, IL-6 and others).	15

V	Renal function tests – tests for glomerular and tubular function – Acute and chronic renal failure – Glomerulonephritis, Nephrotic syndrome, uraemia – urinary calculi – Nephrocalcinosis and Nephrolithiasis – causes, pathology and symptoms. Chronic kidney disease. Dialysis – Hemodialysis and peritoneal dialysis. Electrolyte disorder: Calcium: hypercalcemia and hypocalcemia; Calcium homeostasis in blood; phosphate: hyperphosphatemia or hypophosphatemia; Clinical significance: Potassium: hyperkalemia and hypokalemia, Sodium: hypernatremia and hyponatremia; Chloride: hyperchloremia, hypochloremia. Hormonal disorders and diagnostics: T3, T4 and TSH in the diagnosis of thyroid disorders; Diagnostic methods for disorders associated with adrenal, pituitary and sex hormones – Addison's disease, Cushing's syndrome, pituitary tumour, Hypopituitarism, Hypogonadism. Poster Making: Dialysis	15
	Self-study: Potential sources of variability in the estimation of the analytes: Pre-analytical phase: Acceptance/rejection criteria in terms of haemolysis/icteric/lipemia (HIL) interferences. Analytical phase: Linearity, detection limits, precision, accuracy, specificity, sensitivity; Total Allowable Error. (Definitions and examples). Post-analytical phase: Units of reporting of clinical chemistry parameters. Interpretation of results in clinical chemistry based on laboratory investigations and quality control: Critical/alert values. American Diabetes Association (ADA) Standards of Medical Care in Diabetes (yearly update); HbA1C testing: NGSP. Case studies to review. Quality control for clinical chemistry in laboratory.	
	TOTAL	75

Note: Report Writing on Field visit and Poster making related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ Clinical Case Discussion in Biochemistry: A Book on Early Clinical Exposure (ECE), Poonam Agrawal, 2021, CBS Publishers & Distributors Pvt. Ltd.
- ❖ Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (2018) (8th ed.), Saunders.
- ❖ Dinesh Puri, (2020) Textbook of Biochemistry: A Clinically Oriented Approach – 4th Edition, Elsevier.

Reference Books

- ❖ M.N. Chatterjee and Rana Shinde (2012). Textbook of Medical Biochemistry (8th ed.), Jaypee Brothers Medical Publishers.
- ❖ Montgomery R, Conway T.W., Spector A.A. (1996). Biochemistry: A Case-Oriented Approach (6th ed.), Mosby Publishers, USA.

Web Resources

- ❖ <https://www.aacc.org/science-and-research/clinical-chemistry-trainee-council/trainee-council-in-english/pearls-of-laboratory-medicine/2018/utility-of-hil-in-clinical-chemistry>
- ❖ <https://doi.org/10.2147/JMDH.S286679>
- ❖ <https://diabetesjournals.org/clinical/article/40/1/10/139035/Standards-of-Medical-Care-in-Diabetes-2022>

Mapping with Programme Outcomes:3 Strong,2–Medium,1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	3	3	3	2	2	3
CO2	3	2	3	2	3	3	3	2	2	2
CO3	3	3	3	3	3	2	3	3	2	2
CO4	3	2	2	2	3	2	3	3	3	2
CO5	3	2	3	2	3	3	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to POs	3	3	3	3	3

Course Coordinator

BOS Chairman

SEMESTER II
CORE PRACTICAL II
LAB COURSE IN ENZYMOLOGY, MICROBIOLOGY AND CELL BIOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S2PBCP02	Core Practical-II	Practical	-	-	Y	5	4

Learning Objectives

- ❖ To inculcate skill in students enabling them to apprehend the wider knowledge about principles and techniques to be employed for the assay of enzymes under investigation.
- ❖ To inculcate the knowledge of isolation and purification techniques of enzymes using alkaline phosphatase as an example.
- ❖ To perform experiments to study the factors affecting enzyme activity.
- ❖ To achieve training in assay of enzymes.
- ❖ To achieve training in basic microbiological techniques – preparation of culture, sterilization and staining methods.
- ❖ To perform the blood grouping test and to prepare blood smear to study different types of blood cells.
- ❖ To learn molecular biology techniques like Gel electrophoresis and Blotting techniques.
- ❖ To introduce industrial visit so that students may be aware of actual need of the industry and various opportunities available.

Course Outcomes Mapping With Program Outcome		
Course Outcomes	On completion of this course ,students will;	Programme Outcomes
CO1	The student will be able to employ the relevant techniques for isolation and purification of enzymes and gain skill in kinetic studies, which is essential for research activity.	PO1,PO2, PO4
CO2	Student will acquire ability in performing enzyme assay, and explicate the methods that form the basis of enzyme characterization.	PO1,PO2, PO4
CO3	Learn the basic concepts in microbiology and cell biology, which will be helpful for interdisciplinary research work.	PO1,PO3, PO4
CO4	Students will be trained in separation techniques used in molecular biology, which will be supportive in their future research.	PO1,PO3, PO4,PO10
CO5	Industrial visits will provide the students with an opportunity to learn practically through interaction, working methods and employment practices. Students will have an exposure to industrial standards and current work practices.	PO1,PO2, PO3,PO4, PO10

CORE PRACTICAL II
LAB COURSE IN ENZYMOLOGY, MICROBIOLOGY AND CELL BIOLOGY

UNIT	DETAILS	No.of Hours
I	Enzymology – Alkaline Phosphatase a. Isolation of Alkaline Phosphatase. b. Purification of Alkaline Phosphatase. c. Checking the purity using SDS-PAGE. d. Determination of optimum pH and temperature of Alkaline Phosphatase. e. Determination of specific activity and Km of Alkaline Phosphatase. f. Effect of activators and inhibitors on the activity of Alkaline Phosphatase. Assay of Enzymes a. Salivary Amylase. b. Acid Phosphatase.	15
II	Microbiology a. Safety measures and Good Laboratory Practices in microbiology laboratory. b. Sterilization, Culture and media preparation. c. Staining of bacteria – Gram Staining.	15
III	Physiology & Cell Biology a. Test for blood grouping (Haemagglutination). b. Peripheral Blood smear – Staining and Interpretation.	15
IV	Group Experiments a. Separation of proteins based on molecular weight by SDS-PAGE. b. Agarose gel electrophoresis of genomic DNA.	15
V	Industrial visit can be organized to students through Academia–Industry collaborative Program.	15
	Self-study: 1.Preparation of Buffers and pH measurement. 2.Michaelis-Menten equation and Lineweaver-Burk plot.	
	TOTAL	75

Text Books

- ❖ Jayaraman, J. (2011), Laboratory Manual in Biochemistry, New Age Publishers.
- ❖ Fundamentals of Enzymology; 3rd Edn. Nicholas C. Price and Lewis Stevens, Oxford University Press (2012).

Reference Books

- ❖ Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland, Wiley-VCH Publishers (2000).
- ❖ Cappuccino, J. G. & Sherman, N. (2005). Microbiology – A Laboratory Manual, Pearson Education Inc.
- ❖ Practical Enzymology, Second Revised Edition: Hans Bisswanger, Wiley–Blackwell; 2nd Edition (2011).

Web Resources

- ❖ https://www.researchgate.net/publication/337146254_Kinetic_studies_with_alkaline_phosphatase.
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/>
- ❖ <https://www.ijsr.net/archive/v3i8/MDIwMTU0MDK=.pdf>
- ❖ https://www.researchgate.net/publication/349318898_ABC_of_Peripheral_smear

Mapping with Programme Outcomes:3 Strong,2–Medium,1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	1	3	2	3
CO2	3	3	3	3	2	3	1	3	2	3
CO3	3	3	3	3	2	3	2	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to POs	3	3	3	3	3

Course Coordinator

BOS Chairman

SEMESTER II
CORE ELECTIVE ENERGY AND DRUG METABOLISM

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S2PBCE03	Core Elective- III	Theory	Y	-	-	3	3

Learning Objectives

- ❖ Familiarize on concepts of enthalpy, entropy, free energy, redox system, biological oxidation and high energy compounds.
- ❖ Provide an insight into the relationship between electron flow and phosphorylation.
- ❖ Inculcate knowledge on processes involved in converting light energy to chemical energy and associated food production by autotrophs.
- ❖ Provide a platform to understand the versatile role of Krebs cycle, transport of NADH across mitochondrial membrane.
- ❖ Educate on the various phases of xenobiotic metabolism.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Appreciate the relationship between free energy and redox potential and will be able to justify the role of biological oxidation and energy-rich compounds in maintaining the energy level of the system.	PO1,PO2, PO3,PO4
CO2	Gain knowledge on the role of mitochondria in the production of energy currency of the cell.	PO1,PO2, PO5,PO10
CO3	Acquaint with the process of photosynthesis.	PO1,PO2, PO7
CO4	Comprehend the diverse role of TCA cycle and the energy obtained on complete oxidation of glucose and fatty acid.	PO1,PO3, PO4,PO7
CO5	Correlate the avenues available to metabolize the xenobiotics.	PO1,PO3, PO4,PO7

CORE ELECTIVE -III ENERGY AND DRUG METABOLISM

UNIT	DETAILS	No. of Hours
I	Thermodynamic – principles in biology – Concept of entropy, enthalpy and free energy change. Free energy changes in biological transformations in living systems. Redox systems. Redox potential and calculation of free energy. Biological oxidation – Oxidases, dehydrogenases, hydroperoxidases, oxygenases. Energy-rich compounds – phosphorylated and non-phosphorylated. High-energy linkages. PPT Presentation: Laws of Thermodynamics	09
II	Electron transport chain – various complexes of ETC, Q-cycle. Inhibitors of ETC. Oxidative phosphorylation – P/O ratio, chemiosmotic theory. Structure and mechanism of ATP synthesis – role of F_0-F_1 ATPase, ATP-ADP cycle. Inhibitors of oxidative phosphorylation – ionophores, protonophores. Regulation of oxidative phosphorylation.	09
III	Light reaction – Hill's reaction, absorption of light, photochemical event. Photo ETC – cyclic and non-cyclic electron flow. Photophosphorylation – role of CF_0-CF_1 ATPase. Dark reaction – Calvin cycle, control of C_3 pathway, and Hatch-Slack pathway (C_4 pathway), photorespiration. Synthesis and degradation of starch. Synthesis and degradation of starch. PPT Presentation: Photosynthesis (Animation)	09
IV	Interconversion of major food stuffs. Energy sources of brain, muscle, liver, kidney and adipose tissue. Amphibolic nature of citric acid cycle. Anaplerotic reaction. Krebs cycle, inhibitors and regulation of TCA cycle. Transport of extra-mitochondrial NADH – glycerophosphate shuttle, malate-aspartate shuttle. Energetics of metabolic pathways – glycolysis (aerobic and anaerobic), citric acid cycle, beta-oxidation.	09
V	Activation of sulphate ions – PAPS, APS, SAM and their biological role. Metabolism of xenobiotics – Phase I reactions – hydroxylation, oxidation and reduction. Phase II reactions – glucuronidation, sulphation, glutathione conjugation, acetylation and methylation. Mode of action and factors affecting the activities of xenobiotic enzymes. Poster making: Xenobiotics of drugs	09
	Self-study: 1. Calculation of K_{eq} and ΔG 2. Interrelationship of carbohydrate, protein, and fat metabolism – role of acetyl CoA	
	TOTAL	45

Note: PPT Presentation and Poster making related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ David L. Nelson and Michael M. Cox (2012). Leininger Principles of Biochemistry (6th ed.), W. H. Freeman.
- ❖ Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012). Harper's Illustrated Biochemistry (29th ed.), McGraw-Hill Medical.

Reference Books

- ❖ Metzler, D. E. (2003). The Chemical Reactions of Living Cells (2nd ed.), Academic Press.
- ❖ Zubayr, G. L. (1999). Biochemistry (4th ed.), McGraw-Hill.
- ❖ Devlin, R. M. (1983). Plant Physiology (4th ed.), PWS Publishers.
- ❖ Taiz, L. & Zeiger, E. (2010). Plant Physiology (5th ed.), Sinauer Associates, Inc.

Web Resources

- ❖ <https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch21/gibbs.php>
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7767752/#:~:text=The%20mitochondrial%20electron%20transport%20chain,cellular%20ATP%20through%20oxidative%20phosphorylation.>
- ❖ https://www.researchgate.net/figure/Oxidative-phosphorylation-in-mitochondrial-electron-transport-chain-ETC-and-proton_fig1_230798915
- ❖ <https://www.lyndhurstschools.net/userfiles/84/Classes/851/photosynthesis%20light%20&%20dark%20reactions%20ppt.pdf?id=560837>
- ❖ <https://bajan.files.wordpress.com/2010/05/amphibolic-nature-of-krebs-cycle.pdf>
- ❖ <https://www.sciencedirect.com/topics/medicine-and-dentistry/xenobiotic-metabolism#:~:text=Xenobiotic%20metabolism%20can%20be%20defined,more%20readily%20excreted%20hydrophilic%20metabolites>

Mapping with Programme Outcomes:3Strong,2 –Medium,1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	2	3	3	3	2
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	2	3	2	3	3	3	1
CO5	3	2	3	3	3	2	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course Coordinator

BOS Chairman

**SEMESTER II COREELECTIVE
BIOMEDICALINSTRUMENTATION**

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S2PBCE04	Core Elective – III	Theory	Y	-	-	3	3

Learning Objectives

❖ The course focuses on the instrumentation used in the medical field. By learning this course, the students will be able to understand the basic concepts of biomedical instrumentation, which will be very useful for operating the instruments in the future.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	Programme Outcomes
CO1	Explain the classification of biomedical instruments.	PO1,PO2, PO3,PO4
CO2	Analyze the working of biosensors, electrodes and transducers.	PO1,PO2, PO7,PO10
CO3	Relate the principle & working of biopotential recorders.	PO1,PO2, PO7
CO4	Describe the principles and working of physiological assist devices.	PO1,PO3, PO4,PO7
CO5	Summarize the recent advancements in biomedical instruments.	PO1,PO3, PO4,PO7

CORE ELECTIVE - III BIOMEDICAL INSTRUMENTATION

UNIT	DETAILS	No. of Hours
I	Biomedical Instrumentation: Definition, Classification of Biomedical equipments – Diagnostic, therapeutic and clinical laboratory equipments, sources of biomedical signals, components, design factors and characteristics.	09
II	Biosensors – Principle and mechanism of calorimetric, potentiometric, amperometric and optical biosensors. Autoanalyser – types and application. Electrodes – theory, types – biopotential, microelectrodes, metal plate and needle electrodes. Transducers – types – magnetic induction, piezoelectric, photovoltaic, thermoelectric, strain gauge.	09
III	Biopotential Recorders: Resting and action potential, propagation of action potential, wave forms – ECG, EMG, EEG, EOG, EGG & ERG. Specialized Medical Equipments: X-ray machine, Angiography. Electrical safety in medical environment – shock hazards, leakage current, instrument for checking safety parameters of biomedical equipment. Report on Field Visit to Clinical Laboratory	09
IV	Physiological Assist Devices – pacemakers, artificial heart valves, defibrillators, nerve and muscle stimulator (Galvanic and interrupted Galvanic current), heart-lung machine – mechanical functions, oxygenators – bubble, film. Kidney machine – hemo and peritoneal dialysis.	09
V	Advances in Biomedical Instrumentation – Lasers, endoscopes – types. Cryogenic surgery. Gamma ray camera, computerized tomography, infrared thermography, mammography, ultrasonic imaging, magnetic resonance imaging. PPT Presentation: Ultrasonic Imaging	09
	Self-study: 1.principles of Colorimetry, electro chemistry and spectroscopy	
	TOTAL	45

Note: Report Writing on Field visit, Model preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ Anandanatarajan, R. (2013). Biomedical Instrumentation and Measurements. PHI Learning Pvt. Ltd., New Delhi.
- ❖ Arumugam, M. (2011). Biomedical Instrumentation. Anuradha Publications, Chennai.

Reference Books

- ❖ Khandpur, R. S. (1995). Handbook of Biomedical Instrumentation. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
- ❖ Biomedical Instrumentation, Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer.

Web Resources

- ❖ Gibbs Free Energy – Purdue University
- ❖ Mitochondrial Electron Transport Chain and Oxidative Phosphorylation – NCBI

Mapping with Programme Outcomes:3Strong,2–Medium,1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	3	3	3	2	2	2
CO2	3	2	3	2	3	3	3	2	2	2
CO3	3	3	3	3	3	2	3	3	2	2
CO4	3	2	2	2	3	2	3	3	3	2
CO5	3	2	3	2	3	3	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course Coordinator

BOS Chairman

**SEMESTER II CORE ELECTIVE
NUTRITIONAL BIOCHEMISTRY**

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S2PBCE05	Core Elective–IV	Elective	Y	-	-	3	3

Learning Objectives

- ❖ To understand basic concepts involved in growth, health, nutrition, physiology and metabolism.
- ❖ To discuss the concepts and applications of nutrition in correlation with biochemistry.
- ❖ To define nutritional needs in healthy individuals and modification of diet during illness.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Plan a balanced diet based on an individual's energy requirement, assess nutritional status of an individual.	PO3,PO4, PO7
CO2	Describe the biochemical, physiological and nutritional functions of macronutrients and their integrated role. Understand the role played by antinutritional factors.	PO1,PO10
CO3	Evaluate the functions of vitamins and minerals, and fluid and electrolyte balance in different physiological states and in sportspersons.	PO1,PO10
CO4	Identify nutritional deficiency conditions, its prevention and dietary management.	PO3, PO4
CO5	Acquire knowledge about the importance of balanced diet and diet therapy.	PO7,PO10

CORE ELECTIVE - III NUTRITIONAL BIOCHEMISTRY

UNIT	DETAILS	No. of Hours
I	Basic concepts - Nutrition - Food groups and balanced diet. Novel Foods. Calorific value of foods: Direct and indirect calorimetry. Empty calories. Basal metabolic rate: Factors affecting BMR. SDA and physical activity. Calculation of day's energy requirement. Assessment of nutritional status. Lactose intolerance. Nutritional requirement and biochemical changes in different physiological states - infancy, childhood, pregnancy, lactation, and ageing. Sports nutrition. National and regional food pattern in India. Report on Field Visit to Anganwadi (observing Height, Weight, BMR Chart)	09
II	Elements of nutrition - Plant and animal sources of simple and complex carbohydrates, fats and proteins and their requirement. Biological significance, deficiency and toxicity of macronutrients and micronutrients. Role of dietary fiber. Protein sparing action of carbohydrates and fats. Essential amino acids. Essential fatty acids. Effects of naturally occurring food toxins, preservatives, additives, alcohol and tobacco on health.	09
III	Vitamins and Minerals - Dietary sources, classification, biochemical functions, requirements, absorption, metabolism and excretion. Vitamin B complex as coenzyme. Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper. Chart Preparation: Dietary Sources of Vitamins and Minerals	09
IV	Malnutrition - Diseases arising due to Protein - Calorie Malnutrition and undernutrition (Kwashiorkor and Marasmus), Prevention of malnutrition. Deficiency diseases associated with vitamin B complex, vitamin C and A, D, E & K vitamins - Mineral deficiency diseases - aetiology, signs and symptoms and dietary supplementation. Enrichment and fortification (vitamins and minerals). PPT Presentation: Malnutrition	09
V	Nutrition in diseases - Symptoms of diseases and modification of dietary pattern for patient suffering from fever (Typhoid and Malaria), Jaundice, hyperacidity (Ulcer), Atherosclerosis, Hypertension, kidney diseases and diabetes in adults. Starvation and Obesity.	09
	Self-study: 1. Anti-abuse drugs and food. 2. Selection of foods and market visit, reading and understanding the food labels.	
	TOTAL	45

Note: Report writing on Field visit, Chart Preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ Srilakshmi, E. (2016). Nutrition Science. New Age International Publishers.
- ❖ Margaret McWilliams (2012). Food Fundamentals (10th ed.). Prentice Hall.
- ❖ Mahan, Kathleen L. (2004). Krause's Food, Nutrition and Diet Therapy. W. B. Saunders, 11th Edition.

Reference Books

- ❖ M. Swaminathan (1995). Principles of Nutrition and Dietetics. Bappco.
- ❖ Tom Brody (1998). Nutritional Biochemistry (2nd ed.). Academic Press, USA.

Web Resources

- ❖ <https://www.jmedscindmc.com/article.asp?issn=1011-4564;year=2014;volume=34;issue=5;spage=211;epage=213;aulast=Shrivastava>
- ❖ https://www.researchgate.net/figure/Relationship-between-malnutrition-infection-and-immunity-Malnutrition-is-considered-the_fig1_280722727

Mapping with Programme Outcomes: 3Strong, 2 –Medium, 1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	3	2	2
CO4	3	3	3	3	3	3	3	3	2	1
CO5	3	3	3	3	3	3	3	3	2	2

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course Coordinator

BOS Chairman

SEMESTER II CORE ELECTIVE
BIOCHEMISTRY IN HUMAN HEALTH

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S2PBCE06	Core Elective–IV	Theory	Y	-	-	3	3

Learning Objectives

- ❖ To provide students with up-to-date understanding of the biochemical basis of a wide range of human diseases and conditions.
- ❖ To become knowledgeable in the mechanisms of disease, etiology, progression and pathogenesis in humans.
- ❖ To understand the role of antioxidants in human health.

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	Programme Outcomes
CO1	Be aware of energy requirements for humans in maintaining health.	PO3,PO4, PO7
CO2	Understanding of energy values and requirements.	PO1,PO10
CO3	Understanding basic concept of Communicable Diseases.	PO1,PO10
CO4	Understanding basic concept of non-Communicable Diseases.	PO3, PO4
CO5	Acquire knowledge about the importance of antioxidants.	PO7,PO10

UNIT	DETAILS	No. of Hours
I	International Agencies – Introduction to biochemistry programme, Relationship of health and biochemistry, Food safety and standard regulations. Role of various agencies to improve the nutritional status of the community (WHO, UNICEF, NIN, ICAR, FAO, CSIR). National Health Programs – Planning, Execution and Evaluation of various health programs.	09
II	Energy – Energy content of food, energy utilization in cells. Measurement of fuel values of foods. Direct and indirect calorimetry. Basal metabolic rate (BMR) and specific dynamic action (SDA) and factors affecting BMR, Measurement and calculation of BMR. Energy balance and Energy requirements of man and woman and factors affecting energy requirements. Report on Field Visit to Anganwadi (observing Height, Weight and BMR Chart)	09
III	Community Health and Communicable Diseases Concepts of community Health, National Health Policy. Epidemiology of Communicable Diseases. Factors responsible for the spread of communicable diseases, mode of transmission – typhoid fever, tuberculosis, leprosy, filariasis and AIDS. PPT Presentation: National Health Policy	09
IV	non-communicable diseases Etiology and management of diseases like Obesity, Diabetes mellitus, and Cardiovascular disorders. Immune responses to SARS-CoV-2, Vaccines and Immunotherapy. Preventive health check-ups (PHC) – important parameters/biomarkers; relevance of PHC in health and disease prevention/early diagnosis.	09
V	Antioxidants and human health Chemistry of free radicals and reactive oxygen species, Free radicals in health and disease. Antioxidant defence enzymes – Superoxide dismutase, catalase, glutathione peroxidase, Glutathione reductase, glutathione-S-transferases. Antioxidant vitamins. Chart Preparation: Antioxidant Foods.	09
	Self-study: Concepts of Nutrition and Dietetics Prevention of Diseases	
	TOTAL	45

Note: Report writing on Field visit, Chart Preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ Srilakshmi, E. (2016). Nutrition Science, New Age International Publishers.
- ❖ Margaret McWilliams (2012). Food Fundamentals (10th ed.), Prentice Hall.

Reference Books

- ❖ Mahan, Kathleen L. (2004). Krause's Food, Nutrition and Diet Therapy, W. B. Saunders, 11th Edition.

Web Resources

- ❖ <https://www.jmedscindmc.com/article.asp?issn=1011-4564;year=2014;volume=34;issue=5;spage=211;epage=213;aulast=Shrivastava>
- ❖ https://www.researchgate.net/figure/Relationship-between-malnutrition-infection-and-immunity-Malnutrition-is-considered-the_fig1_280722727

Mapping with Programme Outcomes:3Strong,2 –Medium,1-Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	3	2	2
CO4	3	3	3	3	3	3	3	3	2	1
CO5	3	3	3	3	3	3	3	3	2	2

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course Coordinator

BOS Chairman

SEMESTER – III

SECOND YEAR - SEMESTER III

CORE VII – INDUSTRIAL MICROBIOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBC07	Core-VII	Theory	Y	-	-	5	4

Learning Objectives

- ❖ Students will be introduced to the structure of biomolecules.
- ❖ To gain knowledge of the structure, classification and use of microorganisms in various industries.
- ❖ To know various fermenter designs, culture systems and the application of fermentation process in industry.
- ❖ To understand the production and purification of fermented products and their industrial applications.
- ❖ Understand the basic concepts of food and agricultural microbiology

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Students will be able to understand the structure and classification of microorganisms	PO2,PO4
CO2	Gain knowledge of the uses of microorganisms in various industrial applications	PO3,PO4
CO3	Understand the concepts of fermentation process, harvest and recovery.	PO1,PO5
CO4	Students will know the types of microbial fermentation processes and their applications in pharmaceutical industry.	PO2,PO3,
CO5	Students will learn about the use of microorganisms in beverages, dairy and food industries.	PO3,PO6

CORE VII – INDUSTRIAL MICROBIOLOGY

UNIT	DETAILS	No. of Hours
I	structure of bacteria, fungi and viruses and their classification. Types and characteristics of microorganisms used in Industry (a) Food Industry (b) Chemical Industry (c) Pharmaceutical Industry Assignment writing: Structure of bacteria, fungi and viruses	15
II	Fundamentals and principles of microbial fermentation techniques – application in industry and pharmaceutical Biochemistry. Fermentation – types, techniques, design and operation of fermenters including addition of medium. Types and characteristics of microorganisms, environmental conditions required for the growth and metabolism of industrially and pharmaceutically important microbes. Sterilization methods in fermentation techniques, air, gas, culture medium sterilization. Steam-filtration and chemicals. Types and constituents of fermentative culture medium and conditions of fermentations, Antifoaming devices.	15
III	Recovery and estimation of products of fermentation- Production of ethanol, acetic acid, glycerol, acetone, butanol and citric acid by fermentation. Production of Enzymes- amylase, protease, lipase, Production of pharmaceuticals by fermentation– penicillin, streptomycin, tetracycline, riboflavin, vitamin B12. Beverages-wine, beer and malt beverages. PPT Presentation: Production of ethanol, acetic acid	15
IV	Food Microbiology: Production of dairy products-bread, cheese and yoghurt (preparation and their types). Food borne diseases- Bacterial and Non-Bacterial. Food preservation – Principles– Physical methods: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, Chemical methods – salt, sugar, organic acids, SO ₂ , nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins.	15
V	Agricultural Microbiology: General Properties of soil, microorganisms in soil – decomposition of organic matter in soil. Production of bio fertilizers and its field applications – Rhizobium, azotobacter, blue green algae, mycorrhizae, aspergillum, Production of biofuels (biogas- methane), soil inoculants. Chart Preparation: Production of biofuels.	15
	Self-Study Micro-organisms in food processing and pharma industries Upstream and Downstream processes in Biopharma	
	TOTAL	75

Note: Chart Preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ Food Microbiology: An Introduction, 4th edition, Matthews, K. R., Kniel, K. E. & Montville, T. J.; American Society for Microbiology.
- ❖ Food, Fermentation and Micro-Organisms, 2nd edition, Charles, B. W.; Blackwell Science Ltd.
- ❖ Microbiology, 5th edition, Pelczar, M. J., Chan, E. C. S. & Krieg, N. R.; McGraw-Hill Book Company.
- ❖ Textbook of Microbiology, 11th edition, Ananthanarayanan, R. & Paniker, C. K. J.; Universities Press (India) Pvt. Ltd.
- ❖ Food Microbiology, 3rd edition, Frazier, W. C. & Westhoff, D. C.; Tata McGraw-Hill Publishing Company Ltd., New Delhi.

Web Resources

- ❖ <https://nptel.ac.in/courses/102/105/102105058/>
- ❖ <https://nptel.ac.in/courses/102/106/102106053/>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	2	2	2	3	2	2
CO2	3	2	1	3	2	2	2	3	2	2
CO3	3	2	2	3	3	2	1	3	2	2
CO4	2	3	2	3	2	2	2	3	2	2
CO5	3	3	2	3	1	2	2	3	2	2

Mapping With Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Course coordinator

BOS Chairman

CORE VIII – MOLECULAR BIOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBC08	Core-VIII	Theory	Y	-	-	5	4

Learning Objectives

- ❖ To introduce the students to the process of inheritance, concepts of genes, genome, chromatin and chromosomes.
- ❖ To impart a thorough understanding of the key events of molecular biology, including the mechanisms of DNA replication, transcription and translation along with DNA repair mechanisms.
- ❖ To provide a detailed understanding of post transcriptional and post translational modifications and processing of eukaryotic RNA and proteins
- ❖ To give a detailed explanation of transcriptional regulation with lac operon and tryptophan operon as examples
- ❖ To impart adequate information of the types of regulatory RNAs along with key concepts of gene silencing

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Comprehend the organization of genomes, the molecular basis of DNA replication, recombination and transposition, the significance of these processes, the various ways in which the DNA can be damaged leading to mutations and lesions and the different ways in which they are repaired.	PO1, PO2, PO3, PO4
CO2	Gain knowledge about how genes are transcribed and translated in prokaryotes and eukaryotes and how these processes are regulated, recognize the nature of the genetic code and the various experimental approaches used to crack the code.	PO1, PO2, PO3, PO4, PO5
CO3	Acquire knowledge of the molecular basis of RNA processing and RNA splicing and the various human pathologies that can result from defects of RNA modification.	PO1, PO2, PO3, PO4
CO4	Comprehend the techniques of gene silencing and its applications.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Apply the knowledge they have gained in understanding the above vital life processes to enhancing their analytical and problem-solving skills and develop an interest to pursue high quality research.	PO2, PO3, PO4, PO5, PO6

CORE VIII –MOLECULAR BIOLOGY

UNIT	DETAILS	No. of Hours
I	Mendel's laws of inheritance-dominance-complete, incomplete and co-dominance, multiple alleles-gene mapping in haploids and diploids, recombination mapping- restriction mapping- modes of gene information transfer in bacterial- conjugation, transformation and transduction. The bacterial chromosome, the eukaryotic genome- chromosome structure – Histones, Nucleosome, chromatin- heterochromatin, euchromatin, chromatin remodeling, DNAase hypersensitive sites, genome organization – the C-value paradox, reassociation kinetics, repetitive sequences, gene amplification , telomeres, pseudogenes, split genes, organelle genomes – mitochondrial and chloroplast genome. Chart Preparation: chromosome structure.	15
II	DNA replication and repair: Enzymes of replication, prokaryotic replication mechanisms, primosome & replisomes, eukaryotic DNA replication, the role of topoisomerases and telomerase, regulation of replication, difference between prokaryotic and eukaryotic replication. Mutations –Types of mutations, mechanisms of mutations, mutagenic agents. DNA repair mechanisms – Direct repair, excision repair, mismatch repair, recombination repair, SOS response, eukaryotic repair systems. Recombination and mobile genetic elements- the Holliday model, the general recombination in <i>E.coli</i>, site specific recombination, transposons and repropose. Assignment writing: DNA repair mechanisms.	15
III	Transcription – Prokaryotic transcription-subunits of RNA polymerase, <i>E. coli</i> promoters, sigma factor and promoter recognition, alternative sigma factors, initiation, elongation, Rho-dependent and independent termination of transcription. Eukaryotic transcription- Initiation, promoter elements, RNA polymerases, transcription factors, regulatory sequences in eukaryotic protein – coding genes, CpG islands, enhancers. Translation – organization of the ribosome, the genetic code, evidence for a triplet code, deciphering the genetic code, wobble hypothesis, deviation in the genetic code, unusual codons. Activation, initiation, elongation and termination of translation in <i>E. coli</i>. The role of tRNA and rRNA, suppressor tRNAs and inhibitors of protein synthesis, Comparison of prokaryotic translation with eukaryotic translation.	15
IV	Regulation of gene expression in prokaryotes–Positive and negative control, the lac operon, identification of operator and regulator sequences by mutations, induction and repression, Foot-printing and gel-shift assays for identification of protein-DNA interactions. Catabolite repression. <i>Trp</i> operon – Attenuation, alternative secondary structures of <i>trp</i> mRNA. Regulation of gene expression in eukaryotes- Response elements, DNA- binding motifs, steroid receptors, association of methylation and histone acetylation with gene expression.	15

V	Post transcriptional modifications in eukaryotes- RNA processing- mRNA 5' capping and 3' poly-adenylation, introns and exons, RNA splicing, - spliceosome assembly, alternative splicing, processing of tRNA and rRNA, self-splicing, ribozymes, RNA editing- substitution and insertion/deletion editing, Genome editing-CRISPR- Cas technology Post translational modification of proteins- Proteolytic cleavage, covalent modifications, glycosylation of proteins, disulfide bond formation, Protein sorting – signal peptides, transport of secretory proteins, Golgi and post- golgi sorting, coated vesicles, targeting of mitochondrial, lysosomal and nuclear proteins, Protein degradation-Ubiquitination of proteins, Protein folding-chaperones PPT Presentation: Post translational modification of proteins.	15
	Self-Study 1. Multiple roles of noncoding RNAs (long ncRNA ,siRNA,miRNA) in development and differentiation; implication of ncRNAs in pathologies. 2. mRNA degradation- nonsense-mediated decay.	
	TOTAL	75

Note: Assignment writing, Chat Preparation & PPT Presentation, related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ Lewin's Genes XII : 12th edition, Krebs JE, Goldstein ES, Kilpatrick ST ;Prentice Hall, Delhi
- ❖ Molecular Biology of the Gene : 6th edition, Watson JD , Baker TA, Bell S, Gann A, Levine M, Losick R; Cold Spring Harbor Laboratory Press, New York Essential Cell Biology :3rd edition, Alberts B, Bray D, Hopkin K, Johnson A, Lewis J, Raff M, Roberts K, Walter P ; Garland Science, New York
- ❖ Molecular Cell Biology : 8th edition , Lodish H, Arnold Berk; W.H.Freeman & Co, New York
- ❖ Karp's Cell and Molecular Biology: Concepts and Experiments, 8th Edition; Wiley, India
- ❖ An Introduction to Genetic Analysis 12th edition,, Griffith A. F, Doebley J, Peichel C, David A, Wassarman DA; Albion Press.W.H.Freeman & Co ,New York

Web Resources

- ❖ Molecular Biology Free Online Course by MIT Part 3: RNA Uploaded by edX
- ❖ <https://mooc.es/course/molecular-biology/>
- ❖ https://onlinecourses.swayam2.ac.in/cec20_ma13/preview
- ❖ <https://learn.genetics.utah.edu/>
- ❖ <https://www.cellbio.com/education.html>
- ❖ <https://lifescienceinteractive.com/category/molecular-biology/>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO9	PO10
CO1	3	1	2	3	3	1	1	3	3	2
CO2	3	2	2	3	2	1	3	3	3	1
CO3	3	2	1	3	2	3	3	3	2	1
CO4	3	3	1	3	3	3	3	3	2	2
CO5	3	3	2	3	2	3	3	3	2	2

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Course coordinator

BOS Chairman

CORE IX – GENE EDITING, CELL AND GENE THERAPY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBC09	Core-IX	Theory	Y	-	-	6	4

Learning Objectives

- ❖ To train the student in techniques related to the molecular basis of genetic diseases and to incorporate skills essential for various types of sequencing.
- ❖ To inculcate practical knowledge on comparing the animal models used to model genetic diseases
- ❖ To introduce and also elaborate knowledge about wide varieties of vectors and their features in addition to their applications and to identify the viral and nonviral gene transfer techniques
- ❖ To educate about the characteristics of cell culture, therapeutic strategies in gene therapy with relevant safety/ethics involved and patents as well

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Ability to read, and evaluate scientific articles within the subjects of immune therapy, gene therapy and cell therapy.	PO1,PO2
CO2	To clone gene of their interest for several downstream purposes with a robust comprehension about wide variety of applicable gene delivery vectors	PO1,PO2,PO5
CO3	Be able to provide examples of diseases that can be treated with immune therapy, gene therapy and cell therapy.	PO2,PO3,PO4,
CO4	To identify knowledge gaps and need for further research within their chosen topic of immune therapy, gene therapy or cell therapy.	PO2,PO4,PO5,
CO5	To critically discuss and reflect on ethical and social aspects of using immune, gene or cell therapy. The student will be persuaded to contemplate on upcoming technologies for futuristic benefits.	PO2,PO5,PO6

CORE IX – GENE EDITING, CELL AND GENE THERAPY

UNIT	DETAILS	No. of Hours
I	Gene Editing: Basis of gene editing, DNA repair mechanisms, Double strand DNA breaks, Nonhomologous End-Joining (NHEJ), Homology directed repair, Programmable nucleases for gene editing, Meganucleases, Zinc-Finger nucleases, Transcription Activator-Like Effector Nucleases (TALEN), CRISPR-Cas systems, gene editing using CRISPR-Cas, drawbacks and major challenges to present gene editing techniques, gene editing for human disease therapy PPT Presentation: Basis of gene editing and DNA repair mechanisms	18
II	Gene and cell therapy: Basics of Gene and cell therapy, types of gene therapy, gene therapy strategies, therapeutic targets for gene therapy, choice of the therapeutic target, administration routes, delivery systems, expression of transgene, persistence of the gene therapy, cell targeting, immunological response to the therapy, ethical and legal issues, concerns about gene and cell therapy	18
III	Vectors for Gene therapy: Non-viral and viral vectors for gene therapy, Physical methods of gene delivery, Polymer, Lipid and inorganic material based chemical systems for gene delivery, Viral vectors, Lentiviral, Adenoviral, Adeno- associated virus, Herpes Simplex virus, vaccinia, baculoviral vectors for gene delivery, choice of viral vector and oncolytic virus. Gene therapy applications, Gene therapy for cancer, suicide and oncolytic gene therapy. Chart Preparation: Gene therapy applications.	18
IV	Stem cells and tissue regeneration: Adult and fetal stem cells, embryonic stem cells, cell reprogramming, induced pluripotent stem cells (iPSC), Chemically induced pluripotent stem cells (CiPSC), reprogramming factors, iPSC derived progenitors cells, Organoids, three dimensional (3D) bioprinting.	18
V	Regulatory and Ethical Considerations of stem cell and Gene Therapy, pluripotent stem cell-based cell replacement therapies. Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies. Technological challenges towards development of pluripotent stem cell-based cell replacement therapies.	18
	Self-Study Applications of gene editing strategies CART therapy for Cancer	
	TOTAL	90

Note: Chart Preparation and PPT Presentation, related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ An Introduction to Human Molecular Genetics (2nd Edition), J.J. Pasternak, 2005 An Introduction to Molecular Medicine and Gene Therapy 1st Edition by Thomas F. Kresina Upadhyay, S. K. (Ed.). (2021).
- ❖ Human Molecular Genetics (4th Edition), Tom Strachan & Andrew Read, 2010. Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003,

Reference Books

- ❖ Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press
- ❖ Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press
- ❖ Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Alexander Battler.

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	3	3	3	2	3	3	3
CO2	3	3	3	3	3	2	1	2	3	3
CO3	3	2	2	3	2	2	2	2	1	2
CO4	3	2	2	2	2	2	2	3	3	3
CO5	3	1	3	3	2	1	1	3	3	3

Mapping With Programme Specific Outcomes

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

CORE PRACTICAL III - LAB COURSE ON CLINICAL BIOCHEMISTRY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBCP03	Core Practical-III	Practical	-	-	Y	5	4

Learning Objectives

- ❖ To instill skill in students enabling them to apprehend the wider knowledge about principles and techniques to be employed for the investigation of biological samples, clinical approach, normal values of biochemical constituents and clinical interpretations.
- ❖ To inculcate the knowledge of collection, preservation of blood sample and learning various hematological parameters and their significance.
- ❖ To perform experiments to assess liver functions. And also to study the marker enzymes of liver
- ❖ To evaluate lipid profile and assess their relation to cardiac function.
- ❖ To perform experiments to estimate blood glucose and glycosylated hemoglobin.
- ❖ To perform urine analysis, estimate BUN and clearance test to assess renal function .
- ❖ To learn basic immunotechniques antigen –antibody reactions.
- ❖ To perform data analysis in using MS Excel
- ❖ To introduce visit to hospital so that students may be aware of Phlebotomy, Collection and storage of specimen, Good laboratory practices, Automation and current methods adopted in the diagnostic labs

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	The student will be able to acquire knowledge and skill in hematology techniques. They will get familiar with methods and knowledge to interpret the electrolyte concentration in serum	PO1,PO2, PO3,PO4,PO5
CO2	The student will be able to assess the Liver Function and interpret the biochemical investigation in a given clinical situation	PO1,PO2, PO3,PO4,PO5
CO3	Skill to perform the Renal function test to assess the function of Kidney and report the abnormal parameters with reference range will be achieved by the student	PO1,PO2, PO3,PO4,PO5
CO4	To estimate the blood glucose content and lipid profile , to evaluate the alterations and record the observation in accordance to reference range will be acquired by the student	PO1,PO2,PO3, PO4,PO5,PO6
CO5	The Group Experiments will support them to acquire practical skills to work in health care sector and assist them to understand the automation process in clinical labs	PO1,PO2,PO3, PO4,PO5,PO6

CORE PRACTICAL III -LAB COURSE ON CLINICAL BIOCHEMISTRY

UNIT	DETAILS	No. of Hours
I	Hematology: RBC count, WBC count – total and differential count, ESR, PCV, MCV. Bleeding Time, Clotting Time Estimation of hemoglobin. Determination of Electrolytes :Sodium, Potassium and Calcium	15
II	Liver function test: Estimation of bilirubin – direct and indirect. Estimation of plasma protein, A/G ratio, Thymol turbidity test, Prothrombin Time (PT), Assay of serum glutamate oxaloacetate transaminase, alkaline phosphatase, Gamma-glutamyl transferase (GGT), Isoenzyme separation of LDH by electrophoresis.	15
III	Renal function test: Collection and Preservation of Urine sample Qualitative tests for normal and pathological components of urine. BUN: Estimation of blood Urea, creatinine, and uric acid. Urea Clearance test	15
IV	Estimation of blood glucose by orthotolidine and glucose oxidase method. Determination of glycosylated Hb. Glucose tolerance test. Lipid profile: Estimation of cholesterol by Zak's method, Lipoprotein profile, Estimation of ketone bodies, Estimation of triglycerides, free fatty acids and phospholipids.	15
V	Group Experiments Antigen – Antibody Reaction – HCG kit method , RA kit method Phlebotomy – Venipuncture, Different techniques of venipuncture Collection of blood ,Serum or Plasma separation and Storage Automation in Clinical Biochemistry – Autoanalyses, Semiautoanalyser	15
	Self-Study 1.Laboratory handling of human biological specimen 2.Automation in Clinical Biochemistry	
	TOTAL	75

Text Books

- ❖ Practical Clinical Biochemistry- Varley's by Alan H Gowenlock, published by CBS Publishers and distributors, India Sixth Edition ,1988.
- ❖ Manipal Manual of Clinical Biochemistry (For Med.Lab. And MSc Stud.) 2013 (4 Edition)

Reference Books

- ❖ Practical Biochemistry – Plummer, New Delhi: Tata Mcgraw Hill Publishing Company, 2000.
- ❖ Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005.
- ❖ Jayaraman, J (2011),laboratory Manual in Biochemistry, New age publishers

Web Resources

- ❖ https://www.researchgate.net/publication/260182512_Practical_Manual_in_Biochemistry_and_Clinical_Biochemistry
- ❖ https://main.icmr.nic.in/sites/default/files/upload_documents/GCLP_Guidelines

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	1	3	2	3
CO2	3	3	3	3	2	3	1	3	2	3
CO3	3	3	3	3	2	3	2	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Mapping With Programme Specific Outcomes :

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
weighted percentage of course contribution to Pos	3	3	3	3	3

Course coordinator

BOS Chairman

CORE ELECTIVE –V BIOSTATISTICS AND DATA SCIENCE

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBCE07	Core Elective-V	Theory	Y	-	-	3	3

Learning Objectives

- ❖ To summarize the data and to obtain its salient features from the vast mass of original data.
- ❖ To understand the concept of various measures of dispersion.
- ❖ To understand the concepts of sampling and learning tests of significance.
- ❖ To understand the concept of various attributes and relate to biological studies.
- ❖ To gain knowledge in SPSS, a software package which gives a perfect graphical representation and appropriate result for the data that has been entered.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Concepts of statistical population and sample, variables and attributes. Tabular and graphical representation of data based on variables.	PO1,PO2, PO3
CO2	Conditions for the consistency and criteria for the independence of data based on attributes. Measures of central tendency, Dispersion, Skewness and Kurtosis.	PO,PO2, PO4
CO3	Learning different sampling methods and amphibian statistical significance.	PO1,PO2, PO3,PO4
CO4	Understanding Student's t-test, ANOVA, Chi-square test to analyses the significance of various research.	PO1,PO2, PO3,PO4
CO5	Learning on data science, algorithm for machine learning, artificial intelligence and big data, their applications in clinical and pharma domain.	PO1,PO2, PO3, PO4,PO6

CORE ELECTIVE -V BIOSTATISTICS AND DATA SCIENCE

UNIT	DETAILS	No. of Hours
I	Nature of biological and clinical experiments – Collection of data in experiment- Primary and secondary data. Methods of data collection. Classification and tabulation. Different forms of diagrams and graphs related to biological studies. Measures of Averages- Mean, Median, and mode. Use of these measures in biological studies. Assignment writing: Methods of data collection.	09
II	Measures of Dispersion for biological characters – Quartile deviation, Mean deviation, Standard deviation and coefficient of variation. Measures of skewness and kurtosis. Correlation and regression – Rank correlation – Regression equation. Simple problems based on biochemical data. PPT Presentation: Correlation and regression.	09
III	Basic concepts of sampling- Simple random sample stratified sample and systemic sampling. Sampling distribution and standard error. Test of significance based on large samples. Test for mean, difference of means, proportions and equality of proportions.	09
IV	Small sample tests – Students t test for mean, difference of two way means, tests for correlation and regression coefficients. Chi-square test for goodness of a non independence of attributes. F test for equality of variances. ANOVA- one way and two way. Basic concept related to biological studies	09
V	Introduction to Data Science, Definition of data science, importance, and basic applications, Machine Learning Algorithms, Deep Learning, Artificial Neural Networks and their Application, Reinforcement Learning, Natural Language Processing Artificial Intelligence (AI), Data Visualization, Data Analysis, Optimization Techniques, Big Data, Predictive Analysis. Application of AI in medical, health and pharma industries.	09
	Self-Study 1. Simple problems on probability, theoretical distributions, hypothesis testing 2. Relationship between mean, median and mode pros and cons of the measures of central tendency and deviation	
	TOTAL	45

Note: Assignment Writing and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ Zar, J.H. (1984) —Bio Statistical Methods, Prentice Hall, International Edition
- ❖ Sundar Rao P. S.S., Jesudian G. & Richard J. (1987), —An Introduction to Biostatistics, 2nd edition, Prestographik, Vellore, India,.
- ❖ Warren, J; Gregory, E; Grant, R (2004), —Statistical Methods in Bioinformatics, 1st edition, Springer
- ❖ Milton, J.S. (1992), —Statistical methods in the Biological and Health Sciences, 2nd edition, McGraw Hill,

Web Resources

- ❖ https://www.ibm.com/docs/en/SSLVMB_28.0.0/pdf/Accessibility.pdf
- ❖ https://pure.tue.nl/ws/portalfiles/portal/19478370/20160419_CO_Mzolo.pdf
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5453888/>
- ❖ <https://home.ubalt.edu/ntsbarsh/excel/excel.htm>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	3	3	3	2	3	3	3
CO2	3	3	3	3	3	2	1	2	3	3
CO3	3	2	2	3	2	2	2	2	1	2
CO4	3	2	2	2	2	2	2	3	3	3
CO5	3	1	3	3	2	1	1	3	3	3

Mapping With Programme Specific Outcomes

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course coordinator

BOS Chairman

CORE ELECTIVE V - RESEARCH METHODOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBCE08	Core Elective-V	Theory	Y	-	-	3	3

Learning Objectives

- ❖ To summarize the data and to obtain its salient features from the vastmass of original data.
- ❖ To understand the concept of various measures of dispersion.
- ❖ To understand the concepts of sampling and learning test of significance.
- ❖ To understand the concept of various attributes and relate to biological studies.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Concepts of statistical population and sample, variables and attributes. Tabular and graphical representation of data based on variables	PO1,PO2, PO3,
CO2	Conditions for the consistency' and criteria for the independence of data based on attributes. Measures of central tendency, Dispersion, Skewness and Kurtosis.	PO1,PO2, PO3,
CO3	Learning different sampling methods and 67mphibian statistical significance.	PO1,PO2, PO3,PO4
CO4	Understanding students t test , ANOVA , Chi square test to analyse the significance of various research.	PO1,PO2, PO3,PO4,
CO5	Gain knowledge about concept, philosophical consideration and epistemology of science, ethical terms, principles and theories of bioethics	PO1,PO2, PO3,PO4

CORE ELECTIVE V - RESEARCH METHODOLOGY

UNIT	DETAILS	No. of Hours
I	Nature of biological and clinical experiments – Collection of data in experiment- Primary and secondary data. Methods of data collection. Classification and tabulation. Different forms of diagrams and graphs related to biological studies. Measures of Averages- Mean, Median, and mode. Use of these measures in biological studies. Measures of Dispersion for biological characters – Quartile deviation, Mean deviation, Standard deviation and coefficient of variation. Measures of skewness and kurtosis. Chart Preparation: Methods of data collection.	09
II	Correlation and regression – Rank correlation – Regression equation. Simple problems based on biochemical data. Basic concepts of sampling- Simple random sample stratified sample and systemic sampling. Sampling distribution and standard error. Test of significance based on large samples. Test for mean, difference of means, proportions and equality of proportions.	09
III	Small sample tests – Students' test for mean, difference of two way means, tests for correlation and regression coefficients. Chi- square test for goodness of a non independence of attributes. F test for equality of variances. ANOVA- one way and two way. Basic concept related to biological studies PPT Presentation: ANOVA.	09
IV	Meaning and significance of research, characteristics and types of research, the research process, features of good research study. Research applications. Research report – Structure and components of scientific reports, types of report, writing and documentation of research report, developing successful research proposals,	09
V	Research problem – components of research problem, formulation of research problem, Research Design – Classification of research designs, need for research design, features of good research design, experimental research design	09
	Self-Study 1. Simple problems on probability, theoretical distributions, hypothesis testing 2. Relationship between mean, median and mode pros and cons of the measures of central tendency and deviation	
	TOTAL	45

Note: Chart Preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Textbooks

- ❖ Zar, J.H. (1984) —Bio Statistical Methods, Prentice Hall, International Edition
- ❖ Sundar Rao P. S.S., Jesudian G. & Richard J. (1987), —An Introduction to Biostatistics, 2nd edition, Prestographik, Vellore, India,.
- ❖ Warren, J; Gregory, E; Grant, R (2004), —Statistical Methods in Bioinformatics, 1st edition, Springer
- ❖ Milton, J.S. (1992), —Statistical methods in the Biological and Health Sciences, 2nd edition, McGraw Hill,

Web Resources

- ❖ https://www.ibm.com/docs/en/SSLVMB_28.0.0/pdf/Accessibility.pdf
- ❖ https://pure.tue.nl/ws/portalfiles/portal/19478370/20160419_CO_Mzolo.pdf
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5453888/>
- ❖ <https://home.ubalt.edu/ntsbarsh/excel/excel.htm>
- ❖ https://students.shu.ac.uk/lits/it/documents/pdf/analysing_data_using_spss.pdf
- ❖ <https://www.ibm.com/support/pages/ibm-spss-statistics-28-documentation>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	2	0	0	2	3	2	2
CO2	0	0	0	3	0	0	2	2	2	0
CO3	0	0	0	3	0	0	3	3	2	2
CO4	0	0	0	3	0	0	3	2	2	0
CO5	0	0	0	3	0	0	3	2	2	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course coordinator

BOS Chairman

CORE ELECTIVE V – RECOMBINANT DNA TECHNOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBCE09	Core Elective-V	Theory	Y	-	-	3	3

Learning Objectives

- ❖ To understand the background of developmental biology
- ❖ To gain in-depth knowledge of various model organisms
- ❖ To gain insight into aspects of stem cell technology
- ❖ To gain insights into morphogenesis and organogenesis
- ❖ To acquire in-depth understanding of cell death mechanisms and cell fate decision

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Grasp knowledge about the background of developmental biology	PO1,PO2, PO3,
CO2	Gain abundant knowledge about model organisms and gametogenesis	PO1,PO2, PO3,
CO3	Gain knowledge about stem cells and their applications in regenerative therapy	PO1,PO2, PO3,PO4
CO4	Good knowledge about organogenesis	PO1,PO2, PO3,PO4,
CO5	Learn the basics of cell death mechanisms and cell fate decision	PO1,PO2, PO3,PO4

CORE ELECTIVE V -RECOMBINANT DNA TECHNOLOGY

UNIT	DETAILS	No.of Hours
I	Basic techniques: Cutting DNA molecules, Restriction digestion, isoschizomers, joining DNA molecules – DNA ligase, double linkers, adaptors, homopolymer tailing, selection of recombinants and screening – genetic methods, immuno chemical methods, South- Western screening, Nucleic acid hybridization methods, synthesis of probes, radio-active and non-radioactive labelling of probes, (Check techniques paper-repetition) Next Generation Sequencing, <i>in silico</i> sequence analysis, pulsed field gel electrophoresis. Assignment writing:Next Generation Sequencing	09
II	Cloning strategies: Cloning vectors – plasmids (pBR 322, pUC 18), phage and M 13, cosmids, phasmids, expression vectors, yeast vectors – YEP, YIP, YRP, YCP and YAC, Genomic DNA libraries, cDNA cloning, cDNA library. Inverse PCR, Hot start PCR, RACE, RAPD. Site directed mutagenesis of cloned genes.	09
III	Introduction of genes into animal cells: Reporter genes, selectable markers, viral vectors – SV 40, Retroviruses and Baculovirus, Adenoviruses, Transferring genes into animal cells in culture, oocytes, eggs, embryos and specific tissues, Gene knockout- transgenics and Genome editing.	09
IV	Agrobacterium and viruses mediated gene transfer. Ti plasmids-Co integrated vector, binary vector) and RI vector. Types of gene transfer methods in plants- Physical and Chemical methods. Transgenic plant technology – for pest resistance, herbicide tolerance, stress tolerance, delay of fruit ripening and produce commercially important proteins, resistance to fungi and bacteria.	09
V	Applications of recombinant DNA technology – gene therapy- in vivo, ex vivo and in situ gene therapy, vectors used in gene therapy, production of safe viral vectors for gene therapy, examples- gene therapy for SCID, successes, limitations and failures, antisense therapy, gene-directed enzyme prodrug therapy, production of insulin in <i>E. coli</i> . PPT Presentation: vectors used in gene therapy	09
	Self- study: Central dogma of Molecular biology	
	TOTAL	45

Note: Chart Preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Textbooks

- ❖ Gene Cloning and DNA Analysis: **Brown TA**; Blackwell Publishing;
- ❖ n Introduction to Genetic Engineering: **Old RW, Primrose SB**; Blackwell Science

Reference Books

- ❖ Principles of Gene Manipulation and Genomics: **Twyman RM, Primrose SB**; Blackwell Publishing;
- ❖ Molecular Cloning – A Laboratory Manual : **Sambrook J, Fritsch, EF , Maniatis T**; Cold Spring Harbor Lab Press

Web Resources

- ❖ Recombinant DNA
- ❖ <https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/recombinant-dna/>
- ❖ Biotechnology: Recombinant DNA and Gene Amplification
- ❖ <https://www.lecturio.com/magazine/recombinant-dna-and-gene-amplification/>
- ❖ Gene Therapy-Nature

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	2	0	0	2	3	2	2
CO2	0	0	0	3	0	0	2	2	2	0
CO3	0	0	0	3	0	0	3	3	2	2
CO4	0	0	0	3	0	0	3	2	2	0
CO5	0	0	0	3	0	0	3	2	2	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Course coordinator

BOS Chairman

CORE ELECTIVE –VI MOLECULAR BASIS OF DISEASES AND THERAPEUTIC STRATEGIES

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBCE10	Core Elective VI	Theory	Y	-	-	3	3

Learning Objectives

- ❖ To understand the concepts of the mechanisms involved in regulation of blood sugar and management of diabetes mellitus
- ❖ To gain in-depth knowledge of the mechanisms of cancer and of tumor metastasis
- ❖ The student will review the basic organization of the central and peripheral nervous system that coordinate the sensory and motor functions of the body. In addition, the student will explore impaired features underlying the major neuropathological complications.
- ❖ To gain knowledge in renal diseases
- ❖ To understand the mechanisms involved in cardiac disorders

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Overall view about the complications of diabetes mellitus and its management.	PO1,PO2, PO7,PO10
CO2	Comprehensive understanding of the concepts of cancer biology and implicating the theoretical concepts for further Research	PO2,PO3, PO4,PO7
CO3	Understand and appreciate the pathophysiology of conditions affecting the nervous system.	PO1,PO2, PO3, PO4, PO7
CO4	A thorough knowledge of renal and cardiac diseases with emphasis related to mechanistic aspects and therapeutic interventions.	PO1,PO2, PO3, PO4, PO7
CO5	A thorough knowledge on the experimental models of non-communicable diseases that will be applied for future research or project dissertation. An in- depth knowledge on development of drugs against non-communicable diseases.	PO1, PO2, PO 5

CORE ELECTIVE –VI MOLECULAR BASIS OF DISEASES AND THERAPEUTIC STRATEGIES

UNIT	DETAILS	No. of Hours
I	Mechanism of blood sugar regulation in human body. Pathophysiology of Type I and II diabetes, Diabetes – investigation methods for the diagnosis of diabetes. Nutritional care. Complications related to diabetes – Diabetic cardiovascular disease, retinopathy, neuropathy and nephropathy. Cellular and molecular mechanism of development of diabetes- Management of Type I and Type II diabetes, drugs for the treatment of diabetes. Assignment writing: Diabetes.	09
II	Biology of cancer: Overview of hallmarks of cancer. Tumorigenesis, Tumor progression and mechanism of Metastasis. Proto-oncogene to oncogene. Oncogene- myc and src family. Tumor suppressor gene-Rb and p53 pathway in cancer. Diagnosis- Non- invasive imaging techniques, Tumor diagnosis, Interventional radiology, New imaging technique, Molecular techniques in cancer diagnosis.- treatment of cancer- surgery, radiotherapy, chemotherapy, hormonal treatment, and biological therapy. Introduction to personalized medicine.	09
III	Brain- neuronal network- memory- Neurodegenerative diseases- Parkinson and Alzheimer Disease- molecular understanding of the neurodegenerative diseases- treatment modalities. Model preparation: Brain- neuronal network.	09
IV	Acute and chronic renal failure, glomerular diseases– Glomerulonephritis, nephritic syndrome, diabetes insipidus, diagnosis of kidney disease.	09
V	Introduction to cardiovascular diseases, Lipids and lipoproteins in coronary heart disease-cardiac enzymes, Molecular changes during cardiac remodeling – hypertrophy of hearts – heart failure- treatment modalities.	09
	TOTAL	45

Note: Report writing and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ Wills' Biochemical Basis of Medicine: 2nd edition, Thomas H, Gillham B; Elsevier
- ❖ Molecular Biochemistry of Human Diseases, 2021, Feuer G, de la Iglesia F; CRC Press

Reference Books

- ❖ The Biochemical basis of disease: 2018, Barr AJ; Portland Press Biochemical Basis of Diseases

Web Resources

- ❖ <https://www.biologydiscussion.com/diseases-2/biochemical-basis-of-diseases/44276>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	2	3	3	3	3
CO2	3	3	3	1	2	2	3	3	3	3
CO3	3	2	2	2	3	2	3	3	3	2
CO4	3	2	2	1	3	1	3	3	3	2
CO5	3	3	3	1	3	2	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
weighted percentage of course contribution to Pos	3	3	3	3	3

Course coordinator

BOS Chairman

ELECTIVE –VI CLINICAL LABORATORY TECHNIQUES

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBCE11	Core Elective-VI	Theory	Y	-	-	3	3

Learning Objectives

- ❖ The Course focuses the students to gain knowledge about the routine clinical techniques in medical laboratories
- ❖ To gain knowledge on analysis of biological samples for the diagnosis of diseases

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Explain about the laboratory safety, hazards in clinical laboratories	PO1,PO2,
CO2	Describe the methods of analysis of blood.	PO2,PO3,
CO3	Illustrate the various blood grouping systems, complications in blood transfusion, methods in collection and storage of blood in blood banks	PO1,PO2, PO3,PO4,
CO4	Handle and examine biological samples like urine and stools	PO1,PO2,
CO5	Describe the analysis of Sputum and Semen	PO1,PO2,

ELECTIVE –VI CLINICAL LABORATORY TECHNIQUES

UNIT	DETAILS	No. of Hours
I	Clinical laboratory standards and Basic laboratory safety, hazards in the clinical laboratory. Specimen processing: blood – Phlebotomy, Methods of collection, Anticoagulants – EDTA, Double oxalate, Sodium citrate, Sodium fluoride, Potassium oxalate, Heparin. Preparation of serum and protein free filtrate Field visit: Clinical lab	09
II	Blood: Difference between serum and plasma. Blood cell count: TC – Haemocytometry, DC, Platelet count. Estimation of Hemoglobin – Sahli's Method, Cyan met Haemoglobin method, PCV – Microhaematocrit method. ESR – Westergren's method, bleeding time – Duke's method. Clotting time – Capillary tube method. Clinical interpretation of haematological tests – Anemia, polycythemia and leukemia,	09
III	Human blood group system: ABO, sub groups of ABO, variants of ABO and Rh blood group system. Blood transfusion: Definition and clinical significance. Complications, Blood banking: Blood collection – Screening of donor. Criteria for rejecting donor. Blood collection procedure. Transportation of blood. Storage of blood and changes in the stored blood Hands on training: Human blood group system.	09
IV	Urine analysis: Urine – Methods of collection. Storage – Preservatives. Gross examination of urine, chemical examination of urine. Reducing sugar, Protein, ketone bodies, bile salts and bile pigments Stool examination – Specimen collection, Physical & chemical examination, Test for Occult, Microscopic examination of stool. PPT: presentation: Urine analysis.	09
V	Sputum Analysis: Specimen collection, macroscopic examination – Color, Volume, Odour. Microscopic examination. Semen Analysis: Collection, Gross examination, Microscopic examination, Chemical examination of semen.	09
	Self- study: Basic laboratory safety	
	TOTAL	45

Note: Report Writing on Field Visit, Hands on training and PPT presentation related to the above topics are considered to be Internal Exam Only.

Textbooks

- ❖ Kanai.L. Mukherjee. 2005. Medical Laboratory Technology, Volume III. Tata McGraw- Hill Publishing Co. New Delhi.
- ❖ Ramnik Sood. 2006. Medical Laboratory Technology. Jaypee Brothers Medical Publishers Ltd., New Delhi.

Reference books

- ❖ Harold Varley, Practical Clinical Biochemistry, CBS. 6 edition, 2006.

Web Resources

- ❖ <https://www.youtube.com/watch?v=QNYIX5Ne9lQ>
- ❖ <https://www.slideshare.net/doctorrao/agglutination-tests-and-immunoassays>
- ❖ <https://microbenotes.com/introduction-to-precipitation-reaction/>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	3	3	3	2	3	3
CO2	3	2	3	3	2	3	3	2	2	2
CO3	3	2	1	3	2	2	3	3	2	3
CO4	2	2	3	3	1	1	3	2	3	2
CO5	3	3	2	3	3	2	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Course coordinator

BOS Chairman

CORE ELECTIVE VI – CONCEPTS IN NEUROCHEMISTRY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBCE12	Core Elective-VI	Theory	Y	-	-	3	3

Learning Objectives

- ❖ To introduce basic concepts about the organization, structure, and function of the human central nervous system.
- ❖ To enable students to apply these fundamental principles toward understanding nervous system function and dysfunction.
- ❖ Clinical problem-solving in relation to disorders that affect the nervous system, with emphasis on the central nervous system.
- ❖ Neuroscience is a stand-alone course but it is expected that students have a basic understanding of human anatomy and physiology and the basic vocabulary of the anatomical sciences.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To have in depth insight in basic brain structure and Function reaching from the molecular to systems level.	PO1,PO2, PO3,
CO2	To understand how neural systems contribute to sensory experiences, thoughts, emotions, behavior.	PO1,PO2, PO3,
CO3	To apply and adopt experimental methods to gain new knowledge.	PO1,PO2, PO3,PO4
CO4	Good knowledge about neuroscience.	PO1,PO2, PO3,PO4,
CO5	Learn the basics of neurons and mechanism of nervous system.	PO1,PO2, PO3,PO4

CORE ELECTIVE VI - CONCEPTS IN NEUROCHEMISTRY

UNIT	DETAILS	No. of Hours
I	CNS OVERVIEW Introduction to the Brain; Overview of brain systems and general principles of their functional organization: From cortical maps and subcortical loops to the micro-structure of brain circuits and their interconnections. CNS Organization; CNS Topography; Neuroembryology. VASCULATURE: Metabolism, Cerebral blood flow, CSF; Blood Supply; Stroke. Assignment writing: subcortical loops to the micro-structure of brain circuits	09
II	CELL BIOLOGY OF NEURONS AND GLIA Nucleus and gene expression and regulation, Protein synthesis & translational control (including RNAi), Protein sorting & trafficking (signal peptides, Golgi, secretory and endocytic pathways), Cytoskeleton & transport (cytoskeleton, actin, microtubules, intermediate filaments, dendritic and axonal localization/transport, motors and adaptor), Signaling Pathways. Mitochondria, energy homeostasis and free radicals/energy metabolism in the neuron, Overview of glial cell biology & myelination (types of glia, morphology and function, myelination in CNS and PNS). Chart preparation: Secretory and endocytic pathway	09
III	ELECTRICAL PROPERTIES OF NEURONS Overview of membrane structure & membrane transport, membrane potential, Ion channels and Ion Channel activity (electrochemical gradient), Action potentials, Propagation of action potentials along axons, Modulating action potential, Electrophysiological techniques for studying action potentials and ion channels.	09
IV	TRANSMISSION potentials:- Resting potential; Excitatory; Inhibitory; Threshold; Depolarization; Hyperpolarization; Synapse: Formation; Synaptic communication; Neural circuits, synaptic plasticity: LTP/LTD, Spike Time dependent plasticity. Mechanism of neurotransmitter release, postsynaptic response: electronic properties of dendrites, basic integration, Ionotropic, metabotropic receptors	09
V	TRAUMA AND DISEASE Development diseases; Degenerative disorders; Psychiatric disorders; Injury disorders; Other like Epilepsy; Visual pathways; Ocular movements; Vascular syndromes; Sensory and motor syndrome. PPT Presentation: Degenerative disorders	09
	Self- study: Overview of nervous system development/comparative embryology	
	TOTAL	45

Note: Chart Preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Textbooks

- ❖ J. W. Baynes, M. H. Dominiczak, Medical Biochemistry, 2nd ed., Elsevier Mosby, Philadelphia, New York, Toronto, 2005.
- ❖ G. Siegel, R. W. Albess, S. Brady, D. Price, Basic Neurochemistry, 7th Edition, Amsterdam, Tokio, 2006.
- ❖ George J. Siegel, MD, Editor-in-Chief, Bernard W. Agranoff, MD, R. Wayne Albers, PhD, Stephen K. Fisher, PhD, and Michael D. Uhler, PhD. Basic Neurochemistry, 6th edition, Philadelphia: Lippincott-Raven; 1999.
- ❖ Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony-Samuel LaMantia, James O. McNamara, S. Mark Williams. Neuroscience, third edition, Publishers Sunderland, Massachusetts, U.S.A., 2004.
- ❖ Siegel, George and R. Wayne Albers, Scott Brady and Donald Price. Basic Neurochemistry, 7th edition: Molecular, Cellular and Medical Aspects, Academic Press/2005.
- ❖ Haines, Duane. Neuroanatomy - An Atlas of Structures, Sections and Systems, 5th edition, Lippincott Williams and Wilkins/2000.

Reference Books

- ❖ Afifi and Bergman, Functional Neuroanatomy, Text and Atlas, McGrawHill, 2nd Edition, 2005.
- ❖ Haines, Neuroanatomy: An Atlas of Structures, Sections and Systems, 7th ed. Ed. Lippincott William and Wilkins, 2007.
- ❖ Blumenfeld, Neuroanatomy Through Clinical Cases (Paperback), Sinauer Associates; 2nd edition (2010)

Web Resources

- ❖ <http://hdl.library.upenn.edu/1017.12/927914>
- ❖ https://nu.kz.libguides.com/neuroscience_guide
- ❖ <https://guides.library.uq.edu.au/neuroscience>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	2	0	0	2	3	2	2
CO2	0	0	0	3	0	0	2	2	2	0
CO3	0	0	0	3	0	0	3	3	2	2
CO4	0	0	0	3	0	0	3	2	2	0
CO5	0	0	0	3	0	0	3	2	2	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course, Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course coordinator

BOS Chairman

SEMESTER IV

CORE X – PHARMACEUTICAL BIOCHEMISTRY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S4PBC10	Core X	Theory	Y	-	-	6	4

Learning Objectives

- ❖ To understand the different types of bioinformatic tools for drug discovery.
- ❖ To get an overview of how different bioinformatic tools aid in the process of target identification, drug screening and quantitative structure activity relationship.
- ❖ To assimilate the involvement of different metabolic pathways involved in drug metabolism and correlate their involvement in elimination process
- ❖ To understand the biochemical basis of drug action at the target tissue.
- ❖ To understand different phases in drug clinical trials and its assessment.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To understand and explain the basic concepts of drug discovery and drug development process.	PO1,PO2, PO7
CO2	To review the different software and computational tools which aid in the design of drugs and its rationalization.	PO1,PO2, PO3,PO4,
CO3	To analyze the different stages of the drug discovery process with the target & hit identification, assays for drug screening and preclinical studies	PO1,PO2, PO3,PO4
CO4	To understand the various phases of the clinical trails and the method of conduct of clinical trails.	PO1,PO2, PO7,PO10
CO5	Highlight the clinical trials	PO1,PO2, PO3

CORE X – PHARMACEUTICAL BIOCHEMISTRY

UNIT	DETAILS	No. of Hours
I	Drug discovery and development, drug target identification and validation, Hit identification, General principles of screening, correlations between various animal models and human situations, Correlation between in-vitro and in-vivo screens; Special emphasis on cell-based assay, biochemical assay, radiological binding assay, Pharmacological assay, In vitro, In vivo & Ex-vivo experiments, lead optimization, preclinical studies. PPT Presentation: Drug discovery and development.	18
II	Bioinformatics approaches for drug development: Identification of potential molecules, chemical compound library preparation, Identification of target in pathogen, Ligand & protein preparation, Molecular docking, Binding free energy estimation, High throughput virtual screening, Docking protocol validation and enrichment analysis, Single point energy calculation, Pharmacokinetics and Pharmacodynamics, ADME & toxicity prediction, Molecular dynamic simulation, Rule of three and five, Lipinsky rule, Pharmacophore development, Quantitative structure activity relationship, 3D- QSAR, Techniques of developing a pharmacophore map covering both ligand based and receptor based approaches.	18
III	Drug metabolism & interactions: Drug-receptor interactions, receptor theories and drug action, Xenobiotics, xenobiotics phases (Phase-I, Phase-II and Phase-III), role of cytochrome P450 oxidases and glutathione S-transferases in drug metabolism, factors affecting drug metabolism, Enzymes as a drug target, Kinase inhibitors, ATPase inhibitors, drug protein interaction, DrugDNA interaction. Basic ligand concepts- agonist, antagonist, partial agonist, inverse agonist, efficiency and potency. Forces involved in drug-receptor complexes. Receptor classification – the four super families. Receptor binding assays- measurement of K _d , B _{max} and IC ₅₀ . Assignment writing: Xenobiotics, xenobiotics phases (Phase-I, Phase-II and Phase-III).	18
IV	Biochemical mode of action of antibiotics- penicillin and chloramphenicol, actions of alkaloids, antiviral and antimalarial substances. Biochemical mechanism of drug resistance- sulphonamides. Drug potency and drug efficacy. General principles of chemotherapy: chemotherapy of parasitic infections, fungal infections, viral diseases. Introduction to immunomodulators and chemotherapy of cancer.	18
V	Clinical trials (Phase-I, Phase-II, Phase-III and Phase-IV clinical trial). Main features of clinical trials, including methodological and organizational considerations and the principles of trial conduct and reporting. Key designs surrounding design, sample size, delivery and assessment of clinical trials.	18
	Self- study: Examples of pharmaceutical development of a drug Basic pharmacology of drug action and kinetics	

	TOTAL	90
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Note: Assignment Writing and PPT presentation related to the above topics are considered to be Internal Exam Only.

Textbooks

- ❖ Textbook of Drug Design. Krogsgaard-Larsen, Liljefors and Madsen (Editors), Taylor and Francis, London UK, 2002.
- ❖ Drug Discovery Handbook S.C. Gad (Editor) Wiley-Interscience Hoboken USA, 2005

Reference Book

- ❖ Practical Application of Computer-Aided Drug Design, Ed. Charifson P., Marcel Dekker Inc.
- ❖ 3D QSAR in Drug Design: Theory, Methods and Applications, Ed. Kubinyi H., Ledien
- ❖ Pharmaceutical Profiling in Drug Discovery for Lead Selection, Borchardt RT, Kerns, EH, Lipinski CA, Thakker DR and Wang B, AAPS Press, 2004
- ❖ Pharmacology in Drug Discovery. T. P. Kenakin. Elsevier, 1st Edition 2012.

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	1	2	3	1	3	3	2
CO2	3	3	3	3	2	2	1	3	3	3
CO3	3	3	3	3	2	2	2	3	3	3
CO4	3	3	3	3	2	2	2	3	3	3
CO5	3	3	3	3	2	1	2	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course coordinator

BOS Chairman

CORE XI – BIOCHEMICAL TOXICOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S4PBC11	Core-XI	Theory	Y	-	-	6	4

Learning Objectives

- ❖ To understand the detailed study of biochemical basis of drugs and its toxicity, particularly their actions on living systems.
- ❖ To understand the relevance and methods to identify the chemotherapeutic value of drug.
- ❖ To understand the fundamentals of toxicology and dose-response relationships.
- ❖ To understand the toxicological drug testing procedures based on in vitro and animal studies
- ❖ To understand biochemical pathways of drug toxicity and its manifestation on vital organs.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To appreciate and understand the role of toxicological biomarkers to assess drug toxicities.	PO1,PO2, PO5
CO2	To conceive the role of disposition of drug in human system and their metabolism and methodologies pertaining to toxicological studies.	PO1,PO2, PO3
CO3	To understand and evaluate the functions of different organs on drug disposition and associated drug toxicities.	PO1,PO2, PO4
CO4	To understand the toxicological response to foreign compounds and their pharmacological, physiological and biochemical effects.	PO1,PO2, PO3
CO5	To link the mechanism of toxicity and clinical symptoms with underlying physiological disturbances.	PO1,PO2, PO4,PO5

CORE XI – BIOCHEMICAL TOXICOLOGY

UNIT	DETAILS	No. of Hours
I	Fundamentals of Toxicology and dose-Response Relationships: Introduction, Biomarkers Criteria of Toxicity, Evaluation of Toxicity Interactions; Dose Response; Measurement of Dose- Response; Relationships Linear Dose Response, Hormesis; Hazard and Risk Assessment, Duration and Frequency of Exposure and Effect. PPT Presentation: Dose Response; Measurement of Dose- Response.	18
II	Factors Affecting Toxic Responses: Disposition: Absorption ,Sites of absorption, distribution, Excretion; Metabolism: types of Metabolic change phase I reactions; Phase 2 reactions; control of Metabolism, Toxication Vs. Detoxication	18
III	Toxicity testing; Test protocol, Genetic toxicity testing & Mutagenesis assay: In vitro test systems: bacterial mutation tests- Reversion test, Ames test, Fluctuation test, and Eukaryotic mutation test. In vivo test system Mammalian mutation test- Host mediated assay and Dominant Lethal test. Biochemical basis of toxicity: Mechanism of toxicity: Disturbance of excitable membrane function, Altered Calcium homeostasis, Covalent binding to cellular macromolecules & genotoxicity, Tissue specific toxicity. Assignment Writing: Genetic toxicity testing & Mutagenesis assay.	18
IV	Toxic Responses to Foreign Compounds: Direct Toxic Action: Tissue Lesions; Mechanism and response in cellular toxicity, pharmacological, physiological and Biochemical effects; Developmental Toxicology- Teratogenesis; Immunotoxicity Genetic Toxicity; Chemical Carcinogenesis	18
V	Biosynthesis and degradation of heme. Oxidation and reduction of inorganic sulphur compounds by microbes and plants. Sulpho transferases and their biological role-rhodanases, sulphatases, 3- mercapto pyruvate sulphur transferases. Oxidation of cysteine to sulphate and inter conversion of sulphur compounds.	18
	Self- study: 1. Cori's Cycle and Glucose- Alanine Cycle 2. Coenzymes involved in Methanogenesis	
	TOTAL	90

Note: Report writing and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Textbooks

- ❖ Principles Of Toxicology by: Karen E Stine, Thomas M Brown 2006 Publisher. Crc Press
- ❖ Principles of Biochemical Toxicology by John A. Timbrell Publisher: Informa Healthcare
- ❖ Environmental Toxicology by Sigmund F. Zakrzewski, (2002) Publisher: Oxford University Press, USA

Reference Book

- ❖ Preclinical Safety Evaluation of Biopharmaceuticals: A Science-Based Approach to Facilitating Clinical Trials by Joy A. Cavagnaro
- ❖ A Comprehensive Guide to Toxicology in Nonclinical Drug Development 2nd Edition by Ali S. Faqi

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	2	3	3	3	2
CO2	3	2	3	3	3	2	3	3	3	2
CO3	3	2	3	3	3	2	3	3	3	3
CO4	3	2	3	2	3	2	3	3	3	2
CO5	3	2	3	3	3	2	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Course coordinator

BOS Chairman

CORE ELECTIVE VII– BIOSAFETY, LAB SAFETY AND IPR

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S2PBCE13	Core Elective –VII	Theory	Y	-	-	3	3

Learning Objectives

- ❖ To assimilate the hazards associated with the handling of biological and chemical agents.
- ❖ To understand how to protect from the hazards by the implementation of various safety measures in biochemical laboratories.
- ❖ To implicate the importance of protecting the scientific intellect by filing patent and understanding the various offices for filing and maintaining patents
- ❖ To understand the scope of patenting in biological research.
- ❖ To create an awareness of ethics associated with used of genetically modified organisms/cells and its rationale for use in living organisms.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To understand and implement various aspects of biosafety and carry out risk assessment of products in biological research	PO1,PO2 , PO3
CO2	Understand the basic concepts of ethics and safety that are essential for different disciplines of science and procedures involved and protection of intellectual property and related rights.	PO1,PO2, PO3
CO3	To appreciate the intellectual property rights and its implementation of on the invention related to biological research.	PO1,PO2, PO4
CO4	To understand the statutory bodies that regulate the property rights and its validity in various countries.	PO1,PO2, PO3,
CO5	Critique the ethical concerns associated with modern biotechnology processes and plan accordingly.	PO1,PO2, PO4,PO5

CORE ELECTIVE VII– BIOSAFETY, LAB SAFETY AND IPR

UNIT	DETAILS	No. of Hours
I	Biosafety: Introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; recommended biosafety levels for infectious agents and infected animals; biosafety guidelines – government of India, roles of IBSC, RCGM, GEAC etc. for GMO applications in food and agriculture; environmental release of GMOs; risk assessment. PPT Presentation: GMO applications in food and agriculture.	09
II	Laboratory safety – Chemical, electrical and fire hazards; handling and manipulating human or animal cells and tissues, toxic, corrosive or mutagenic solvents and reagents; mouth pipetting, and inhalation exposures to infectious aerosols, Safe handling of syringe needles or other contaminated sharps, spills and splashes onto skin and mucous membranes. Health aspects; toxicology, allergenicity, antibiotic resistance. Personal protective equipment, Laboratory facilities and safety equipment, Disinfection, decontamination, and sterilization, Regulatory compliance, Laboratory security and emergency response and administrative controls. Demonstration performance: Safe handling of syringe needles or other contaminated sharps.	09
III	Intellectual Property Rights (IPR): Introduction to patents, types of patents, process involved in patenting in India, trademarks, copyright, industrial design, trade secrets, traditional knowledge, geographical indications, history of national and international treaties and conventions on patents, WTO, GATT, WIPO, Budapest Treaty, Patent Cooperation Treaty (PCT) and TRIPS. Patent databases: Searching international databases; analysis and report formation. Indian Patent Act 1970; recent amendments; filing of a patent application; precautions before patenting disclosure/non-disclosure; procedure for filing a PCT application.	09
IV	Patent filing and infringement: Patent application- forms and guidelines, fee structure, time frames; types of patent applications: provisional and complete specifications; PCT and convention patent applications, international patenting- requirement, financial assistance for patenting-introduction to existing schemes; Publication of patents- gazette of India. Research Patenting: Patenting by researchers and scientists-University/organizational rules in India and abroad. Detailed information on patenting biological products, Case studies on patents (basmati rice, turmeric, neem etc.), and patent infringement.	09
V	Bioethics: Introduction to bioethics, human genome project and its ethical issues, genetic manipulations and their ethical issues, ethical issues in GMOs, foods and crops in developed and developing countries, environmental release of GMOs, ethical issues involved in stem cell research and use, use of animals in research experiments, animal cloning, human cloning and their ethical aspects, testing of drugs on human volunteers.	09
	Self-Study Review of drug patent documents Safety in biological research laboratories	
	TOTAL	45

Note: Demonstration Preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ Biosafety in Microbiological and Biomedical Laboratories, (2020) 6th Ed.
- ❖ Kankanala C., (2007), Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd.,

Reference Books

- ❖ V. Shree Krishna, (2007). Bioethics and Biosafety in Biotechnology, New Age International Pvt. Ltd. Publishers. (Unit III, Unit IV and Unit V)
- ❖ Deepa Goel, Shomini Parashar, (2013). IPR, Biosafety and Bioethics, Pearson. (Unit II)

Web Resources

- ❖ https://www.cdc.gov/labs/pdf/SF19_308133-A_BMBL6_00-BOOK-WEB-final3.pdf

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	3	3	3	2	2	3
CO2	3	2	3	2	3	3	3	2	2	2
CO3	3	3	3	3	3	2	3	3	2	2
CO4	3	2	2	2	3	2	3	3	3	2
CO5	3	2	3	2	3	3	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course coordinato

BOS Chairman

CORE ELECTIVE VII- CANCER BIOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S4PBCE14	Core Elective-VII	Practical	-	-	Y	3	3

Learning Objectives

- ❖ To understand the genetic basis of cancer.
- ❖ To understand the disease processes involved in malignancy.

Course Outcomes Mapping With Program Outcome		
Course Outcomes	On completion of this course, students will;	Programme Outcomes
CO1	To understand cell signal transduction pathways	PO1,PO2, PO4
CO2	To comprehend the concepts of apoptosis	PO1,PO2, PO4
CO3	To know the process of carcinogenesis	PO1,PO3, PO4
CO4	To aware of carcinogens.	PO1,PO3, PO4,
CO5	To understand the functions of tumor suppressor genes	PO1,PO2, PO3,PO4,

CORE ELECTIVE II- CANCER BIOLOGY

UNIT	DETAILS	No. of Hours
I	Cell signaling; Extra cellular signal molecules, Cell surface receptor proteins- Ion channel linked receptors, G-Protein coupled receptors, and Enzyme linked receptors. Signal transduction; RTK-Ras dependent pathway, RTK-Ras independent pathway, MAP kinase pathways.	09
II	Overview of cell cycle, check points in cell cycle, Regulation of cell cycle Programmed cell death or Apoptosis: mechanism, regulation, pro- apoptotic regulators. Model Preparation: Cell cycle.	09
III	Introduction to cancer, Differences between normal cell and cancer cell, Cytological changes, Molecular changes and genetic changes in cancer cell. Onset of cancer: Carcinogenesis- initiation, promotion and progression, Tumor micro environment influence cancer development, Angiogenesis	09
IV	Causes of cancer- physical and chemical carcinogens. Oncogenes, viral oncogenes, activation of proto oncogenes. PPT Presentation: physical and chemical carcinogens.	09
V	Tumor suppressor genes- Rb, p53, BCL2 and BRCA2. Loss of heterozygosity, Tumor markers.	09
	TOTAL	45

Note: Model Preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Textbooks

- ❖ The Cell – A Molecular Approach, Geoffrey M. Cooper and Robert ausman, sixth edition, 2013
- ❖ Cell Biology, Veer Bala Rastogi, MedTech Science Press.

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	1	3	2	3
CO2	3	3	3	3	2	3	1	3	2	3
CO3	3	3	3	3	2	3	2	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to POs	3	3	3	3	3

Course coordinator

BOS Chairman

CORE ELECTIVE VII –NANOTECHNOLOGY IN HEALTH SCIENCE

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBCE15	Core Elective-VII	Theory	Y	-	-	3	3

Learning Objectives

- ❖ The course provides over view of the distinctive features of nanotechnology and their application to health science and technology. It includes active participation of student in class room through in-depth discussion sessions, presentation and a group projects.
- ❖ Aim to cater students from different disciplines to understand the interdisciplinary nature of science.
- ❖ Aims to provide knowledge and recent development in nanotechnology in regenerative medicine.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Understand the concepts begin usage of nanomaterials in health science.	PO1,PO2, PO3,
CO2	Describe structure and function of nanomaterials.	PO1,PO2, PO3,
CO3	Understand and account for the design strategies and nano- scale phenomenon nanomedicine	PO1,PO2, PO3,PO4
CO4	Explain strategies behind drug development and its mode of action	PO1,PO2, PO3,PO4,
CO5	Understand and describe the design and function of nano-carriers for drug and gene delivery	PO1,PO2, PO3,PO4

CORE ELECTIVE VII – NANOTECHNOLOGY IN HEALTH SCIENCE

UNIT	DETAILS	No. of Hours
I	Basics of Biomaterial Science Introduction of biomaterials science-Definition and classification of biomaterials-metals, ceramics, polymers and nanocomposites- Properties of biomaterials (Physical-Chemical-Biological- Mechanical-Electrochemical properties) - Nano-scale phenomena in biomaterials-Smart gels and their properties. Assignment writing: Nano-scale phenomena in biomaterials	09
II	Materials for Bone and Dentistry Materials in Orthopedics: Structure and composition of bone- Conventional materials for orthopedics-Orthopedic nanomaterials- Biological properties of bone grafts-Alloplastic materials-Bone stabilizers-Artificial implant devices-Implant failure. Dental materials: Dental anatomy-Characteristics of oral environment - Classification of dental restorative materials - Bonding agents-Principles of adhesion-Resins-Dental ceramics-Cements- Glass ionomers-Dental implant devices.	09
III	Nanobiomaterials and Tissue Engineering Principles of tissue engineering-Hard and soft tissue engineering-Nanobiomaterials for artificial cells-Scaffolds for tissue engineering-Materials-Fabrication techniques-Synthetic matrices for bladder reconstruction; Nanoparticles-Magnetic nano beads-Artificial skin; Composite grafts-Skin substitutes-Construction of small blood vessel; Production of retrovirus-Collagen gel scaffolds- Silicone materials; Breast and genital implants. Poster Making: Magnetic nano beads	09
IV	Basics of Nanomedicines Concept of nanomedicines-Rationale for designing of nanomedicines-Nano-structures in nanomedicines-transport of nanoparticles across the biological barriers, parameters affecting binding and uptake of nanoparticles-size, shape, surface charge, protein corona, surface modification-Clinical translation of nanomedicines: Preclinical and clinical considerations of nanomedicines-Regulation of nanomedicines.	09
V	Regenerative Medicine Introduction to regenerative medicine-Methods of cell based therapy-Stem cells-Molecular and cellular based of organ development-Therapeutic uses of stem cells-Molecular bases of disease-Bio-artificial organs; Artificial pancreas-Liver-Ear-Heart- Ethics-Current issues in patent law-From concept to market (Regenerative products).	09
	Self- study: Bioavailability of Nano carrier drugs and their applications	
	TOTAL	45

Note: Assignment, Poster making and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Textbooks

- ❖ Biomaterial science an introduction to materials in medicine, Buddy D. Ratner, Allans S. Hoffman, Frederick J. Schoen, Jack E. Lemons, **2004, ISBN: 0-12- 582463-7.**
- ❖ Biomechanics and Biomaterials in Orthopedics, Dominique G. Poitout, 2nd edition, Springer, **2004, ISBN: 978-1-84882-663-2.**
- ❖ Advanced Dental Biomaterials, Zohaib Khurshid Shariq Najeeb Muhammad Sohail Zafar Farshid Sefat, 1st edition, 2019, **ISBN: 9780081024768.**

Reference Books

- ❖ Biomaterials, Sujata V. Bhat, Alpha Science International, **2005, ISBN: 1842652079.**
- ❖ Nanobiomaterials in Soft Tissue Engineering, Alexandru Mihai Grumezescu, Volume 4, **2016, 978-0-323-42865-1.**

Web Resources

- ❖ <https://ocw.mit.edu>
- ❖ <https://chalmers.instructure.com>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	2	0	0	2	3	2	2
CO2	0	0	0	3	0	0	2	2	2	0
CO3	0	0	0	3	0	0	3	3	2	2
CO4	0	0	0	3	0	0	3	2	2	0
CO5	0	0	0	3	0	0	3	2	2	0

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to POs	3	3	3	3	3

Course coordinator

BOS Chairman

CORE ELECTIVE VIII- DEVELOPMENTAL BIOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S4PBCE16	Core Elective-VIII	Theory	Y	-	-	3	3

Learning Objectives

- ❖ The candidates undertaking this course will understand the concepts of developmental biology.
- ❖ To understand the background of developmental biology
- ❖ To gain in-depth knowledge of various model organisms
- ❖ To gain insight into aspects of stem cell technology
- ❖ To gain insights into morphogenesis and amphibian development
- ❖ To acquire in-depth understanding of cell death mechanisms and cell fate decision

Course Outcomes		
Course Outcomes	On completion of this course, students will be able to	Programme Outcomes
CO1	Grasp knowledge about the background of developmental biology	PO1,PO2, PO3,PO4
CO2	Gain abundant knowledge about model organisms and gametogenesis	PO1,PO2, PO5,PO10
CO3	Gain knowledge about stem cells and their applications in regenerative therapy	PO1,PO2,
CO4	Good knowledge about organogenesis	PO1,PO3, PO4,
CO5	Learn the basics of cell death mechanisms and cell fate decision.	PO1,PO3, PO4,

CORE ELECTIVE –VIII DEVELOPMENTAL BIOLOGY

UNIT	DETAILS	No. of Hours
I	Overview of Developmental biology: Background of Developmental biology – Principles of developmental biology –Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development. Assignment writing: Background of Developmental biology.	09
II	Model organisms: Gametogenesis – production of gametes, Formation of zygote, fertilization and early development: molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination. <i>Drosophila</i> Developmental biology- Axis formation, Genes & mutation. <i>C.elegans</i> – Vulva formation, Axis formation.	09
III	Regeneration Developmental Biology Stem cells – Definition, Classification, Embryonic and adult stem cells, properties, identification, Culture of stem cells, Differentiation and dedifferentiation, Stem cell markers, techniques and their applications in modern clinical sciences. Three- dimensional culture and transplantation of engineered cells. Tissue engineering – skin, bone and neuronal tissues.	09
IV	Morphogenesis & Organogenesis: Cell aggregation and differentiation in <i>Dictyostelium</i> ; axes and pattern formation in <i>Drosophila</i> , amphibian and chick; organogenesis – vulva formation in <i>Caenorhabditis elegans</i> , eye lens formation, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.	09
V	Cellular senescence and Cell fate decision Cellular senescence – concepts & Frizzled receptor in Development and disease. Diabetes and developmental biology, Cell death pathways in developments. Markers of important diseases. PPT Presentation: Markers of important diseases.	09
	TOTAL	45

Note: Assignment writing and PPT Presentation related to the above topics are considered to be Internal Exam Only

Textbooks

- ❖ Developmental biology: VIII edition, Gilbert, SF; Sinauer Associates, Inc

Reference Books

- ❖ Developmental Biology – Gilbert Scott

Web Resources

- ❖ <http://bgc.org.in/pdf/study-material/developmental-biology-7th-ed-sf-gilbert.pdf>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	2	3	3	3	2
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	2	3	2	3	3	3	1
CO5	3	2	3	3	3	2	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course Coordinator

BOS Chairman

CORE ELECTIVE VIII - PLANT BIOCHEMISTRY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S4PBCE17	Core Elective –V III	Theory	Y	-	-	3	3

Learning Objectives

❖ This paper aims to provide a basic understanding of plant physiology, photosynthesis, nitrogen fixation, and phytohormones. This paper also provides the knowledge about secondary metabolites and plant tissue culture

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Understand the basic knowledge of mechanism of water transport and Photosynthesis	PO1,PO2, PO3,PO4
CO2	Describe the nitrogen fixation mechanisms in plants and interrelationship between photosynthesis and nitrogen metabolism.	PO1,PO2, PO7
CO3	Get the Knowledge about the Biosynthesis, transport, distribution, mechanism of action and physiological effects of plant hormones	PO1,PO2, PO5
CO4	Understand the role of secondary metabolites in drug development	PO1,PO3, PO4
CO5	Know about the isolation, fusion and culture of protoplast and also understand genetic manipulation of plants.	PO1,PO3, PO4,PO5

CORE ELECTIVE - VIII PLANT BIOCHEMISTRY

UNIT	DETAILS	No. of Hours
I	Water absorption – Mechanism of water absorption, symplast and apoplast concepts. Transpiration – types, mechanism and factors affecting transpiration. Photosynthesis – Photosynthetic apparatus, role of photosynthetic pigments, Biochemistry of light reactions of Photosynthesis – photo systems, factors affecting photosynthesis, cyclic and non-cyclic photo phosphorylation. Biochemistry of dark reactions of Photosynthesis – Carbon reactions in C3, C4, CAM plants – Calvin cycle, Hatch – Slack pathway. Poster making: Biochemistry of dark reactions of Photosynthesis.	09
II	Nutrients – Role of macro and micronutrients in plants and hydroponics, Nitrogen fixation and its types. Biochemistry of symbiotic and nonsymbiotic nitrogen fixation. Physiology of nodule formation. Gene manipulation of nitrogen fixation genes. Nitrogen assimilation, Interrelationship between photosynthesis and nitrogen metabolism.	09
III	Biosynthesis, transport, distribution, mechanism of action and physiological effects of Phytohormones – Auxin, Gibberellins, Cytokines, Absciscic acid and Ethylene. Phytochrome, biological clock, physiology and biochemistry of seed germination. Dormancy – types and methods to overcome dormancy. Senescence. PPT Presentation: Phytohormones.	09
IV	Secondary metabolites – Basic biosynthetic pathways. Functions of secondary metabolites – Flavonoids, alkaloids, terpenoids, anthocyanins, Tannins, steroids and lignin. Applications of secondary metabolites – Drug development, Biopesticides and Biofertilizers.	09
V	Plant tissue culture- Micropropagation, Callus induction, cell and protoplast culture, organogenesis and somatic embryogenesis. Applications of tissue culture for crop improvement in agriculture, horticulture and forestry.	09
	TOTAL	45

Note: Poster making and PPT Presentation related to the above topics are considered to be Internal Exam Only

Text Books

- ❖ Plant Biochemistry, Dey J.B. Harborne, 2000. Academic Press.
- ❖ Plant Biochemistry and Molecular Biology Peter J. Lea Richard. C. Lee good, 1999 2nd edition. John Wiley & Sons, NY.
- ❖ Introduction to Plant Biochemistry Goodwin T.W. and Mercer E.I 1998. 2nd edition. CBS publication.
- ❖ Plant pathology by Pandey B.P, S. 2009 Chand & Co.

Reference Books

- ❖ An introduction to Plant Tissue culture. Razdan M.K. 2003. Oxford & IBH Publishing Co, New Delhi.
- ❖ Plant Tissue culture, A Practical approach Dixon R.A and Gonzales R.A., 2nd edition.
- ❖ Natural Products: A Laboratory Guide. Raphael Ikan. 1991. Academic Press

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	3	3	3	2	2	2
CO2	3	2	3	2	3	3	3	2	2	2
CO3	3	3	3	3	3	2	3	3	2	2
CO4	3	2	2	2	3	2	3	3	3	2
CO5	3	2	3	2	3	3	3	3	3	3

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course Coordinator

BOS Chairman

CORE ELECTIVE VIII– ECOLOGY AND ENVIRONMENTAL BIOLOGY

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBCE18	Core Elective-VIII	Theory	Y	-	-	3	3

Learning Objectives

- ❖ To study the physical and biological characters of the environment.
- ❖ To learn about the interrelationship between biotic and abiotic components of nature.
- ❖ To understand relationship among the individuals of the biotic components.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Develop an appreciation of the modern scope of scientific inquiry in the field of Ecology.	PO1,PO2, PO3,
CO2	Become familiar with the variety of ways that organisms interact with both the physical and the biological environment.	PO1,PO2, PO3,
CO3	Develop an understanding of the differences in the structure and function of different types of ecosystems.	PO1,PO2, PO3,PO4
CO4	Gain abundant knowledge about nature resources.	PO1,PO2, PO3,PO4,
CO5	To have in depth insight in environment and their importance.	PO1,PO2, PO3,PO4

CORE ELECTIVE VIII –ECOLOGY AND ENVIRONMENTAL BIOLOGY

UNIT	DETAILS	No. of Hours
I	INTRODUCTION TO ENVIRONMENT AND ECOLOGY The Environment: definition, types of environment and their importance: physical environment; biotic environment; social environment; biotic and abiotic interactions. Ecology: scope of ecology; historical background; ecology in India; terminology of ecology; basic concepts of ecology. Assignment writing: biotic environment	09
II	ENVIRONMENTAL COMPLEX Environmental complex, Environmental and ecological factors-Direct and indirect factors; four categories of ecological factors-climatic, topographic, edaphic and biotic factors; interaction of ecological factors. Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.	09
III	POPULATION ECOLOGY Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations. Model Preparation: population regulation of life	09
IV	ECOLOGICAL SUCCESSION Ecological succession types, mechanisms, changes involved in succession, concept of climax. Ecosystem Ecology: Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, and P); primary production and decomposition.	09
V	APPLIED ECOLOGY Environmental pollution-Types, global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves) PPT Presentation: biodiversity management approaches	09
	Self- study: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.	
	TOTAL	45

Note: Assignment, Model Preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only.

Text Books

- ❖ Handbook of Environmental Science, S S Negi, 2008.
- ❖ A Text Book of Environmental Pollution, P.Panday, 2010.
- ❖ A Text Book of Environmental Science, V. Thakur, 2012.
- ❖ A Textbook of Environmental Science, Prabhat Patnaik, 2011.

Reference Books

- ❖ Cell Biology, Genetics, Molecular Biology, Evolution And Ecology, P.S. Verma and V.K.Agarwal, S. Chand Company Ltd 2005.
- ❖ Ecology and Environmental Biology, T.K.Saha, Books and Allied (P) Ltd, Kolkata 2011.
- ❖ Modern concepts of Ecology, H.D.Kumar, 8th ed, Vikas Publishing House Pvt Ltd, 2008.

Web Resources

- ❖ <https://libguides.brighton.ac.uk/ecology>
- ❖ <https://libguides.mcalester.edu/ecol>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	2	0	0	2	3	2	2
CO2	0	0	0	3	0	0	2	2	2	0
CO3	0	0	0	3	0	0	3	3	2	2
CO4	0	0	0	3	0	0	3	2	2	0
CO5	0	0	0	3	0	0	3	2	2	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course coordinator

BOS Chairman

NME COURSES OFFERED TO OTHER DEPARTMENTS
HUMAN PHYSIOLOGY AND NUTRITION

Subject Code	Subject	Category	L	T	P	HOURS	Credit
24S3PBCN02	NME II	Theory	Y	-	-	2	2

Learning Objectives

- ❖ To understand the functions and activities of organs, tissues or cells and of physical and chemical phenomena involved in the human body
- ❖ To understand nutritional needs in healthy individuals

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Explain the digestion process, exchange of gases, design of blood vessels and cardiac cycle	PO1,PO2, PO5,PO6
CO2	Summarize the events in transmission of nerve impulses and mechanism of muscle contraction	PO2,PO3,PO4 PO5,PO6
CO3	Elaborate the structure and functions of digestive system, structure of nephron and mechanism of urine formation and role of kidney in maintenance of pH.	PO1,PO2,PO3 PO4,PO5,PO6
CO4	Identify and explain nutrients in foods and the specific functions in maintaining health.	PO1,PO2,PO3 PO4 ,PO5,PO6
CO5	Explain the nutritional consequences in human health	PO1,PO2, PO5

NME II - HUMAN PHYSIOLOGY AND NUTRITION

UNIT	DETAILS	No. of Hours
I	Digestive system: outline of digestive system. Buccal, gastric and Intestinal digestion. Role of liver in digestion. Intestinal- Absorption and assimilation- hormonal influence in digestion. Excretory system; Structure of kidney and ultra- structure of nephron. Formation and composition of urine. Outline of excretory system - 'Micturition'. PPT Presentation: Structure of kidney and ultra-structure of nephron.	06
II	Respiratory and Circulatory system: Types of respiration. - Outline of respiratory system' respiratory pigments, Transport of O ₂ and CO ₂ . Factors affecting oxygen dissociation curve and carbondioxidedissociation curve. Chloride shift. Circulatory organs, composition of blood, systemic, pulmonary circulation, Heartbeat, cardiac cycle, origin and conduction of heart beat, Regulation of heart beat, human heart' coronary circulation, ischemic heart disease, ECG, Blood pressure and Cardiac output.	06
III	Nervous and Muscular system: outline of nervous system, structure of neuron, types of neuron, neurotransmitters. Condition of nerve impulse transmission, synaptic transmission. Muscle – Types of muscle- Role of Actin and Myosin.-Action Potential. Neuro muscular junction. Reflex action. Assignment writing: structure of neuron, types of neuron	06
IV	Introduction on Nutrition: Food factors for human being. Nutritional classification, foods, Energy– Energy value of food and its determination, energy expenditure – components – basal metabolism, physical activity and thermogenesis- foods' Basal metabolism: Definition, determination of basal metabolic rate (BMR). Standards of BMR factors affecting BMR, energy utilization in cells and energy balance. Dietary fiber- Definition, types of fiber in plant foods, sources, composition, role of dietary fiber and resistant starch in nutrition, effect of over consumption of fiber.	06
V	Nutritional consequences and Dietary Allowances Nutritive value of protein' Protein calorie malnutrition in children. protein and energy/ requirements Nitrogen balance and imbalance. Deficiency Disease of Vitamins and Minerals (Iron, sodium, potassium, fluoride, magnesium and calcium.) Infant nutrition, nutrition for preschool children, school children, adolescents, pregnant and lactating mothers. Industrial workers. Geriatric nutrition and Lathyrism. Obesity: A etiology and occurrence, physiological regulation of foods intake assessment, complication, treatment and prevention of obesity. Therapeutic diets.	06
	TOTAL	30

Note: Report writing on Field visit, Chart Preparation and PPT Presentation related to the above topics are considered to be Internal Exam Only

Textbooks

- ❖ Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed). John Wiley & Sons. Inc.
- ❖ Bruce Alberts and Dennis Bray (2013), Essential Cell Biology, (4th ed), Garland Science.

Reference Books

- ❖ Wayne M. Baker (2008) the World of the Cell. (7th ed). Pearson Benjamin Cummings Publishing, San Francisco. Cell Biology
- ❖ Essentials of Food and Nutrition, Vol. I & II, M.S. Swaminathan.

Web resources

- ❖ <http://old.noise.ac.in/SecHmscicour/english/LESSON03.pdf>
- ❖ <https://study.com/academy/lesson/energy-yielding-nutrients-carbohydratesfat-protein>.

Mapping with Programme Outcomes: 3 Strong, 2 – Medium , 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	3	2	2
CO4	3	3	3	3	3	3	3	3	2	1
CO5	3	3	3	3	3	3	3	3	2	2

Mapping With Programme Specific Outcomes

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of course contribution to Pos	3	3	3	3	3

Course Coordinator

BOS Chairman