MARUDHAR KESARI JAIN COLLEGE FOR WOMEN (AUTONOMOUS)

Vaniyambadi – 635 751

PG and Research Department of Biochemistry

for

Postgraduate Programme

Master of Science in Biochemistry

From the Academic Year 2024 - 2025

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1. Preamble

Biochemistry, as a scientific field, delves into the chemical processes within living organisms, focusing on cellular and molecular levels. The Department of Biochemistry at MKJC aims to produce biochemists who can innovate, invent, and share knowledge for the betterment of humanity. It also seeks to provide students with comprehensive training in applying biochemical skills.

The Department of Biochemistry was established in 2004, the department initiated its Post Graduate course in 2007, followed by the M.Phil course in 2012 and the Research Course (Ph.D) in 2021. Biochemistry covers a wide array of scientific disciplines, including Genetics, Microbiology, Forensics, Plant Sciences, Medicine, and Nutrition. It's an ideal choice for students interested in healthcare delivery services and those who want to contribute innovative information to technological advancements in understanding life processes.

Equipped with advanced tools and instruments, the Biochemistry Department's laboratory conducts a variety of biochemical tests on blood and urine to understand health and disease.

The department organizes National and International Conferences, Health Awareness Programs, and Blood Grouping Programs for first-year students every academic year. These events provide valuable information and problem-solving skills to students in biology.

To foster academic and professional advancement, the department has signed Memorandums of Understanding (MoUs) with Microlab, Sacred Heart College, Vanni Tech, Saveetha Institute of Medical & Technical Science, and Xcellogen Biotech. Currently, the department comprises 11 faculty members and has a student strength of 142.

2. PROGRAMME OUTCOMES (PO)

Programme	**M.Sc BIOCHEMISTRY**
Programme Code	**PS06**
Duration	**PG (2 years)**
Programme Outcomes	**PO1: Acquire** knowledge in the field of Biological Sciences and to apply the knowledge in their day- to- day life for betterment of self and society. **PO2:** Develop critical, analytical thinking and problem-solving skills **PO3: Develop** related skills in defining the problem, formulate and test thehypothesis, analyse, interpret, and draw conclusion from data. **PO4:** Address and develop solutions for societal and environmental needs of local, regionaland national development. **PO5: Work** independently and engage in lifelong learning and enduring proficient progress. **PO6:** Provoke employability and entrepreneurship among students along with ethics and communication skills. **PO7: PO7:**Understand the importance of ethical behavior in business contexts and be able to recognize and address ethical dilemmas they may encounter in their professional careers. **PO8:**Prepared for lifelong learning and professional development, including the ability to adapt to changes in technology, business practices, and economic conditions throughout their careers.
PROGRAM-SPECIFIC OUTCOMES	**PSO1: Students** will be able to understand the principles and methods of various techniques in Biochemistry, Immunology, Microbiology, Enzyme kinetics, and Molecular Cell Biology. 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: Insight** on the structure-function relationship of biomolecules, their synthesis and breakdown, the regulation of these pathways, and their importance in terms of clinical correlation. Students will also acquire knowledge of the principles of nutritional biochemistry and also understand diseases and their prevention through Pharmaceutical Biochemistry. **PSO3:**To understand the concepts of Recombinant DNA Technology, Molecular Endocrinology and Developmental Biology in association with various research methods. Acquire insight into the immune system and its responses, and use this knowledge in the processes of immunization, vaccine development, transplantation and organ rejection.

3. Eligibility for Admission:

Candidate for admission to the first year of M.Sc., Biochemistry shall be required to passed the UG with any one of the followings-Biochemistry/ Chemistry / Microbiology / Biotechnology / Life Sciences.

4. Methods of Evaluation and Assessment

Methods of Evaluation		
Internal Evaluation		25 Marks
External Evaluation	End Semester Examination	75 Marks
	Total	**100 Marks**
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand / Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate Between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Semester - I						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24PBCC11	CC – 1 Biomolecules	3	1	2	0	5
24PBCC12	CC – 2 Cell Biology	3	1	2	0	3
24PBCC13P	CC - 3 Practical Isolation, characterization techniques and quantitative analysis	0	0	4	0	3
24PBCE11	EC - 1 Human Physiology	3	1	1	0	3
24PBCE12	EC – 2 Plant Biochemistry	3	1	1	0	3
24PBCA11	AECC – 1 Biostatistics and data science	1	1	0	0	2
24PCHR11	VE - 1 Humam Rights	1	1	0	0	2
TOTAL					30	21

Semester - II						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24PBCC21	CC – 4 Enzymology	3	1	2	0	4
24PBCC22	CC – 5 Intermediary Metabolism	3	1	2	0	4
24PBCC23	CC - 6 Practical Enzyme Assays	0	0	4	0	3
24PBCC24	CC – 7 Biochemical Techniques	2	1	1	0	3
24PBCE21	EC - 3 Ecology Evolution and Biodiversity	2	1	1	0	3
24PBCE22	EC - 4 Genetics	2	1	1	0	3
24PBCS21	SEC - 1 (NME) Bioinformatics	1	1	0	0	2
TOTAL					30	22

Semester – III						
24PBCC31	CC – 8 Clinical Biochemistry	3	1	2	0	5
24PBCC32	CC – 9 Molecular Biology	3	1	2	0	5
24PBCC33P	CC - 10 Practical III - Laboratory Courses on Clinical Biochemistry	0	0	6	0	4
24PBCC34	CC – 11 Immunology and Immunotechnology	3	1	1	0	3
24PBCE31 24PBCE32	EC – 5 1. Nutritional Biochemistry 2. Microbiology	2	1	1	0	3
24PBCS31	SEC – 2 Pharmaceutical Biochemistry	1	1	0	0	2
					30	24

Semester – IV						
24PBCC41	CC – 12 Gene Editing, Cell and Gene Therapy	3	2	1	0	5
24PBCC42	CC – 13 – Advanced Molecular Endocrinology	3	1	2	0	5
24PBCC43P	CC - 14 Project	0	0	6	0	5
24PBCE41 24PBCE43	EC – 6 1. Research Methodology 2. Phytomedicine	3	1	2	0	4
24PBCF41	PEC – 1 Personality Development and leadership skills	1	1	0	0	2
24PBCL41	SLC – 1 Biotechnology	0	0	1	3	2
					30	23
	Total Credits	**90+2***				

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmudalvan within the fifth semester. Additionally, engaging in a specified Self-learning Course is mandatory to qualify for the degree, and successful participation will be acknowledged with an extra credit of 2*.

L- Learning T- Tutorial P-Practice S-Seminar

CC	Core Course	14
EC	Elective Paper	6
SEC	Skill Enhancement Course	2
AEC	Ability Enhancement Compulsory Courses	1
VE	Value Educations	1
	Internship	1
PEC	Professional Enhancement Course	1
SLC	Self-Learning Course	1
NME	Non-Major Elective	
AECC	Ability Enhancement Compulsory courses	

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC11	CC- Biomolecules	Core	3	1	2	0	5	6	25	75	100

Learning Objectives	
LO1	To enable the students to learn the basic functions, structures, and biological importance of lifeless chemical compounds
LO2	To 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.
LO3	To study the structure, properties and biological significance of lipids in the biological system.
LO4	To get knowledge about the structure, functions and biological importance of Nucleic acids.
LO5	To know the biochemical functions, disorders and treatment for water soluble and fat-soluble vitamins.

Unit	Content	Hours
1	**UNIT I: WATER AND CARBOHYDRATES:** Water - Unique properties, weak interactions in aqueous systems, ionization of water, buffers. Classification, chemical properties of carbohydrates, Chemistry and biological roles of homo and heteropolysaccharides. Structural elucidation of polysaccharides; Oligosaccharides – lectin interaction in biochemical processes. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Blood group polysaccharides. Bacterial cell wall (peptidoglycans, teichoic acid) and plant cell wall carbohydrates.	20
2	**UNIT II: AMINO ACIDS AND PROTEIN:** Amino acids– classification, structure and physiochemical properties, chemical synthesis of peptides – solid phase peptide synthesis. Proteins – classification, purification, and criteria of homogeneity. Structural organization, sequence determination and characterization of proteins. Conformation of proteins – Ramachandran plots. Denaturation of proteins. Apoprotein and Prosthetic group- Porphyrins – Structure and properties of porphyrins – heme, Chlorophyll and Cytochromes.	20
3	**UNIT III: LIPIDS:** Lipids – Classification of lipids, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, glycolipids, sphingolipids and steroids – Biological importance. Eicosanoids- classification, structure and functions of prostaglandins, thromboxanes, leukotrienes. Lipoproteins – Classification, structure, transport (endogenous and exogenous Pathway) and their biological significance.	20

4	**UNIT IV: NUCLEIC ACIDS:** Nucleotides- structure and properties, physicochemical properties of nucleic acids, cleavage of nucleic acids by enzymatic methods, non – enzymatic transformation of nucleotides and nucleic acids, methylation, Sequencing, chemical synthesis of DNA. Three-dimensional structure of DNA. Different forms of DNA – circular DNA and Supercoiling. Types of RNA mRNA, tRNA, rRNA, Sn RNA, Si RNA, Hn RNA. Structure of t-RNA. Nucleotides as source of energy, component of coenzymes, second messengers. Forces stabilizing nucleic acid structure. C-value, C-value paradox, Cot curve. Structure and role of nucleotides in cellular communications.	15
5	**UNIT V: VITAMINS AND PORPHYRINS:** Vitamins - water soluble - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid-sources, structure, biochemical functions, deficiency diseases, daily requirements; fat soluble - vitamin A, vitamin D, vitamin E and vitamin K - sources, structure, biochemical functions, deficiency diseases and daily requirements. Porphyrins – Porphyrin ring system, Chlorophyll, Haemoglobin, Myoglobin and Cytochrome.	15

CO	Course Outcomes
CO1	Helps to understand about the polysaccharides and its types
CO2	A Clear Knowledge regarding amino acids and protein characterization
CO3	Gives a clear understanding about the lipids and its role.
CO4	Provides the structure and properties of Nucleic acids
CO5	Analyse the functions and disorders of Vitamins and Porphyrins.

Textbooks:	
1	D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry (7th Edition), W.H.Freeman, 2017
2	D. Voet and J. G. Voet, Biochemistry, (4th Edition), Wiley & Sons, 2011.
3	Zubay G.L (1999) Biochemistry, (4th ed), Mc Grew-Hill.
4	Lubert Stryer (2010) Biochemistry, (7th ed), W.H.Freeman
5	Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.
Reference Books:	
1	J. M. Berg, J. L. Tymoczko and L. Stryer, Biochemistry (9th Edition), W.H. Freeman,2019.
2	P. W. Kuchel, G. B. Ralston et al., Schaum's outline of theory and problems of biochemistry (3rd Edition) McGraw-Hill, 2009
3	W. B. Wood, J. H. Wilson, R. M. Benbow, and L. E. Hood., Biochemistry: Aproblems approach, (2nd Edition), Benjamin/Cummins Publishing Company, 1981.
4	Garrett,R. and Grisham.C.2010.Biochemistry,4th Edition, Saunders college Publishing.
5	Chemistry of Biomolecules by R J Simond
Web resources:	
1	https://my.clevelandclinic.org/health/articles/15416-carbohydrates
2	https://www.medicalnewstoday.com/articles/196279
3	https://www.britannica.com/science/lipid
4	https://www.britannica.com/science/nucleic-acid
5	https://egyankosh.ac.in/bitstream/123456789/102832/1/Unit-14.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	3	3	3	2
CO2	3	2	3	2	3	3	3	3	3	3	2
CO3	3	2	3	2	3	3	3	3	3	3	2
CO4	3	2	3	2	3	3	3	3	3	3	2
CO5	3	2	3	2	3	3	3	3	3	3	2
Total	15	10	15	10	15	15	15	15	15	15	10
Average	3	2	3	2	3	3	3	3	3	3	2

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC12	**CC-2 Cell Biology**	Core	3	1	2	0	3	6	25	75	100

Learning Objectives	
LO1	Students will be able to learn the structure and function of the subcellular organelles.
LO2	Students will understand the cellular transport.
LO3	Students will get knowledge on how chromosome organized in cell.
LO4	Students will study the stages of the cell cycle in order, including the steps of cell division in both somatic cells.
LO5	Students will focus on the mechanisms underlying fundamental processes such as cell growth, the transformation of normal cells to cancer cells, and the spread (metastasis) of cancer cells.

Unit	Content	Hours
1	**UNIT I: STRUCTURAL ORGANIZATION AND FUNCTION OF INTRACELLULAR ORGANELLES** Structure and function of prokaryotic and eukaryotic cell. Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility). Cytoskeleton - Microtubule and Microfilaments.	20
2	**UNIT II: MEMBRANE STRUCTURE AND TRANSPORT** Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Active and passive transport, channels and Sodium- potassium pumps, Calcium pump, Proton pump of cells, electrical properties of membranes	20
3	**UNIT III: ORGANIZATION OF GENES AND CHROMOSOMES** Genes and chromosomes, DNA structure (double helix) Operon, unique and repetitive DNA, interrupted genes, gene families, nucleosomes, histones, non-histone proteins, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.	20
4	**UNIT IV: CELL DIVISION AND CELL CYCLE** Overview of cell cycle, Mitosis and meiosis, their regulation, regulation and control of cell cycle. check - points in cell cycle regulation. S-phase, mitotic phase and cytokinesis, control of cell division and cell growth.	15

5	**UNIT – V CANCER BIOLOGY** Programmed cell death or Apoptosis; mechanism, regulation, pro-apoptotic factors, Pro-apoptotic regulators. Benign and malignant tumors. Cancer transformation, Metastatic tumor cells Alteration in cell cell interaction blood vessel formation - Tumor micro-environment influence cancer development - Isolation of DNA from tumor cells-Transformation of normal cultured cells. Types of cancer cells and their morphological architechiture	15

CO	Course Outcomes
CO1	Understand the structural organization and function of intracellular organelles
CO2	Illustrate the membrane structure and transport
CO3	Gain knowledge on Organization of Genes and Chromosomes
CO4	Study the Cell Division and Cell Cycle
CO5	Gain knowledge on cancer, cell death.

Textbooks:	
1	David L. Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H.Freeman
2	Voet.D and Voet. J.G (2010) Biochemistry, (4th ed), John Wiley & Sons, Inc.
3	Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
4	Zubay G.L (1999) Biochemistry, (4th ed), Mc Grew-Hill.
5	Textbook of Biochemistry with Clinical Correlations, 7th Edition, Thomas M. Devlin (Editor), Wiley.
Reference Books:	
1	Molecular Biology of the Cell" by Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. (Publisher: Garland Science; Edition: 6th edition, 2014)
2	Genetics: From Genes to Genomes" by Leland H. Hartwell, Michael L. Goldberg, Janice A. Fischer, and Leroy Hood. (Publisher: McGraw-Hill Education; Edition: 5th edition, 2018)
3	Cell Biology: A Short Course" by Stephen R. Bolsover, Jeremy S. Hyams, Elizabeth A. Shephard, Hugh A. White, and Claudia G. Wiedemann. (Publisher: Wiley-Blackwell; Edition: 3rd edition, 2013)
4	Microbial Physiology" by Albert G. Moat, John W. Foster, and Michael P. Spector. (Publisher: Wiley-Liss; Edition: 4th edition, 2002)
5	Human Biochemistry – James M. Orten & Otto.W.Neuhan- 10th edn- The C.V.Mosby Company
Web resources:	
1	https://nicholls.edu/biol-ds/bio1155/Lectures/Cell%20Biology.pdf
2	https://www.medicalnewstoday.com/article/320878.php
3	https://biologydictionary.net /cell
4	https://www.genome.gov/genetics-glossary/Cell-Cycle
5	https://www.ncbi.nlm.nih.gov/books/NBK26873/

Mapping with Programme Outcomes and Programme-Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	2	1	3	3	3	3
CO2	3	3	3	3	3	2	1	3	3	3	3
CO3	3	3	3	3	3	2	1	3	3	3	3
CO4	3	3	3	3	3	2	1	3	3	3	3
CO5	3	3	3	3	3	2	1	3	3	3	3
Total	15	15	15	15	15	10	5	15	15	15	15
Average	3	3	3	3	3	2	1	3	3	3	3

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCP13P	**CC-3 Isolation, Characterization Techniques and Quantitative Analysis**	Core	**0**	**0**	4	0	3	4	25	75	100

Learning Objectives	
LO1	Able to isolate glycogen, DNA, RNA from a biological sample and estimate its concentration using appropriate techniques.
LO2	Able to separate sugar, amino acids, components in a mixture using TLC and analyze the results.
LO3	Able to separate lipid components in a mixture using TLC and analyze the results.
LO4	Able to determine the concentration of biomolecules in a sample using titrimetric or spectrophotometric methods.
LO5	Able to prepare buffers of desired pH and accurately measure pH using indicators and pH meters.

Unit	Content	Hours
1	**Isolation, characterization techniques** 1. Isolation and estimation of Glycogen 2. Isolation and estimation of DNA 3. Isolation and estimation of RNA	20
2	**Quantitative analysis** 1.Estimation of inorganic phosphorus by Fiske and Subbarow method. 2.Estimation of Pyruvate 3.Estimation of Tryptophan 4.Estimation of protein by Lowry's method.	20
3	**Separation techniques** 1. Preparation of Buffers and measurement of pH using indicators and pH meter 2. Separation of lipids by TLC 3. Separation of amino acids by TLC 4. Separation of Sugars by TLC 5. Paper chromatography separation and detection of amino acids and simple sugars 6. Chromatographic separation of chlorophyll, carotenes of flower pigments using column Chromatography	20

CO	Course Outcomes
CO1	To understand and apply principles behind different quantitative analysis methods.
CO2	Students will be able to isolate glycogen, DNA, and RNA from biological samples using appropriate extraction and purification methods.
CO3	Students will successfully separate lipids, amino acids, and sugars using thin-layer chromatography (TLC) and interpret chromatograms effectively.
CO4	Students will accurately estimate the concentrations of glycogen, DNA, and RNA using spectrophotometric or other suitable techniques.
CO5	Students will be able to quantitatively analyze ascorbic acid, inorganic phosphorus, pyruvate, tryptophan, and proteins using standard spectrophotometric or colorimetric methods.

Textbooks:	
1	Principles and Techniques of Biochemistry and Molecular Biology" by Keith Wilson and John Walker Publication: Cambridge University Press; 7th Edition (2010)
2	Biochemical Techniques" by Keith Wilson and John Walker Publication: Garland Science; 1st Edition (2010)
3	Experimental Biochemistry" by Wilson, Walker, and Cox Publication: Oxford University Press; 4th Edition (2017)
4	Laboratory Techniques in Biochemistry and Molecular Biology" by Teresa M. Garrett and Michael J. Sanger Publication: Elsevier Science; 1st Edition (2005)
5	Basic Laboratory Methods for Biotechnology" by Lisa A. Seidman and Cynthia J. Moore Publication: Cengage Learning; 2nd Edition (2008)
Reference Books:	
1	Quantitative Chemical Analysis" by Daniel C. Harris Publication: W. H. Freeman; 9th Edition (2015)
2	Thin-Layer Chromatography: A Laboratory Handbook" by E. Stahl Publication: Springer; 2nd Edition (1969)
3	Principles and Practice of Chromatography" by Jack Cazes Publication: CRC Press; 1st Edition (1997)
4	Chromatography: Concepts and Contrasts" by James M. Miller and Jane C. Miller Publication: John Wiley & Sons; 2nd Edition (2005)
5	Basic Laboratory Methods for Biotechnology" by Lisa A. Seidman and Cynthia J. Moore Publication: Cengage Learning; 2nd Edition (2008)
Web resources:	
1	https://youtu.be/2XBVUKn_I5w?si=8Zjw1yooSWHwAn3v
2	https://www.promega.in/resources/guides/nucleic-acid-analysis/dna-purification/
3	https://www.pace.edu.in/img/lab-demo/LAB_DEMO_LOWRYS_METHOD.pdf
4	https://rockedu.rockefeller.edu/component/tlc-hs/
5	https://byjus.com/chemistry/paper-chromatography/

Mapping with Programme Outcomes and Programme-Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	3	3	2	2
CO2	3	3	3	3	3	3	1	3	3	2	2
CO3	3	3	3	3	3	3	1	3	3	2	3
CO4	3	3	3	3	3	3	1	3	3	2	3
CO5	3	3	3	3	3	3	1	3	3	2	3
Total	15	15	15	15	15	15	5	15	15	10	13
Average	3	3	3	3	3	3	1	3	3	2	2.6

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE11	**Elective Course -1 Human Physiology**	EC	3	1	1	0	3	5	25	75	100

Learning Objectives	
LO1	Students will be able to explain the process of haemostasis and its significance in maintaining homeostasis.
LO2	Students will be able to describe the neural and chemical regulation of respiration and its impact on gas exchange in the lungs.
LO3	Students will be able to identify the anatomical structures of the central nervous system (CNS) and explain their functions in processing sensory information and generating responses.
LO4	Students will be able to explain the mechanisms of urine formation and regulation of water and electrolyte balance in the body.
LO5	Students will be able to compare and contrast the hormonal regulation of reproductive processes in males and females, including spermatogenesis and oogenesis.

Unit	Content	Hours
1	**UNIT I: Blood circulation and Cardiovascular System** Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. Cardiovascular System: structure and functions of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation.	**15 Hours**
2	**UNIT II: Digestive system and Respiratory system** Digestive system – structure and functions of the Digestive system, Digestive juices; digestion and absorption of carbohydrates, lipids, proteins. Intestinal and bile secretion and functions Respiratory system - structure and functions of lungs – transport and exchange of respiratory gases. Lung volumes and capacities, neural and chemical regulation of respiration	**15 Hours**
3	**UNIT III: Nervous System and Muscle** Nervous system – organization, conduction of nerve impulse and neurotransmission, action potential, Reflex action. Anatomical structure and function of nervous system, Gross anatomical structure of brain; CNS - Cerebral hemisphere, Diencephalon, brain stem, the	**15 Hours**

	spinal cord. Sense organs - Vision, hearing and tactile response. Muscle; Types of muscle. Structure of skeletal muscle. proteins - myosin, actin, troponin, tropomyosin. Mechanism and regulation of contraction and relaxation of skeletal muscle. The neuromuscular junction, Role of acetylcholine and Ach Receptor.	
4	**UNIT IV: Excretory system and Thermoregulation** Excretory system -structure and function of kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, electrolyte balance, acid-base balance. Thermoregulation - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization. Stress and adaptation.	**18 Hours**
5	**UNIT V: Endocrinology and Reproductive biology** Endocrinology - Endocrine glands, hormones of thyroid hormones, pancreas, adrenal, ovary, testis. Reproductive biology- Male and female reproductive system, Spermatogenesis, oogenesis, Menstrual cycle, Physiology of pregnancy, parturition and lactation.	**18 Hours**

CO	**Course Outcomes**
CO1	Able to describe the composition of blood, including its formed elements and plasma, and explain their functions; comprehend the structure and function of the heart.
CO2	Able to describe the structure and functions of digestive juices and their role in digestion and absorption of macromolecules; components and functions of the respiratory system
CO3	Understand the organization of the nervous system and the conduction of nerve impulses.
CO4	understand the regulation of water balance, blood volume, blood pressure, electrolyte balance, and acid-base balance and physiology of excretion
CO5	Gain knowledge on - Endocrine glands and reproductive process

Textbooks:	
1	A Textbook of Human Anatomy and Physiology by Dr. Shaik Harun Rasheed Publisher: Pharma Med Press Edition: Second Revised and Updated Edition
2	Atlas Of Human Anatomy, Professional Edition by Frank H. Netter MD Publisher: Elsevier Edition: 7th Edition
3	Atlas of Human Anatomy (Netter Basic Science) by Frank H. Netter MD Publisher: Elsevier Edition: 7th Edition (Paperback)
4	A Textbook of Human Physiology by H. D. Singh Publisher: Jaypee Brothers Medical Publishers
5	Vander's Human Physiology by Eric P. Widmaier, Hershel Raff, and Kevin T. Strang Publisher: McGraw-Hill Education

Reference Books:	
1	Human Physiology: From Cells to Systems by Lauralee Sherwood Publisher: Cengage Learning
2	Principles of Physiology by Robert M. Berne and Matthew N. Levy Publisher: Mosby
3	Gray's Anatomy for Students by Richard Drake, A. Wayne Vogl, and Adam W. M. Mitchell Publisher: Elsevier Edition: 4th Edition
4	Vander's Human Physiology by Eric P. Widmaier, Hershel Raff, and Kevin T. Strang Publisher: McGraw-Hill Education Edition: 15th Edition
5	Vander's Human Physiology: The Mechanisms of Body Function by Eric P. Widmaier, Hershel Raff, and Kevin T. StrangPublisher: McGraw-Hill Education Edition: 15th Edition
Web resources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link
2	https://tvuni.academia.edu/mvinayagam
3	https://ncert.nic.in/textbook.php
4	https://ndl.iitkgp.ac.in/
5	https://cec.nic.in/cec/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	1	2	3	2	3
CO2	3	3	3	2	1	2	2	2	2	3	2
CO3	3	3	3	2	1	1	2	2	3	2	3
CO4	3	2	3	2	1	1	2	2	3	3	2
CO5	3	3	3	3	2	2	2	2	2	3	3
Total	15	13	14	12	7	8	9	10	13	13	13
Average	3	2.6	2.8	2.4	1.4	1.6	1.8	2	2.6	2.6	2.6

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE12	**EC 2- Plant Biochemistry**	Core	3	1	1	0	3	5	25	75	100

Learning Objectives	
LO1	Students will be able to explain the structure and function of chloroplasts and mechanism of photosynthesis
LO2	Students will be able to outline the plant Respiration and Nitrogen Metabolism
LO3	Students will be able to describe the biosynthesis and functions of Plant Hormones
LO4	Students will be able to explain the plant Sensory Photobiology and Transport
LO5	Students will be able to describe the biosynthesis of secondary metabolites and their role in Stress Physiology

Unit	Content	Hours
1	Photosynthesis –structure and function of chloroplast; role of photosynthetic pigments; light absorption and energy conservation. Light absorption by pigment molecules; the reaction centre complex. The photo systems I and II; cyclic and noncyclic photophosphorylation. Carbon reactions in C3, C4 and CAM plants - Calvin cycle; Hatch-Slack pathway	15 hrs
2	Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport system, chemiosmotic hypothesis and ATP synthesis, photorespiratory pathway. Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis. Regulation of nif and nod genes of nitrogen fixation.	15 hrs
3	Plant hormones – Auxins, cytokinins, Gibberellins, ethylene, Abiscic acid - Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.	15 hrs
4	Sensory photobiology - Structure, function, and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes, and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photo assimilates.	15 hrs

5	Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses	15 hrs

CO	Course Outcomes
CO1	Understand the photosynthesis and photoprotective mechanisms.
CO2	Illustrate the respiration and photorespiration
CO3	Gain knowledge on Nitrogen metabolism
CO4	Study the Sensory photobiology
CO5	Gain knowledge on Secondary metabolites

Textbooks:	
1	Devlin RM (1983) Plant Physiology (4th ed), PWS publishers
2	Taiz L, Zeiger E (2010), Plant Physiology (5th ed), Sinauer Associates, Inc
3	Modern Plant Physiology - R.K. Sinha, Narosa Publishing House, 2004.
4	Plant Physiology" by Lincoln Taiz and Eduardo Zeiger. (Publisher: Sinauer Associates Inc; Edition: 6th edition, 2015)
5	Plant Physiology and Development" by Lincoln Taiz, Eduardo Zeiger, Ian M. Møller, and Angus Murphy. (Publisher: Sinauer Associates Inc; Edition: 6th edition, 2014)
Reference Books:	
1	Plant Physiology" by Frank B. Salisbury and Cleon W. Ross. (Publisher: Brooks/Cole; Edition: 4th edition, 1991)
2	Physiology of Crop Production" by H. A. Mills. (Publisher: Wiley-Blackwell; Edition: 2nd edition, 2007)
3	Plant Physiology: Molecular, Biochemical, and Physiological Fundamentals of Metabolism and Development" by Hans-Henning Kunz. (Publisher: Wiley-VCH; Edition: 2nd edition, 2010)
4	Plant Physiology: A Treatise" edited by Frank B. Salisbury. (Publisher: Academic Press; Multiple volumes)
5	Plant Physiology: Molecular, Biochemical, and Physiological Fundamentals of Metabolism and Development" by Felix L. Soldatov and Elena V. Tyutereva. (Publisher: Springer; Edition: 2019)
Web resources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link
2	https://tvuni.academia.edu/mvinayagam
3	https://ncert.nic.in/textbook.php
4	https://ndl.iitkgp.ac.in/
5	https://cec.nic.in/cec/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	2	3	3	3
CO2	3	3	3	2	1	2	1	2	3	2	2
CO3	3	3	3	3	1	2	2	2	3	3	3
CO4	3	3	3	2	2	2	1	2	3	2	2
CO5	3	3	3	3	1	2	2	2	3	3	3
Total	15	15	15	13	7	10	8	10	15	13	13
Average	3	3	3	2.6	1.4	2	1.6	2	3	2.6	2.6

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCA11	**AECC-Biostatistics and Data science**	AECC	1	1	0	0	2	2	25	75	100

Learning Objectives	
LO1	Students will learn to summarize data and extract its salient features from the vast mass of original data.
LO2	Students will understand the concept of various measures of dispersion, aiding in data analysis and interpretation.
LO3	Students will comprehend the concepts of sampling and learn tests of significance, enhancing their ability to draw meaningful conclusions from data.
LO4	Students will understand various attributes and their relevance to biological studies, connecting statistical concepts with real-world applications.
LO5	Students will gain knowledge in SPSS, a software package providing perfect graphical representation and appropriate results for the entered data, improving their data analysis skills.

Unit	Content	Hours
1	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.	6
2	Measures of Dispersion for biological characters – Quartile deviation, Mean deviation, Standard deviation and coefficient of variation. Measures of skewness and kurtosis. Correlation and regression.	6
3	Basic concepts of sampling- Simple random sample stratified sample and systemic sampling. Sampling distribution and standard error.	6
4	Small sample tests – Students‘t’ test for mean. Chi-square test for goodness of a non-independence of attributes. ANOVA- one way and two way.	6
5	Definition to Data Science, Algorithms - Machine Learning Deep Learning, Artificial Neural Networks, Artificial Intelligence (AI), Big Data and their Application in medical, health and pharma industries.	6

CO	Course Outcomes
CO1	Concepts of statistical population and sample, variables and attributes. Tabular and graphical representation of data based on variables.
CO2	Conditions for the consistency' and criteria for the independence of data based on attributes. Measures of central tendency, Dispersion, Skewness and Kurtosis
CO3	Learning different sampling methods and analysing statistical significance.
CO4	Understanding students t test, ANOVA, Chi square test to analyse the significance of various research
CO5	Learning on data science, algorithm for machine learning, artificial intelligence and big data, their applications in clinical and pharma domain

Textbooks:	
1	Zar, J.H. (1984) "Bio Statistical Methods", Prentice Hall, International Edition
2	Sundar Rao P. S.S., Jesudian G. & Richard J. (1987), "An Introduction to Biostatistics", 2nd edition, Prestographik, Vellore, India.
3	Warren,J; Gregory,E; Grant,R (2004), "Statistical Methods in Bioinformatics",1st edition, Springer
4	Milton,J.S. (1992), "Statistical methods in the Biological and Health Sciences", 2nd edition, Mc Graw Hill,
5	Rosner,B (2005), "Fundamentals of Biostatistics", Duxbury Press
Reference Books:	
1	Introducing Data Science, Davy Cielen, Anro DB Meysman, Mohamed Ali.
2	Introduction to Statistical Learning: with Applications in R" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani. (Publisher: Springer; Edition: 2013)
3	Fundamentals of Biostatistics" by Bernard Rosner. (Publisher: Cengage Learning; Edition: 8th edition, 2015)
4	Biostatistics: The Bare Essentials" by Geoffrey R. Norman and David L. Streiner. (Publisher: B.C. Decker; Edition: 4th edition, 2014)
5	Biostatistics: A Computing Approach" by Stewart Anderson. (Publisher: Chapman and Hall/CRC; Edition: 2000)
Web resources:	
1	https://byjus.com/maths/data-collection-methods/
2	https://www.geeksforgeeks.org/measures-of-dispersion/
3	https://www.investopedia.com/terms/s/sampling.asp#:~:text=Sampling%20allows%20researchers%20to%20use,of%20random%20sampling%20or%20bias.
4	https://stats.libretexts.org/Bookshelves/Introductory_Statistics/Introductory_Statistics_(Shafer_and_Zhang)/08%3A_Testing_Hypotheses/8.04%3A_Small_Sample_Tests_for_a_Population_Mean
5	https://emeritus.org/in/learn/data-science-data-science-machine-learning/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	2	2	3
CO2	2	3	3	2	1	1	1	3	2	3	2
CO3	1	3	3	3	2	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	2	2	3
CO5	3	2	3	2	3	3	3	3	2	2	3
Total	12	14	15	13	13	13	13	15	10	11	14
Average	2.4	2.8	3	2.6	2.6	2.6	2.6	3	2	2.2	2.8

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PCHR11	**VE-1 Human Rights**	VE	**1**	**1**	0	0	2	2	25	75	100

Learning Objectives	
LO1	Awareness about Human
LO2	To promote awareness of Human Rights significantly
LO3	To protect Human Rights and its enforceability
LO4	To trace the development of Human Rights.
LO5	To evaluate the Redressal mechanisms practiced in India

Unit	**Content**	**Hours**
1	Human Rights: Meaning, Definition, Nature, Content- Legitimacy of Human Rights- Origin and Development of Human Rights- Theories – Principles of Magna Carta – Modern Movements of Human Rights – The Future of Human Rights.	6
2	International human rights – Human Right concepts Prior and after World War II – UNO – Universal Declaration of Human Rights (UDHR) – International Covenant on Civil and Political Rights (ICCPR) – International Covenant on Economic, Social and Cultural Rights (ICESCR)- Optional Protocols- Human Right Declarations – Role of United Nation Commissions – Convention on the Elimination of All forms of Discrimination against women (CEDAW) – United Nations Convention against Torture (UNCAT) - United Nations Convention on the Rights of the Child (CRC or UNCRC) - Conventions on the Protection of the Rights of Migrant Workers and Disabled.	6
3	European Human Rights System- African Human Rights System – International Human Rights – Enforceability before Domestic Courts.	6
4	The Constitution of India – Fundamental Rights – Right to Life and Liberty – Directive Principles of State Policy – Fundamental Duties – Individual and Group Rights – Other facets of Human Rights – Measures for Protection of Human Rights in India.	6
5	Human Rights – Infringement of Human Right by State Machinery and by Individual – Remedies for State action and inaction – Constitutional remedies – Public Interest Litigation (PIL) - Protection of Human Rights Act, 1993 – National Human Rights Commission – State Human Rights Commissions – Constitution of Human Right Courts	6

CO	Course Outcomes
CO1	The student will be able to know the nature of human rights its origin , the theories, the movements in the march of human rights and the facets of future of human rights.
CO2	The student will be able to know the international dimension of human rights, the role of UN and the global effort in formulating conventions and declarations
CO3	The student will be able to Perceive the regional developments of human rights in Europe , Africa and Asia and the enforceable value of human rights in international arena.
CO4	The student will be able to have knowledge on the human rights perspectives in India, more developed by its constitution and special legislations
CO5	The student will be able to know the redressal mechanism made available in case of human rights violation confined to India.

Textbooks:	
1	Human Rights Lalit Parmar, Anmol Publications Pvt. Limited, 1998
2	Alston, Philip, And Frederic Megret, Eds. The United Nations And Human Rights: A Critical Appraisal. Second Edition. Oxford University Press, 2014.
3	Rebecce Wallace, International Human Rights, Text And Materials 1997
4	Human Rights Bharatiya Values, Mandagadde Rama Jois, Bharatiya Vidya Bhavan, 2015
5	G S Bhargave and R M Pal Human Rights of Dalit Societal Violation 1999
Reference Books:	
1	Protection Of Human Rights Act, 1993.
2	Constitutional Law of India (3 Volumes) by Seervai H.M 2015
3	The Human Rights Watch Global Report On Women's Human Rights 2000 Oxford Publication
4	RS Sharma Perspectives In Human Rights Development
5	Research Handbook On International Human Rights Law, Edited By Sarah Joseph & Edited By Sarah Joseph, Edward Elgar Publishing Limited USA
Web resources:	
1	https://www.un.org/en/global-issues/human-rights#:~:text=Human%20rights%20are%20rights%20inherent,and%20education%2C%20and%20many%20more.
2	https://www.ohchr.org/en/instruments-mechanisms/instruments/international-covenant-civil-and-political-rights
3	https://digitalcommons.law.uga.edu/cgi/viewcontent.cgi?article=1079&context=stu_llm
4	https://byjus.com/free-ias-prep/directive-principles-of-state-policy/
5	https://niu.edu.in/sla/online-classes/Amartish-Kaur_Human-Rights.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	3	3	3	2
CO2	2	3	3	2	2	3	2	2	2	3	2
CO3	3	3	2	2	3	2	3	2	3	2	2
CO4	3	3	3	3	2	3	3	2	3	2	2
CO5	3	2	3	3	3	3	2	2	2	3	3
Total	14	14	14	13	13	13	13	11	13	13	11
Average	2.8	2.8	2.8	2.6	2.6	2.6	2.6	2.2	2.6	2.6	2.2

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC21	**ENZYMOLOGY**	Core	**3**	**1**	2	0	4	6	25	75	100
Learning Objectives											
LO1	Students will be introduced to the classification of enzymes										
LO2	Mechanisms of catalysis and factors affecting catalysis will be Understood.										
LO3	Mechanism of enzymic action will be studied										
LO4	Students will learn about the applications of coenzymes and isoenzymes in research, medicine, and industry										
LO5	Industry and Clinical uses of enzymes, Which will prepare them for careers in industrial and biomedical research.										
Unit	**Content**										**Hours**
1	Nomenclature and classification of enzymes, isolation and purification of enzymes - enzymeprotein determination by different methods, criteria of purity - specific activity. Enzyme units - Katal, IU. Measurement of enzyme activity - two-point assay, kinetic assay, using radiolabelled substrates. Active site - determination of active site amino acids - chemical probe, affinity label, and site-directed mutagenesis, intrinsic and extrinsic regulations. Investigation of 3-D structure of active site. A brief account of nonprotein enzymes - ribozymes and DNA enzymes.										20
2	Kinetics of single substrate enzyme - catalyzed reactions - Michaelis - Menten equation,importance of Vmax, Km, MM equation, and turnover number; Lineweaver - Burk plot,Eadie - Hofstee plot, .Presteady - state kinetics and relaxation kinetics. Kinetics of Allosteric enzymes - MWC andKNF models Hill' equation coefficient. Kinetics of multi - substrate enzyme - catalysedreactions - Ping-pong bi-bi, random order and compulsory order mechanism.										20
3	Mechanism of enzymic action , mechanism of serine proteases - chymotrypsin, lvsozyme, carboxy peptidase A and ribonuclease. Reversible inhibition - competitive, uncompetitive, noncompetitive, mixed, substrate and allosteric inhibition. Irreversible inhibition.										20
4	Enzymes - prosthetic group, classification - vitamin and nonvitamin coenzymes, thiamine pyrophosphate - mechanism of oxidative and nonoxidative decarboxylation, transketolase reaction, PALP and PAMP - role of PALP in transamination and decarboxylation reaction, folate coenzymes and vitamin C, metabolite and nonvitamin coenzymes, lipoic acid, coenzyme Q, nucleoside triphosphate and S-adenosyl methionine. Isoenzymes.										15

5	Industrial uses of enzymes - sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry, detergents and cheesed production. Clinical enzymology - Enzymes as thromblytic agents, anti-inflammatory agents. Immobilization of enzymes and their applications.	15

CO	Course Outcomes
CO1	Will be able to understand the classification of enzymes
CO2	Choose and use the appropriate methods to isolate and purify enzymes and check the purity of the enzyme
CO3	Gain the knowledge on Mechanism of enzymic action
CO4	Describe the isoenzyme and coenzymes role and its application
CO5	Highlight the use of enzymes in industries and biomedicine

Textbooks:	
1	1.Enzymes: Biochemistry, Biotechnology and Clinical chemistry, 2nd edition, 2007, Palmer T and Bonner P; Affiliated- East West press private Ltd, New Delhi
2	Fundamentals of Enzymology, 3rd edition, 2003, Price NC and Stevens L; Oxford University Press, New York
3	Lehninger Principles of Biochemistry, 8th edition, 2021, .Nelson DL and Cox MM; WH Freeman & Co, New York
4	Biochemistry, Berg JM, Stryer L, Gatto,G, 8th ed, 2015;WH Freeman & Co., New York.
5	Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.
Reference Books:	
1	J. M. Berg, J. L. Tymoczko and L. Stryer, Biochemistry (9th Edition), W.H. Freeman, 2019.
2	Voet's Biochemistry, Adapted ed, 2011,Voet,D and Voet JG; Wiley, India
3	W. B. Wood, J. H. Wilson, R. M. Benbow, and L. E. Hood., Biochemistry: A problems approach, (2nd Edition), Benjamin/Cummins Publishing Company, 1981.
4	Garrett,R. and Grisham.C.2010.Biochemistry,4th Edition, Saunders college Publishing.
5	Enzyme Kinetics and Mechanism; Cook PF, Cleland W, ;2007; Garland Science, London

Web resources:	
1	https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Fundamentals_of_General_Organic_and_Biological_Chemistry_(LibreTexts)/19%3A_Enzymes_and_Vitamins/19.03%3A_Enzyme_Classification
2	https://teachmephysiology.com/biochemistry/molecules-and-signalling/enzyme-kinetics/
3	https://byjus.com/chemistry/enzyme-inhibition/#:~:text=Enzyme%20inhibitors%20can%20block%20the,hydrophobic%20contacts%2C%20and%20ionic%20bonds.
4	https://byjus.com/question-answer/what-are-enzymes-define-apoenzyme-and-coenzyme/
5	https://byjus.com/biology/applications-of-enzymes/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	3	1	3	2	2	3
CO2	3	3	3	3	2	2	1	3	2	3	2
CO3	3	3	3	3	2	2	2	3	2	2	3
CO4	3	3	3	3	2	2	2	3	2	2	3
CO5	3	3	3	2	2	1	2	3	2	2	3
Total	15	14	15	12	10	10	08	15	10	11	14
Average	3	2.8	3	2.4	2	2	1.6	3	2	2.2	2.8

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC22	**INTERMEDIARY METABOLISM**	Core	**3**	**1**	2	0	4	6	25	75	100

Learning Objectives	
LO1	Familiarize on modes of synthesis and degradation of glucose
LO2	Provide an insight into the metabolic path way of Fatty acid & Cholesterol
LO3	Inculcate knowledge on nucleotide metabolism and disorders
LO4	Provide a platform to understand the Biosynthesis of Non-essential amino acids
LO5	Educate on heme and Jaundice

Unit	**Content**	**Hours**
1	Glycolysis – aerobic and anaerobic, inhibitors, and regulation. Glyoxalate cycle and its regulation. Gluconeogenesis- source, key enzymes, reaction sequence and its regulation. Pentose phosphate pathway- significance and its regulation. Metabolism of glycogen – glycogenesis and Glycogenolysis - its regulation.	20
2	Oxidation of fatty acids-oxidation of saturated and unsaturated fatty acids (α, β & ω oxidation). Ketogenesis and its regulation. Biosynthesis of fatty acid–saturated and unsaturated, chain elongation, regulation. Biosynthesis of prostaglandins, thromboxanes and leukotrienes. Biosynthesis and degradation of triacylglycerol, phosphoglycero lipids-lecithin, cephalin, plasmalogens and phosphatidyl inositol, Sphingolipid-sphingomyelin. Cholesterol biosynthesis and its regulation.	20
3	Metabolism of nucleotides- *De novo* 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.	15
4	Biosynthesis of Non-essential amino acids-Alanine,Arginine, Glutamine,asparagine and proline . Interconversion of amino acids - proline to glutamate, methionine to cysteine, serine to glycine. Degradation of amino acids –glucogenic and ketogenic amino acids. Formation of acetate from leucine and aromatic amino acid, pyruvate from cysteine, threonine and hydroxy proline, α-keto glutarate from histidine.	20
5	Heme Biosynthesis and degradation:Structure of heme,Biosynthesis of heme,Porphyria types-Congenital porphyria and acquired porphyria catabolism of heme, Jaundice-classification-Hemolytic jaundice,Hepato cellular jauntice and obstructive jaundice.Differential diagnosis of jaundice.	15

CO	Course Outcomes
CO1	Appreciate the modes of synthesis and degradation of glucose
CO2	Gain knowledge on oxidation of fatty acids and cholesterol metabolism
CO3	Recall the nucleotide metabolism and disorders
CO4	Gain knowledge on Biosynthesis of Non-essential amino-acids
CO5	Gain the knowledge on biosynthesis of heme and Jaundice

Textbooks:	
1	David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H.Freeman
2	Voet.D and Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.
3	Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
4	Zubay G.L (1999) Biochemistry , (4th ed), Mc Grew-Hill.
5	Textbook of Biochemistry with Clinical Correlations, 7th Edition,Thomas M. Devlin (Editor), Wiley
Reference Books:	
1	Lehninger Principles of Biochemistry" by Albert Lehninger, David L. Nelson, and Michael M. Cox
2	Harper's Biochemistry" by Robert K. Murray, Daryl K. Granner, and Peter A. Mayes
3	Biochemistry" by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer
4	Textbook of Biochemistry with Clinical Correlations" by Thomas M. Devlin
5	Biochemical Pathways: An Atlas of Biochemistry and Molecular Biology" by Gerhard Michal and Dietmar Schomburg
Web resources:	
1	**https://www.embopress.org/doi/full/10.1038/msb.2013.19**
2	**https://people.wou.edu/~guralnl/450Glycogen%20metabolism.pdf**
3	**https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3243375/**
4	**https://www.researchgate.net/publication/334458898_Urea_Cycle**
5	**https://www.researchgate.net/publication/51233381_Heme_biosynthesis_and_its_regulation_Towards_understanding_and_improvement_of**

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	1	3	3	1	3	3	2	3
CO2	3	3	3	3	2	2	1	3	2	3	2
CO3	3	3	3	2	2	2	2	3	2	2	3
CO4	3	3	3	3	3	2	2	3	3	2	3
CO5	3	3	3	2	2	1	2	3	2	2	3
Total	15	14	15	11	12	10	08	15	12	11	14
Average	3.0	2.8	3.0	2.2	2.4	2.0	1.6	3.0	2.4	2.2	2.8

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC23	**CORE COURSE - 6** **Practical - Enzyme Assays**	Core	**0**	**0**	4	0	3	4	25	75	100

Learning Objectives	
LO1	Students will be able to determine the optimum pH and temperature for various enzymes, interpreting the impact of these conditions on enzyme activity.
LO2	Students will be able to assess the effects of substrate concentration on enzyme activity, using Michaelis-Menten kinetics to describe the relationship between substrate concentration and reaction rate
LO3	Students will be able to relate the findings of enzyme assays to clinical and physiological implications, such as diagnosing diseases based on enzyme levels in serum

Unit	**Content**	**Hours**
1	**Alkaline phosphatase** a.Determination of optimum pH. b.Determination of optimum temperature. c.Effect of substrate concentration on alkaline phosphatase activity. d.Activity of Alkaline Phosphatase **Salivary Amylase** a. Determination of optimum pH of salivary amylase b. Determination of optimum temperature of salivary amylase. c. Effect of substrate concentration on the activity of salivary amylase. e. Activity of salivary Amylase **Assay of Serum Acid phosphatase** a. Determination of optimum pH of Acid phosphatase b. Determination of optimum temperature of Acid phosphatase c. Effect of substrate concentration on the activity of Acid phosphatase **Assay of serum Transaminases** SGOT- serum glutamic-oxaloacetic transaminase SGPT- serum glutamic-oxaloacetic transaminase	60 Hours

CO	Course Outcomes
CO1	Students will demonstrate an understanding of enzyme kinetics, including the effects of pH, temperature, and substrate concentration on enzyme activity
CO2	Students will develop practical skills in enzymatic assays, including the preparation of buffers, incubation of enzyme reactions.
CO3	Able to quantification of enzyme activity using spectrophotometry.
CO4	Students will apply critical thinking to analyze experimental data, interpret results
CO5	Understand the physiological significance of enzyme activity

Textbooks:	
1	Voet, Donald and Judith G. Voet, Book Name: Biochemistry, Edition Year: 4th Edition (2011), Publisher: John Wiley & Sons
2	J. JayaramanLaboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011
3	S. K. SawhneyRandhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd 2 edition, 2005.
4	Alan H GowenlockVarley's Practical Clinical Biochemistry, CBS Publishers and distributors, India Sixth Edition, 1988.
5	Practical Biochemistry - K. Wilson and I. Walker. 5th edition, Cambridge University press, 2000.
Reference Books:	
1	Medical laboratory Technology Volume I, II & III - KL Mukherjee
2	Biochemical Methods - S.Sadasivam & A.Manickam, New Age International
3	Practical Biochemistry – Shawney.
4	Gupta, Book Name: Practical Biochemistry, Edition Year: 3rd Edition (2017) Publisher: Tata McGraw-Hill
5	J. A. Berg and R. M. R. C. McKenzie, Book Name: Practical Biochemistry: Principles and Techniques, Edition Year: 2nd Edition (2018), Publisher: Springer
Web resources:	
1	https://courseware.cutm.ac.in/wp-content/uploads/2020/06/Practice-6.pdf
2	https://www.iitg.ac.in/biotech/BTechProtocols/Ascorbic.pdf
3	https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/3%20ESTIMATION%20OF%20SUGAR.pdf
4	https://fssai.gov.in/upload/uploadfiles/files/Revised-method-acid-value_Oils_Fats_20_02_2018.pdf
5	https://egyankosh.ac.in/bitstream/123456789/43428/1/Experiment-24.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	15	15	15	15	15	15	15	15	15	15
Average	3	3	3	3	3	3	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC24	**Core Course -7 Biochemical Techniques**	Core	2	1	1	0	3	4	25	75	100

Learning Objectives	
LO1	Will be able to explain the electromagnetic spectrum, principles, instrumentation, and applications of various spectroscopic techniques.
LO2	Will demonstrate a clear understanding of chromatographic principles
LO3	Will acquire hands-on skills in performing electrophoresis for proteins and nucleic acids
LO4	Will be proficient in measuring and detecting radioactivity using tools like GM counters Will scintillation counters
LO5	Will learn various immunotechniques

Unit	Content	Hours
1	**UNIT I : Spectroscopy** Electromagnetic spectrum-Regions. Definitions for wavelength, wavenumber and frequency, Stoke's shift. Absorption and emission spectra. Beer- Lambert law. Absorbance and transmittance. Principle, Instrumentation, and applications - UV and Visible spectrophotometry, Spectrofluorimetry, Atomic absorption and Flame emission spectroscopy, circular dichroism, NMR and ESR and X-ray diffraction.	**12 Hours**
2	**UNIT II: Chromatography** Principles of chromatography, Partition coefficient- Rf value. Principle, operation procedure and applications of - Paper chromatography, thin layer chromatography, Ion exchange, Gel permeation chromatography and affinity chromatography, GC, HPLC, HPTLC.	**12 Hours**
3	**UNIT III: Ultracentrifugation and Radioactivity** Ultracentrifugation - basic principles. Preparative ultracentrifugation - differential centrifugation and density gradient centrifugation. Analytical centrifugation, applications - determination of molecular mass and purity of macromolecules. Nature of radioactivity - stable and radioactive isotopes - units and interaction of radioactivity with matter. Detection and measurement of radioactivity - GM counter, solid and liquid scintillation counter, Autoradiography. Applications of radioisotopes in the biological sciences.	**12 Hours**
4	**UNIT IV: Electrophoresis** General principles. Support media. Electrophoresis of proteins -SDS - PAGE, 2D - PAGE, native gels, isoelectric focusing. Cellulose acetate electrophoresis. Blotting-DNA, mRNA. Electrophoresis of nucleic acids - agarose gel electrophoresis, pulsed field gel electrophoresis.	**12 Hours**

5	**UNIT V: Histochemical and Immunotechniques** Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, immunofluorescence microscopy, FISH (Fluorescence In Situ Hybridization) and GISH (Genomic In Situ Hybridization) Techniques. Immunohistochemistry, H & E Staining.	**12 Hours**

CO	Course Outcomes
CO1	Will understand the principles, instrumentation, and applications of various spectroscopic methods
CO2	Will gain a comprehensive understanding of chromatography techniques and electrophoresis methods used in protein and nucleic acid analysis
CO3	Will explore the principles and applications of ultracentrifugation and the use of radioisotopes in biological sciences, focusing on their measurement and detection methods
CO4	Will learn various electrophysiological techniques such as single-neuron recording, brain activity recording, PET, and MRI to study brain function and pharmacological testing
CO5	Will be able to utilize advanced immunotechniques like ELISA, RIA, western blot, and FISH/GISH for the detection of biomolecules and genetic material in biological research

Textbooks:	
1	Analytical Biochemistry by P.Asokan, China publications, (2003)
2	David L. Nelson, Michael M. Cox – Lehninger Principles of Biochemistry, 7th Edition, W.H. Freeman and Company.
3	Keith Wilson, John Walker – Principles and Techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press.
4	Douglas A. Skoog, F. James Holler, Stanley R. Crouch – Principles of Instrumental Analysis, 7th Edition, Cengage Learning.
5	Donald Voet, Judith G. Voet – Biochemistry, 4th Edition, John Wiley & Sons
Reference Books:	
1	Practical Biochemistry by K. Wilson and I. Walker. 5th edition, Cambridge University press (2000)
2	Physical Biochemistry by David Frifelder. W. H. Freeman; 2 edition (1982)
3	Instrumental Methods of Chemical Analysis by Galen Wood Ewing Mcgraw-Hill College ; Fifth edition (1985).
4	George G. Guilbault – Chromatography: A Laboratory Handbook of Chromatographic and Electrophoretic Methods, 2nd Edition, Springer.
5	Jeremy M. Berg, John L. Tymoczko, Lubert Stryer – Biochemistry, 8th Edition, W.H. Freeman and Company.
Web resources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link
2	https://tvuni.academia.edu/mvinayagam
3	https://ncert.nic.in/textbook.php
4	https://ndl.iitkgp.ac.in/
5	https://cec.nic.in/cec/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	2	3	2
CO3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	2	3	3	3	3	3	3	3	3	2
CO5	3	3	3	3	3	3	3	3	2	3	3
Total	15	13	15	15	15	15	15	15	13	13	13
Average	3	2.6	3	3	3	3	3	3	2.6	2.6	2.6

3 – Strong, 2- Medium, 1- Low

1st YEAR : SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE21	**Elective Course -3 Ecology Evolution and Biodiversity**	Elective	2	1	1	0	3	4	25	75	100

Learning Objectives	
LO1	Understand Fundamental Ecological Concepts
LO2	Analyze Population and Community Dynamics
LO3	Interpret Ecosystem Functions and Biogeochemical Cycles
LO4	Examine Evolutionary Processes and Mechanisms
LO5	Evaluate Biodiversity and Conservation Strategies

Unit	Content	Hours
1	**UNIT I : Fundamentals of Ecology** Principles of ecology, scope and significance. Levels of organization: individual, population, community, ecosystem. Types of ecosystems (terrestrial, aquatic, marine) and their components. **Population Ecology** Characteristics of populations: population size, density, age structure. Population growth models (exponential, logistic). Population regulation, life history strategies (r and K selection)	**12 Hours**
2	**UNIT II: Community Ecology** Structure and composition of communities. Ecological niches, species interactions (competition, predation, mutualism). Community succession and climax community. Ecological stability, resilience, and diversity. **Ecosystem Structure and Function** Energy flow and food chains/webs. Ecological pyramids (biomass, energy, and numbers). Biogeochemical cycles (carbon, nitrogen, phosphorus, water). Primary and secondary productivity.	**12 Hours**
3	**UNIT III: Evolutionary Biology** Theories of origin and evolution of life. Early Earth conditions and the Miller-Urey experiment. Mechanisms of Evolution - Hardy-Weinberg equilibrium and factors affecting it. Natural selection, genetic drift, gene flow, mutation. Adaptation, fitness, and evolutionary trade-offs. Sexual selection and kin selection	**12 Hours**
4	**UNIT IV: Speciation and Extinction** Mechanisms of speciation: allopatric, sympatric. Adaptive radiation and convergent evolution. Mass extinctions and their causes. Phylogenetics and evolutionary trees. Evolutionary Theories and Evidence: Darwinism, Neo-Darwinism, and Modern Synthesis. Molecular evolution, gene duplication, and genome evolution Paleontology, fossil records, and molecular clocks.	**12 Hours**

5	**UNIT V: Biodiversity and Conservation** Levels of biodiversity: genetic, species, and ecosystem diversity. Hotspots and global patterns of biodiversity. Endemism, keystone species, and flagship species. Species-area relationships, alpha, beta, and gamma diversity. Factors influencing biodiversity gradients (latitudinal diversity). In-situ (protected areas, biosphere reserves) and ex-situ conservation (zoos, gene banks). Role of international agreements (CITES, CBD). IUCN categories of threatened species. Restoration ecology and rewilding.	**12 Hours**

CO	**Course Outcomes**
CO1	Explain the core principles of ecology, including the hierarchical levels of organization and their relevance in understanding individual, population, and community dynamics within different ecosystems
CO2	Analyze species interactions, including competition, predation, and mutualism, and evaluate the process of community succession, climax communities, and factors contributing to ecological stability and resilience.
CO3	Demonstrate a clear understanding of evolutionary mechanisms such as natural selection, genetic drift, mutation, and gene flow
CO4	Identify and differentiate between various speciation processes, describe the phenomena of adaptive radiation, and critically assess the evolutionary patterns from the fossil record, phylogenetics, and molecular clocks
CO5	Evaluate the importance of biodiversity at different levels, discuss conservation strategies for biodiversity hotspots, and assess the role of international conventions

Textbooks:

1	Eugene P. Odum, Gary W. Barrett Fundamentals of Ecology, Edition: 5th Edition Year: 2005 Publication: Cengage Learning
2	Peter J. Morin, Community Ecology, Edition: 2nd Edition Year: 2011, Publication: Wiley-Blackwell
3	Douglas J. Futuyma, Mark Kirkpatrick, Evolution, Edition: 4th Edition Year: 2017, Publication: Sinauer Associates
4	Brian K. Hall, Benedikt Hallgrimsson, Strickberger's Evolution, Edition: 5th Edition, Year: 2014, Publication: Jones & Bartlett Learning
5	Michael J. Jeffries, Biodiversity and Conservation, Edition: 2nd Edition, Year: 2006 Publication: Routledge

Reference Books:

1	Odum, E.P. Fundamentals of Ecology, Edition: 5th, Year: 2005, Publisher: Brooks/Cole Cengage Learning
2	Smith, T.M., and Smith, R.L., Elements of Ecology, Edition: 9th, Year: 2015, Publisher: Pearson Education
3	Begon, M., Townsend, C.R., and Harper, J.L. Ecology: From Individuals to cosystems, Edition: 4th., Year: 2006, Publisher: Wiley-Blackwell
4	Freeman, S., Herron, J.C. Title: Evolutionary Analysis, Edition: 5th, Year: 2014 Publisher: Pearson Education
5	Krebs, C.J. Title: Ecology: The Experimental Analysis of Distribution and Abundance Edition: 6th Year: 2009, Publisher: Benjamin Cummings

Web resources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link – eBooks google drive
2	https://tvuni.academia.edu/mvinayagam - Educational networks to share research, knowledge, teaching documents, chapters, e-notes, e-books, thesis, materials.
3	https://ncert.nic.in/textbook.php
4	National Digital Library - https://ndl.iitkgp.ac.in/
5	https://cec.nic.in/cec/ - e-Content courseware in UG/PG subjects

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	3	1	2	2	3	2	2	2
CO2	3	3	2	2	2	3	2	2	2	2	3
CO3	3	3	3	3	2	2	2	3	2	2	2
CO4	3	3	3	3	2	3	2	3	2	2	3
CO5	3	3	2	2	2	3	2	2	2	2	3
Total	15	14	13	13	9	13	10	13	10	10	13
Average	3	2.8	2.6	2.6	1.8	2.6	2	2.6	2	2	2.6

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE22	**Elective Course -4 Genetics**	Elective	2	1	1	0	3	4	25	75	100

Learning Objectives	
LO1	Acquire knowledge of the Premendelian theories of heredity.
LO2	To comprehend the Laws of Probability and Mendelian Inheritance.
LO3	To understand Morgan's Law, the Linkage, and crossing across.
LO4	To comprehend both quantitative and human genetics.
LO5	To understand Hardy Weinberg Law and population genetics.

Unit	Content	Hours
1	**UNIT-I: Genetic basis of life** A fundamental overview of genetics, history and scope of the subject. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests. Mendelian genetics, laws of inheritance (Law of Segregation and Independent Assortment), monohybrid and dihybrid crosses.	**12 Hours**
2	**UNIT-II: Extensions of Mendelian principles** Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited, and sex influenced characters	**12 Hours**
3	**UNIT-III: Genetic variations** Sources of genetic variation: mutations, recombination (including models of recombination), independent assortment; analyzing genetic variation by using markers: phenotypic, biochemical and molecular (isozymes and DNA markers).	**12 Hours**
4	**UNIT-IV: Human and Quantitative genetics:** Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.	**12 Hours**
5	**UNIT-V: Mutation and Recombination**: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination: Homologous and non-homologous recombination including transposition.	**12 Hours**

CO	Course Outcomes
CO1	Define the characteristics of Mendelian concepts of heredity, rediscovery of Mendel's original work, and genetic maps.
CO2	Explain the laws of segregation and independent assortment. Provide examples of Mendel's monohybrid and dihybrid crosses.
CO3	Develop your understanding of linkages, their types, and their implications. Significance
CO4	Perceive the key concepts. Human genetics and quantitative genetics
CO5	Develop an understanding of population genetics, frequency, factors affecting gene frequency, eugenics, euphenics, and euthenics.

Textbooks:	
1	A.V.S.S Sambamurty, (2007), Molecular Genetics, Narosa, Chennai.
2	P.J. Russell (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings
3	An Introduction to Human Molecular Genetics (2nd Edition), J.J.Pasternak, 2005
4	Human Molecular Genetics (4th Edition), Tom Strachan & Andrew Read, 2010.
5	Cell and molecular biology by G. Karp, John Wiley & Sons Inc (2002)
Reference Books:	
1	E.J. Gardner, M.J.Simmons and D.P. Snustad (2008). VIII ed. Principles of Genetics. Wiley India.
2	D.P. Snustad M.J. Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3	W.S. Klug, M.R. Cummings, C.A, Spencer, C.A. (2009). Concepts of Genetics. XI Edition.Benjamin Cummings.
4	B.R. Glick, J.J Pasternak (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
5	Gurbachan S Miglani (2006), Developmental Genetics, IK. International, New Delhi.
Web resources:	
1	https://youtu.be/16awMF47TjY?si=WvIgYyxmhSqqo25J
2	https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/General_Biology_(Boundless)/12%3A_Mendel's_Experiments_and_Heredity/12.01%3A_Mendels_Experiments_and_the_Laws_of_Probability/12.1E%3A_Rules_of_Probability_for_Mendelian_Inheritance
3	https://youtu.be/ZSGLiZWwpnM?si=9ES5EXP8FThLe47H
4	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10491316/
5	https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/General_Biology_(Boundless)/19%3A_The_Evolution_of_Populations/19.01%3A_Population_Evolution/19.1B%3A_Population_Genetics

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	3	3	3	2
CO4	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	2	2
Total	15	13	15	15	15	15	15	15	13	13	13
Average	3	2.6	3	3	3	3	3	3	2.6	2.6	2.6

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCS21	**BIOINFORMATICS**	SEC-1 NME	**3**	**1**	2	0	2	2	25	75	100

Learning Objectives	
LO1	This unit introduces students to the basic concept of bioinformatics, focusing on the simple definition and importance of bioinformatics.
LO2	This unit covers the basics of biological databases.
LO3	Students will learn what sequence alignment.
LO4	Students will learn the DNA and Protein sequence alignment.
LO5	The final unit focuses on how bioinformatics is used in everyday life.

Unit	Content	Hours
1	**Unit 1: Introduction to Bioinformatics** Introduction to bioinformatics, The history and evolution of bioinformatics, the scope of its applications in drug discovery, genomics, and proteomics. Key terminologies and concepts like genes, proteins, and DNA sequences.	6
2	**Unit 2: Biological Databases and Tools** Introduction to Biological databases. Types of biological database. the real-world applications of DNA and protein databases. Bioinformatics tools used for sequence alignment - BLAST (Basic Local Alignment Search Tool).	6
3	**Unit 3: DNA sequence databases** DNA sequence databases like GenBank, European Nucleotide Archive (ENA), and DNA Data Bank of Japan (DDBJ).	6
4	**Unit 4: protein sequence databases** Protein sequence databases - UniProt, Protein Data Bank (PDB), and Swiss-Prot.	6
5	**UNIT-V: application of Bioinformatics** Medical application of Bioinformatics. Drug designing. Discovery, Preclinical pharmacology and toxicology studies, agriculture, healthcare.	6

CO	Course Outcomes
CO1	Students will comprehend the basic concepts and the significance of DNA and protein databases in bioinformatics.
CO2	Students will be able to differentiate between DNA sequence databases like GenBank and protein databases
CO3	Students will gain practical knowledge of tools like BLAST
CO4	Students will be capable understanding how these sequences are used in biological research
CO5	Students will understand the practical applications of DNA and protein databases

Textbooks:	
1	Dassanayake S.Ranil, Y.I.N. Silva Gunawardene, 2011. Genomic and Proteomic Techniques, Narosa Publishing House Pvt. Ltd, New Delhi.
2	Thiagarajan B, Rajalakshmi.P.A., 2009. Computational Biology, MJP publishers, Chennai.
3	Bosu Orpita, SimminderKaurThukral, 2007. Bioinformatics Databases, Tools and Algorithms, Oxford University press, New Delhi.
4	Rastogi.S.C, Mendiratta.N, Rastogi.P, 2004. Bioinformatics methods and applications, Prentice-Hall of India private limited, New Delhi.
5	Lohar s. Prakash, 2009. Bioinformatics, MJP Publishers, Chennai.
Reference Books:	
1	Structural Bioinformatics" by Philip E. Bourne and Helge Weissig
2	Protein Structure Prediction: Methods and Protocols" edited by David M. Webster
3	Structural Genomics and High-Throughput Structural Biology" edited by J. M. Thornton
4	Molecular Modeling and Simulation: An Interdisciplinary Guide" edited by Scott C. Smith
5	Protein-Ligand Interactions: Methods and Protocols" edited by Mark R. Sanderson
Web resources:	
1	https://www.youtube.com/watch?v=lhU3CzslFqw
2	https://www.youtube.com/results?search_query=Biological+Databases+and+Tools+
3	https://www.youtube.com/results?search_query=DNA+sequence+databases+
4	https://www.youtube.com/results?search_query=protein+sequence+databases+
5	https://www.youtube.com/results?search_query=application+of+Bioinformatics

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	1	3	3	3	3
CO2	3	3	3	3	2	2	1	3	2	3	2
CO3	3	3	3	3	3	3	3	2	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3
Total	15	15	15	15	13	14	11	12	14	15	14
Average	3.0	3.0	3.0	3.0	2.6	2.8	2.2	2.4	2.8	3.0	2.8

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC31	**CC – 8: Clinical Biochemistry**	**Core**	**3**	**1**	**2**	**-**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To gain knowledge on the role of biochemical investigations in diagnosing, prognosing, and monitoring diseases, while identifying and diagnosing blood cell disorders.
LO2	To discuss the Carbohydrate and lipid metabolic disorder disease
LO3	To explore the different organ function tests for liver and kidney.
LO4	To explore the Hormonal disorders free Radical and Diseases
LO5	To understand the clinical significance of diagnostic enzymes

Unit	Content	Hours
I	**Biochemical investigations in diagnosis, prognosis, monitoring, screening:** Specimen collection – blood, (primary /Secondary specimen)., urine and CSF. Preservation of biological specimens -blood, urine, CSF and amniotic fluid. ; . Biological reference ranges; **Disorders of blood cells:** Hemolytic, iron deficiency and aplasticanemia and diagnosis, sickle cell anaemia, thalassemia HBA1C variants. Porphyrias, Thrombocytopenia, Causes of leucopenia, leukemia and leucocytosis. Disorders of blood clotting mechanism - Von wille brands disease, Hemophilia A, B and C, diag	16
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 (IFT), 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, Micralbuminuira, eGFR, Diet and life style modifications	16

III	**Liver function tests.** Serum bilirubin, Serum albumin, Alanine transaminase (ALT), Aspartate transaminase (AST), Alkaline phosphatase (ALP), Gamma-glutamyl transpeptidase (GGT), Serum glucose test, Prothrombin time (PT), Van Ben Bergh reaction. **Renal function tests**. Clearance Tests: Creatinine clearance test, Urea clearance test, Inulin clearance test, Blood Urea Nitrogen	20
IV	**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. **Free Radical and Diseases:** Free radicals - reactive oxygen species and reactive nitrogen species. Formation of free radicals- Oxidative stress- Free radical and diseases. Metabolism of iron, calcium and phosphorus, Trace elements and their deficiency. Applications of Artificial Intelligence in Medicine.	20
V	**Diagnostic Enzymology:** Clinically Important Enzymes and Isoezyme as diagnostic markers: Clinical significance of AST, ALT, ALP, ACP, CK, 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. New born screening (NBS) for In born errors of metabolism, Tandem mass spectrometry application in NBS	18
	Course Outcomes **The student will be able to**	
CO1	Appreciate the basics of clinical biochemistry lab practices and biological sample analysis	
CO2	Access the disorders of Carbohydrates and lipids metabolism	
CO3	Analyze and implement the various organ function tests.	
CO4	Access the Hormonal disorders and free radical diseases	
CO5	Examine the Clinically Important Enzymes and Pre and Post-natal testing	

Textbooks:	
1	MN. Chatterjee - Text book of medical biochemistry - Fourth edition- Jaypee Publisher
2	U.Sathyanarayana& U. Chakrapani, Biochemistry - Third edition, Book and Allied (p) ltd.
se 3	Vasudevan DM, Sreekumari S, Vaidyanathan K. Biochemistry for Medical Students. 3rd ed. New Delhi: Jaypee Brothers Medical Publishers; 2020.
4	K.V. Krishna Das, Text Book of Medicine - Jaypee Brothers Medical Publishers (P) Ltd, 1996.
5	Ambika Shanmugam's Biochemistry for medical students, 8 th edition, published by Wolters Kluwer India Pvt. Ltd.
Reference Books:	
1	Philip. D. Mayne, Clinical Chemistry in diagnosis and treatment.ELBS Publication, 6 th edition, 1994.
2	Thomas M. Devlin (2014) Text book of Biochemistry with clinical correlations (7thed). John Wiley and sons.
3	Tietz Fundamentals of clinical chemistry and molecular Diagnostics (2014) (7thed) Saunders.
4	Crook MA. Clinical Biochemistry in Practical Medicine. 2nd ed. London: CRC Press; 2018
5	Ferrier DR. Lippincott's Illustrated Reviews: Biochemistry. 8th ed. Philadelphia, PA: Wolters Kluwer; 2022.

Webresources:	
1	https://labtestsonline.org.uk/articles/accuracy-precision-specificity-sensitivity https://www.inorganicventures.com/icp-guide/accuracy-precision-mean-and-standard-deviation
2	https://www.niddk.nih.gov/health-information/blood-diseases
3	https://www.britannica.com/science/metabolic-disease/Disorders-ofcarbohydrate metabolism https://medlineplus.gov/carbohydratemetabolismdisorders.html https://www.osmosis.org/learn/Disorders_of_carbohydrate_metabolism:_Pathology_review https://pmc.ncbi.nlm.nih.gov/articles/PMC8551734/
4	https://www.webmd.com/a-to-z-guides/inherited-metabolic-disorder-types-and-treatments
5	https://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	3	3	3	2	3	3	3	3	3
CO4	3	2	3	3	3	2	3	3	3	3	3
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	9	15	15	15	13	15	15	15	15	15
Average	3	2	3	3	3	2.6	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC32	**CC – 9 : Molecular Biology**	**Core**	**3**	**1**	**2**	**0**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To provide an in-depth understanding of Gene Mapping and Genome Organization in Prokaryotes and Eukaryotes.
LO2	To impart knowledge on DNA replication and repair.
LO3	To provide a comprehensive understanding of the Mechanisms of Gene Expression: Transcription and Translation in Prokaryotes and Eukaryotes.
LO4	To explore the mechanisms of Regulation of gene expression.
LO5	To provide an in-depth understanding of Post-Transcriptional and Post-Translational Modifications and their mechanisms.

Unit	Content	Hours
I	**Gene Mapping and Genome Organization in Prokaryotes and Eukaryotes:**The bacterial chromosome, The eukaryotic genome-chromosome structure – Histones, Nucleosome, chromatin-heterochromatin, euchromatin, chromatin remodelling, DNAase hypersensitive sites, genome organization – the C-value paradox, reassociation kinetics, repetitive sequences, gene amplification, telomeres, organelle genomes – mitochondrial and chloroplast genome. Gene mapping in haploids and diploids, recombination mapping- restriction mapping.	16
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. 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 *E.coli*, site-specific recombination, transposons, and retroposons.	20
III	**Mechanisms of Gene Expression: Transcription and Translation in Prokaryotes and Eukaryotes:** **Transcription**: Prokaryotic transcription-subunits of RNA polymerase, E. coli 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,	20

	transcription factors, regulatory sequences in eukaryotic protein – coding genes, CpG islands, enhancers. 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 **Translation**: Organization of the ribosome,The role of tRNA and rRNA, suppressor tRNAs the genetic code, evidencefor a triplet code, deciphering the genetic code, wobble hypothesis, deviation in the genetic code, unusual codons. Activation, initiation, elongation and termination of translation in E. coli and inhibitors of protein synthesis.	
IV	**Regulation of gene expression:** 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. *Trp* operon– Attenuation, alternative secondary structures of *trp*mRNA. Regulation of gene expression in eukaryotes- Response elements, DNA binding motifs, steroid receptors, association of methylation and histone acetylation with gene expression.	16
V	**Protein Sorting:**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.	18

	Course Outcomes **The student will be able to**
CO1	Analyze and interpret Gene Mapping and Genome Organization in Prokaryotes and Eukaryotes.
CO2	Describe the fundamental processes of DNA replication and repair.
CO3	Explain the mechanisms of transcription and translation in prokaryotes and eukaryotes.
CO4	Compare and contrast gene regulation mechanisms in prokaryotes and eukaryotes.
CO5	Assess to explain the molecular processes involved in RNA and protein modifications.

Textbooks:	
1	Lewin's Genes XII: 12th edition, Krebs JE, Goldstein ES, Kilpatrick ST; Prentice Hall, Delhi
2	Molecular Cell Biology: 8th edition, Lodish H, Arnold Berk; W.H.Freeman& Co, New York
3	Karp's Cell and Molecular Biology: Concepts and Experiments, 8th Edition; Wiley, India
4	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
5	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
Reference Books:	
1	Cox, M. M., Doudna, J. A., & O'Donnell, M. (2015). *Molecular biology: Principles and practice*. W.H. Freeman and Company.
2	Green, M. R., & Sambrook, J. (2012). *Molecular cloning: A laboratory manual* (4th ed.). Cold Spring Harbor Laboratory Press.
3	Goodman, M. F. (2007). *DNA repair and mutagenesis* (2nd ed.). ASM Press.
4	Berg, J. M., Tymoczko, J. L., &Stryer, L. (2007). *Biochemistry* (6th ed.). W.H. Freeman and Company.
5	Twyman, R. M. (2014). *Advanced molecular biology: A comprehensive review of molecular biology concepts and techniques*. Garland Science.

Webresources:	
1	https://mooc.es/course/molecular-biology/
2	https://onlinecourses.swayam2.ac.in/cec20_ma13/preview
3	https://lifescienceinteractive.com/category/molecular-biology/
4	https://learn.genetics.utah.edu/
5	https://www.cellbio.com/education.html

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	3	3	3	3	3
CO2	3	3	3	3	2	2	2	3	3	3	3
CO3	3	3	3	1	2	2	2	3	3	3	3
CO4	3	3	3	3	2	2	2	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3
Total	15	15	15	12	11	10	12	15	15	15	15
Average	3	3	3	2.4	2.2	2.0	2.4	3	3	3	3

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC33P	**CC -10 Practical III - Laboratory Course on Clinical Biochemistry**	**Core**	**-**	**-**	**6**	**-**	**4**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To learn how to measure RBC, WBC (both total and differential counts), ESR, Bleeding Time, and Clotting Time.
LO2	To explain the Measure plasma protein levels and determine the A/G ratio, indicating liver.
LO3	To illustrate the Perform estimations of key renal markers like blood urea, creatinine, and uric acid to evaluate kidney function.
LO4	To describe the procedure and clinical significance of estimating cholesterol levels using Zak's method.
LO5	To gain hands-on experience in various techniques for Antigen and Antibody reaction, venipuncture, blood collection and Automation in Clinical Biochemistry.

Unit	Content	Hours
1	**Haematology:** a) RBC count b) Total WBC count-total and differential count c) ESR d) Estimation of hemoglobin By Shali's method.	90
2	**Liver function test:** a) Estimation of Bilirubin direct and indirect. b) Estimation of Plasma protein, A/G ratio c) Estimation of Alanine Aminotransferase (ALT) d) Estimation of Aspartate Aminotransferase (AST) e) Estimation of Lactate Dehydrogenase (LDH)	
3	**Renal function test:** a) Collection and Preservation of Urine sample(pH, Specific Gravity, Color) b) Qualitative tests for normal and pathological components of urine. c) Estimation of blood Urea by DAM method d) Estimation of blood Creatinine by Alkaline picrate methods e) Estimation of blood uric acid by Phosphotungstic Acid Method	

4	a) Estimation of blood glucose by Ortho toluidine b) Lipid profile: Estimation of cholesterol by Zak's method	
5	**Group Experiments** a) Antigen-Antibody Reaction - HCG kit method b) Phlebotomy-Venipuncture, Different techniques of venipuncture c) Collection of blood, Serum or Plasma separation and Storage. **d)** Automation in Clinical Biochemistry Semi autoanalyzer -Demo	

CO	**The student will be able to Course Outcomes**
CO1	Accurately measure RBC, WBC (total and differential counts), ESR
CO2	Analyze and measure plasma protein levels and determine the A/G (albumin/globulin) ratio, which plays a critical role in assessing liver.
CO3	Perform estimations of key renal markers—blood urea, creatinine, and uric acid to evaluate kidney function.
CO4	Estimate cholesterol levels using Zak's colorimetric method.
CO5	Gain practical experience in various essential laboratory techniques.

Textbooks:	
1	Voet, Donald and Judith G. Voet, Book Name: Biochemistry, Edition Year: 4th Edition (2011), Publisher: John Wiley & Sons
2	J. JayaramanLaboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011
3	S. K. SawhneyRandhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd 2 edition, 2005.
4	Alan H GowenlockVarley's Practical Clinical Biochemistry, CBS Publishers and distributors, India Sixth Edition, 1988.
5	Practical Biochemistry - K. Wilson and I. Walker. 5th edition, Cambridge University press, 2000.
Reference Books:	
1	Medical laboratory Technology Volume I, II & III - KL Mukherjee
2	Biochemical Methods - S.Sadasivam&A.Manickam, New Age International
3	Practical Biochemistry – Shawney.
4	Gupta, Book Name: Practical Biochemistry, Edition Year: 3rd Edition (2017) Publisher: Tata McGraw-Hill
5	J. A. Berg and R. M. R. C. McKenzie, Book Name: Practical Biochemistry: Principles and Techniques, Edition Year: 2nd Edition (2018), Publisher: Springer
Webresources:	
1	https://courseware.cutm.ac.in/wp-content/uploads/2020/06/Practice-6.pdf
2	https://www.iitg.ac.in/biotech/BTechProtocols/Ascorbic.pdf
3	https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/3%20ESTIMATION%20OF%20SUGAR.pdf
4	https://fssai.gov.in/upload/uploadfiles/files/Revised-method-acid-value_Oils_Fats_20_02_2018.pdf
5	https://egyankosh.ac.in/bitstream/123456789/43428/1/Experiment-24.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	1	2	2	3	2	2	2
CO2	3	3	2	2	2	3	2	2	2	2	3
CO3	3	3	3	3	2	2	2	3	2	2	2
CO4	3	3	3	3	2	3	2	3	2	2	3
CO5	3	3	2	2	2	3	2	2	2	2	3
Total	15	14	13	13	9	13	10	13	10	10	13
Average	3	2.8	2.6	2.6	1.8	2.6	2	2.6	2	2	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC34	CC – 11 Immunology and Immunotechnology	Core	3	1	1	0	3	5	25	75	100

Learning Objectives	
LO1	To understand the wide knowledge about Immunity and Lymphoid Organs and Immune Cells.
LO2	To explain the Structure and Properties of Antigens & Antibodies and acquire the knowledge on Major Histocompatibility Complex.
LO3	To analyze the clinical manifestations of various Autoimmune diseases and Hypersensitivity.
LO4	To evaluate clinical diagnostic applications of various Immunotechniques.
LO5	To create a vaccine chart and illustrate key characteristics and differences between vaccine types.

Unit	Content	Hours
I.	History of immunology - Types of immunity: Innate and acquired Immunity, Antibody Mediated Immunity and Cell Mediated Immunity-Lymphoid organs: primary & secondary – Hematopoiesis- Cells of the Immune System - T Lymphocytes, B Lymphocytes and Natural Killer Cells, Antigen Presenting Cells.	15
II.	Antigens and immunogens – Characteristics of ideal antigens – Properties and Types of Antigens - haptens and adjuvants. Antibody types – Domain structure and biological properties – Antibody diversity. Antigen antibody interactions –Agglutination assays and Precipitation assays. Major Histocompatibility Complex (MHC). Complement Pathways.	15
III.	Hypersensitivity: types – Clinical aspects of type I, Type II, III and IV - Autoimmune diseases – Addisons Disease, Rheumatoid Arthritis, Grave's Disease and Myasthenia Gravis. Transplantation – Types of Grafts, Graft Rejection and Graft Acceptance.	15
IV.	Principles of ELISA – types- direct, indirect and sandwich – clinical diagnostic applications - ELISpot assay. Principles and Applications – RIA, Immunohistochemistry, Immunoelectrophoresis, Isoelectric Focussing (IEF) Immunofluorescence and Western Blotting. Hybridoma Technology.	15

V.	Definition of Vaccine - Vaccination methods- History of Vaccine development -Types of Vaccines and their Characteristics – Whole Organism Vaccines (Killed Vaccines and Live Attenuated Vaccines) – Subunit Vaccines (Toxoid Vaccines and Polysaccharide Vaccines) and Nucleic Acid Vaccines (DNA Plasmid Vaccines and Recombinant Vector Vaccines). Vaccine Chart.	15

	Course Outcomes **The student will be able to**
CO1	Analyze the types of Immunity, Immune cells and Lymphoid Organs and its mechanism.
CO2	Apply knowledge of antigen-antibody interactions to understand the principles of immunological assays.
CO3	Evaluate the clinical manifestations and treatment options for autoimmune diseases and describe the clinical aspects of each type of hypersensitivity reaction
CO4	Identify the techniques and applications of immunohistochemistry, immunoelectrophoresis, isoelectric focusing (IEF), immunofluorescence, and Western blotting.
CO5	Assess the vaccine production, types and its applications.

Textbooks:	
1	J. Kuby, R.A. Goldsby, T.J. Kindt and B.A. Osborne, B.A. (2007), Immunology, 4th edition, W.H. Freeman and Company, New York, USA.
2	I. Roitt, J. Brostoff and DMale (2002), Essential Immunology, 8th edition, English Language Book Society, London.
3	J. Kuby (2002), Immunology, 5th edition, W.H. Freeman and Company, New York.
4	Annadurai. B (2008), A textbook of Immunology and Immunotechnology, 1st Edition. S.Chand& Co, Ltd,New York.
5	Rajasekaran Pandian (2007), Immunology and Immunotechnology, Panima Publishers, Chennai.
Reference Books:	
1	Benjamini E, Coico R and G. Sunskise (2008) Immunology a short course. IV edn. (Chapters 1–13) Wiley – Liss publication.
2	Peter J.Delves, Ivan Maurice Roitt,,Seamu J. Martin and Deninis Burton (2006), Roitt's Essential Immunology, 11th edition.
3	Immunology and Immunotechnology, Ashim K.Chakravarthy.
4	Murphy Kenneth (2008), Janeway's Immunobiology, Garland Science Publishers.
5	Ian R. Tizard (2000), Immunology: An Introduction., 4th edition, W.B.SaundersCo.,Philadelphia.

Webresources:	
1	https://ebooks.inflibnet.ac.in/biocp16/chapter/types-of-immunity-innate-and-acquired/
2	https://microbiologynotes.org/immunoglobulin-introduction-structure-and-function/
3	https://www.biologydiscussion.com/biochemistry/immunochemical-techniques/top-7-types-of-immunochemical-techniques-used-in-biochemistry/12525#google_vignette
4	https://microbenotes.com/hypersensitivity-introduction-causes-mechanism-and-types/
5	https://byjus.com/biology/vaccine-definition/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	3	3	3	3	3	3	3	2
CO2	3	2	2	2	3	3	3	3	3	3	2
CO3	3	2	1	2	3	3	3	3	3	3	3
CO4	3	2	2	2	3	3	3	3	3	3	3
CO5	3	2	1	2	3	3	3	3	3	3	3
Total	15	10	7	11	15	15	15	15	15	15	13
Average	3	2	1.4	2.2	3	3	3	3	3	3	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE31	**EC – 1. Fundamentals of Nutritional Biochemistry**	**EC**	**2**	**1**	**1**	**0**	**3**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To impart knowledge about basic concepts of nutrition.
LO2	To identify and understand the Role of Elements in Nutritional Biochemistry.
LO3	Tounderstand nutritional deficiency diseases.
LO4	To analyze the role of antioxidants.
LO5	To evaluate the diet therapy for various diseases.

Unit	Content	Hours
I.	**Concepts of Nutrition**: Food groups and balanced diet. Novel Foods. The calorific value of foods: Direct and indirect calorimetry. Empty calories. Basal metabolic rate: Factors affecting BMR. SDA and physical activity. Calculation of the day's energy requirement. Nutritional requirement and biochemical changes in different physiological states -infancy, childhood, pregnancy, lactation, and aging. Sports nutrition.	12
II.	**Role of Elements in Nutritional Biochemistry**: Plant and animal sources of simple and complex carbohydrates, fats, proteins, Vitamins, and Minerals and their requirement and biochemical functions 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.	12
III.	**Nutritional Deficiency Diseases:** Diseases arise from Protein - Calorie Malnutrition, and undernutrition (Kwashiorkor and Marasmus). Prevention. Deficiency diseases associated with the vitamin B complex include Beri-Beri, Cheilosis, Glossitis, Pellagra, and Scurvy. Diseases associated with fat-soluble Vitamins A, D, E & K - Night Blindness, Rickets, Osteoporosis, Anemia, and Hemorrhagic diseases. Mineral deficiency diseases - symptoms and dietary supplementation. Enrichment and fortification (vitamins and minerals)	12
IV.	**Role of Antioxidants:** Concept of Antioxidants and free radicals. The effect of free radicals, Disease-fighting antioxidants, Sources of antioxidants, and antioxidants, Dietary recommendations for antioxidants- Sources and role of isoprenoids, isoflavones, flavonoids, carotenoids, tocotrienols, terpenoids,	12

	lycopene proanthocyanin, Concept of probiotic, prebiotic, and symbiotic, and its applications in human nutrition.	
V.	**Diet Therapy:** Diet for infection and fevers (typhoid, influenza, malaria), obesity and underweight, cardiovascular diseases, gastrointestinal diseases (Peptic ulcer, Constipation, Irritable bowel syndrome), diabetes, kidney diseases (Glomerular nephritis, Dialysis), food sensitivity and cancer.	12

CO	**The student will be able to Course Outcomes**
CO1	Appropriatelearn the basic concepts of Nutrition.
CO2	Examine the role of Elements in Nutritional Biochemistry.
CO3	Evaluate the Nutritional Deficiency Diseases.
CO4	Identify the Role of Antioxidants.
CO5	Create Diet Therapy for various diseases.

Text Books	
1	Srilakshmi. E .(2016) Nutrition Science, New Age International Publishers.
2	M. Swaminathan (1995) Principles of Nutrition and Dietetics. Bappco
3	Mahan, Kathleen L. (2004) Krause's Food, Nutrition and Diet Therapy, W.B.Saunder's 11th Edition
4	Tom Brody (1998) Nutritional Biochemistry (2nd ed). Academic Press, USA
5	Margaret Mc Williams (2012). Food Fundamentals (10th ed) Prentice Hall Press, USA
Reference Books:	
1	Andreas M. Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1st ed) CRC Press.
2	Weighley, E.S. 1997. Robinson's Basic Nutrition and Diet Therapy, 8th Edition, Macmillan Publishers.
3	Bamji,M.S.et al., 2009. Textbook of Human Nutrition, 3rd Edition, Oxford and IBH Publishers.
4	Insel, P. et al. 2013. Discovering Nutrition, 4th Edition, Jones and Bartlett Publishers.
5	Human Nutrition and Dietetics by Davidson and Passmore. Churchill Livingstone; 8th edition (1986)
6.	Modern Nutrition and Health Diseases by M.E. Skilis and V.R. Young

Web resources:

1. https://www.jmedscindmc.com/article.asp?issn=1011-4564;year=2014;volume=34;issue=5;spage=211;epage=213;aulast= Shrivastava
2. https://www.researchgate.net/figure/Relationship-between- malnutrition-infection-and-immunity-Malnutrition-is-considered- the_fig1_280722727
3. https://en.wikipedia.org/wiki/Novel_food
4. https://www.chemicalsafetyfacts.org/preservatives/
5. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/food-enrichment

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	3	1	3	2	2	3
CO2	3	3	3	3	2	2	1	3	2	3	2
CO3	3	3	3	3	2	2	2	3	2	2	3
CO4	3	3	3	3	2	2	2	3	2	2	3
CO5	3	3	3	2	2	1	2	3	2	2	3
Total	15	14	15	12	10	10	08	15	10	11	14
Average	3	2.8	3	2.4	2	2	1.6	3	2	2.2	2.8

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE32	**EC 2: Microbiology**	**EC**	**2**	**1**	**1**	**0**	**3**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To describe the ultra-structure of bacteria, fungi, algae, and protozoa. Classify microbes based on morphological and molecular taxonomy.
LO2	To illustrate microbial growth and explain its mathematical expression. the microbial growth curve and describe its different phases. Various methods for measuring microbial growth.
LO3	To understand the principles of microbial nutrition and the requirements for microbial growth. and different types of culture media based on microbial nutritional needs.
LO4	To classify viruses based on their host range (bacterial, plant, animal, and tumor viruses). the classification and structural characteristics of viruses.
LO5	To evaluate the mechanisms and impact of antibiotic resistance in microbial infections. antibiotics derived from prokaryotic sources and their applications.

Unit	Content	Hours
1	**MORPHOLOGY AND ULTRASTRUCTURE** Ultrastructure of bacteria, fungi, algae and protozoa. Classification of microbes, molecular taxonomy, cell walls of eubacteria - peptidoglycan and related molecules. Structure and synthesis of cell wall and cell membrane of gram-positive and negative bacteria. Flagella and motlility. Cell inclusion bodies. Blue and green bacteria. Budding and appendaged bacteria, spirilla, spirochaetes, gliding and sheathed bacteria, pseudomonads, lactic and propionic acid bacteria. Endospore-forming rods and cocci, mycobacteria, rickettsia and mycoplasma. Archaebacteria.	12
2	**MICROBIAL GROWTH AND METABOLISM** Microbial growth - definition. Mathematical expression of growth, growth curve, measurement of growth and factors affecting growth. Microbial metabolism - overview, photosynthesis in microbes. Role of chlorophylls, carotenoids and phycobilins, Calvin cycle. Chemolithotrophy: hydrogen - iron - nitrite-oxidizing bacteria: nitrate and sulfate reduction: methanogenesis and acetogenesis, fermentations - diversity, syntrophy - role of anoxic decompositions. Nitrogen metabolism, nitrogen fixation, hydrocarbon transformation	12

3	**MICROBIOLOGICAL TECHNIQUES** Methods in microbial identification. Pure culture techniques. Theory and practice of sterilization. Principles of microbial nutrition, construction of culture media. Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microbes.	12
4	**VIRUSES** Bacteria, plant, animal and tumor viruses. Classification and structure of viruses. Lytic cycle and lysogeny. DNA viruses: positive and negative strands. Double-stranded RNA viruses. Replication: example of herpes, pox, adenoviruses, retroviruses, viroids and prions	12
5	**MEDICAL MICROBIOLOGY** Disease reservoirs; Epidemiological terminologies. Infectious disease transmissions. Respiratory infections caused by bacteria and viruses; Tuberculosis, sexually transmitted diseases including AIDS; Vector bone diseases, water borne diseases, Public health and water quality. Pathogenic fungi, Antimicrobial agents, Antibiotics. Penicillins and cephalosporins, Broad spectrum antibiotics. Antibiotics from prokaryocytes, antifungal antibiotics - mode of action, Resistance to antibiotics.	12

CO	**Student will be able to Course Outcomes**
CO1	Demonstrate knowledge of microbial ultrastructure, morphology, and classification based on molecular taxonomy.
CO2	Analyze microbial growth and nutritional requirements for laboratory applications, and formulate suitable culture media for different microbial groups.
CO3	Implement enrichment culture techniques to investigate diverse microbial metabolic processes.
CO4	Compare and contrast the lytic and lysogenic replication cycles, and evaluate the replication strategies of DNA and RNA viruses, including the molecular mechanisms of herpes, pox, adenoviruses, and retroviruses.
CO5	Assess the effectiveness of antimicrobial agents, including antibiotics and antifungal drugs, by evaluating their mechanisms of action and clinical applications.

Textbooks:	
1	Brock Biology of Microorganisms (13th Edition) 13th Edition by Michael T. Madigan (Author),
2	Quantitative Aspects of Growth and Metabolism of Microorganisms" by A.H. Stouthamer
3	Handbook Of Techniques In Microbiology - A Laboratory Guide To Microbes, A.S. Karwa, M.K. Rai & H.B. Singh
4	Principles of Virology" by S.J. Flint, L.W. Enquist, V.R. Racaniello, and A.M. Skalka
5	Medical Microbiology" by Patrick R. Murray, Ken S. Rosenthal, and Michael A. Pfaller
Reference Books:	
1	**Prescott'Microbiology"**Joanne Willey, Linda Sherwood, and Christopher J. Woolverton
2	Microbial Growth and Metabolis General Microbiology - 1st Edition"LindaBruslin.
3	Microbiology by OpenStax Paperback – Import, 6 February 2023 by Nina Parker (Author), Mark Schneegurt (Author), Anh-Hue Thi Tu (Author) .
4	Medical Microbiology, 4th edition Samuel Baron.Galveston (TX): University of Texas Medical Branch at Galveston; 1996.ISBN-10: 0-9631172-1-1
5	The Short Textbook of Medical Microbiology: Including Parasitology 10th Edition by M.D. Gupte, Satish (Author), Dr. Sekhon, A. S.

Web resources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link– eBooks google drive
2	https://link.springer.com/book/10.1007/978-981-16-0723-3
3	https://asm.org/articles/2020/december/virtual-resources-to-teach-microbiology-techniques
4	https://openstax.org/books/microbiology/pages/6-2-the-viral-life-cycle
5	https://en.wikipedia.org/wiki/Antimicrobial_resistance

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	3	3	3	2	3	3	3	3	3
CO4	3	2	3	3	3	2	3	3	3	3	3
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	9	15	15	15	13	15	15	15	15	15
Average	3	2	3	3	3	2.6	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCS31	**Skill Enhancement Course: Pharmaceutical Biochemistry**	**SEC**	**1**	**1**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	Define the fundamental concepts of pharmacology, including drug classification, sources, and principles of drug action.
LO2	Explain the pharmacokinetics processes and analyze factors affecting drug bioavailability and dosage adjustments.
LO3	Illustrate the drug-receptor interactions and Dose-Response Relationship.
LO4	Describe the methods involved in new drug development and calculate LD50 and ED50 values in toxicity studies.
LO5	Evaluate the clinical trial phases and analyze the biochemical mode of action of antibiotics.

Unit	**Content**	**Hours**
I.	Definition, Scope, Importance and applications of Pharmacology. Drug - Sources and Classification. Routes of Drug Administration - Enteral Route - Oral, Sublingual, Buccal, Rectal. Parenteral Route - Intravenous, Intramuscular, Subcutaneous, Intradermal, Intraperitoneal, Intra-articular, Intra-arterial, Intrathecal. Topical Route- Inhalation, Nasal, Otic, Ophthalmic, Dermal.	6
II.	Pharmacokinetics – Drug Absorption- Factors Affecting Drug Absorption, Distribution- Bioavailability, Metabolism- Phase I, Phase II and Phase III Reactions, and Excretion. Half-Life and Dosage Adjustment.	6
III.	Pharmacodynamics – Mechanism of Drug Action. Drug-Receptor Interactions. Dose-Response Relationship- Potency, Efficacy, and Therapeutic Index. Agonists, Antagonists, and Enzyme Inhibitors	6
IV.	Methods involved in the development of new drugs. Drug safety, Preclinical studies. Calculation of LD50, ED50. Acute, subacute and chronic toxicity studies.	6
V.	Clinical trials (Phase-I, Phase-II, Phase-III and Phase-IV clinical trial). Biochemical mode of action of antibiotics- penicillin and chloramphenicol.	6

CO	The student will be able to Course Outcomes
CO1	Summarize the scope, classification, and general principles of pharmacology, along with different drug administration routes.
CO2	Analyze drug metabolism and excretion processes, apply knowledge to adjust drug dosages.
CO3	Analyze the different drug-receptor interactions and dose-response relationships in pharmacodynamics.
CO4	Interpret toxicological study data and evaluate the safety profile of drugs using LD50, and ED50 calculations.
CO5	Assess the significance of clinical trial phases and design a basic framework for understanding antibiotic mechanisms of action.

Textbooks:	
1	Ruchi Tiwari, Textbook of Pharmacology, Shashwat Publication, 1st Edition
2	Prasad Neerati, Textbook of Pharmacology, Shashwat Publication, 1st Edition
3	Joginder Singh Pathania, Rupendra Kumar Bharti, and Vikas Sood, Textbook of Pharmacology, Vision Health Sciences Publisher, 2nd Edition, 2022.
4	Thieme's Color Atlas of Pharmacology by Heinz Lullmannhttps://drive.google.com/file/d/17cobo-ZXQU1rdG5uZk4rX1Xc69nUZx7a/view?usp=drive_link
5	VN Sharma, Pharmacology for Health Professionals ANZ Book. By Kathleen Knights. CBSPD (2015)
Reference Books:	
1	Lippincott Illustrated Reviews: Pharmacology: Edited by Karen Whalen, 2nd South Asian Edition https://drive.google.com/file/d/1azL_Y0awUWdOGtMeSKpfE40hD8i9te-K/view?usp=drive_link
2	Goodman and Gilman's the Pharmacological Basis of Therapeutics, 14th Edition by Laurence Brunton; Bjorn Knollmann.
3	Katzung's Basic and Clinical Pharmacology, 16th Edition by Todd W. Vanderah 2024.https://drive.google.com/file/d/1p4kXZ8dkglof_uC6LyqRZH2xwXDML-yq/view?usp=drive_link
4	A Textbook of Clinical Pharmacology and Therapeutics, James M Ritter, fifth edition. https://drive.google.com/file/d/14l3Q8RnJOvo4sVdehpDhOJT5fk8ULuYo/view?usp=drive_link
5	Essentials Of Pharmacology Basic Principles and General Concepts (Fifth Edition)

Webresources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link – eBooks google drive
2	https://tvuni.academia.edu/mvinayagam - Educational networks to share research, knowledge, teaching documents, chapters, e-notes, e-books, thesis, materials.
3	https://ncert.nic.in/textbook.php
4	National Digital Library - https://ndl.iitkgp.ac.in/
5	https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_science_students/pharmacology.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	2	2	3	2	2
CO2	3	3	2	3	2	2	2	3	3	3	2
CO3	3	2	3	2	3	2	2	3	3	3	2
CO4	3	2	2	3	3	2	2	3	3	3	2
CO5	3	2	3	2	2	3	2	2	3	2	2
Total	15	11	13	12	13	11	10	13	15	13	10
Average	3	2.2	2.6	2.4	2.6	2.2	2	2.6	3	2.6	2

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	CourseName	Category	L	T	P	S	Credit	Hours	Marks	
									CIA	Total
24PBCIN31	Internship		0	0	3	0	2	1	25	100

Learning Objectives	
LO1	To understand the workflow of diagnostic laboratories, including sample collection, processing, analysis, reporting, and quality control.
LO2	To gain insight into research methodologies used in biochemistry, including hypothesis formation, data collection, and analysis.
LO3	To enhance problem-solving skills in experimental biochemistry and clinical diagnostics.
LO4	To develop professional ethics and discipline needed for laboratory and research work.
LO5	To strengthen communication skills required for documenting experiments, preparing reports, and collaborating in laboratory teams.

S.No	REGULATIONS	Hour
	1. Biochemistry students must complete a 15 - day's internship in any approved Hospital, Diagnostic Lab, Research Institute, Pharma/Biotech Company, or Food Industry during the Semester II vacation. 2. The candidates must demonstrate the ability to perform routine biochemical analyses, document laboratory procedures accurately, maintain an internship logbook, and monitor the outcomes or interpretations of the biochemical tests performed. 3. The candidates must develop skills in biochemical screening and assessment, including sample handling, preliminary diagnostic evaluation, and interpretation of laboratory results for patient or clinical samples. 4. During the Third Semester, candidates are required to refine the work completed during the internship by incorporating constructive feedback received from the Hospital/industry during reviews, and by further developing the project to meet Hospital/industry standards. 5. The Candidates have to prepare and submit the manuscript of the Internship experience as a Report as per the requirements of the Department for Evaluation. 6. The submission of the Internship Report will be done at the end of the Third Semester for Presentation and Viva-Voce during the Practical Examinations of the Semester. The Passing Minimum for Internship is 50%. 7. If the Candidate fails to score 50% in the Internship, the Candidate has to improve it during the next attempt. 8. A Faculty Member from the Department will act as a Guide to supervise/monitor the progress of the Candidates. 9. The Faculty Member will act as the Internal Examiner during the course of the Internship as well as at the time of conducting the Viva-Voce Examination. 10. The Internal Marks for the Internship will be awarded by the concerned Guide /Internal Examiner. 11. The Internal and External Examiners shall both evaluate the Internship Report, Presentation and conduct the Viva-Voce Examination.	

CO	Course Outcomes **Students will be able to**
CO1	Understand and describe the complete workflow of diagnostic laboratories, including sample collection, processing, biochemical analysis, reporting, and quality control procedures.
CO2	Apply basic research methodologies in biochemistry, including collecting experimental data and performing scientific analysis.
CO3	Enhance problem-solving skills in experimental biochemistry and clinical diagnostic situations.
CO4	Develop professional ethics, responsibility, and discipline required for laboratory and research environments.
CO5	Improve communication skills essential for documenting experiments, preparing scientific reports, and effectively collaborating with laboratory teams.

INTERNAL MARKS AWARDED FOR THE INTERNSHIP -25Marks
✓ Internship Review1 (During the beginning of the Semester)-5 Marks ✓ Internship Review2 (At the end of the Semester)-5 Marks ✓ Progress of the Internship by the Candidate's active Participation-15 Marks
EXTERNAL MARKS AWARDED FOR THE INTERNSHIP-75Marks
✓ Evaluation of the Internship Report -50 Marks ✓ Presentation & Viva-Voce Examination-25 Marks

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24PBCC41	CC – 12 Gene Editing, Cell and Gene Therapy	Core	3	2	1	-	5	6	25	75	100

Learning Objectives	
LO1	To train the student in techniques related to the molecular basis of genetic diseases and to incorporate skills essential for various types of sequencing.
LO2	To inculcate practical knowledge on comparing the animal models used to model genetic diseases.
LO3	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.
LO4	To educate about the characteristics of cell culture, therapeutic strategies in gene therapy with relevant safety/ethics involved and patents as well.
LO5	To identify technological barriers in translating stem cell research into safe and effective clinical therapies.

Unit	Content	Hours
I	**Gene Editing**: Basis of gene editing, DNA repair mechanisms, Double strand DNA breaks, No homologous End-Joining (NHEJ), Homology directed repair, Programmable nucleases for gene editing, Mega nucleases, Zinc-Finger nucleases, Transcription Activator-Like Effectors Nucleases (TALEN), CRISPR-CASs systems, gene editing using a CRISPR-CASs, drawbacks and major challenges to present gene editing techniques, gene editing for human disease therapy.	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 transgenic, 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,	18

	Viral vectors, Lent viral, Adenoviral, Adeno-associated virus, Herpes Simplex virus, vaccine, baculo viral vectors for gene delivery.	
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, Or ganoids, three dimensional (3D) bioprinting.	18
V	**Regulatory and Ethical Considerations**: 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.	18

CO	**Course Outcomes** The student will be able to
CO1	Explain the molecular basis of genetic diseases and demonstrate proficiency in techniques related to various sequencing methods.
CO2	Evaluate different animal models used to study genetic diseases
CO3	Identify various types of vectors, their structural features, and analyze their applications in viral and non-viral gene transfer techniques.
CO4	Understanding of cell culture characteristics and apply knowledge to design therapeutic gene therapy strategies while considering safety, ethical, and patent issues.
CO5	Assess the technological challenges in translating stem cell research into safe and effective clinical therapies.

Reference Books:	
1	An Introduction to Human Molecular Genetics (2nd Edition), J.J. Pasternak, 2005.
2	An Introduction to Molecular Medicine and Gene Therapy 1st Edition by Thomas F. Kresina Upadhyay, S. K. (Ed.). (2021).
3	Human Molecular Genetics (4th Edition), Tom Strachan & Andrew Read, 2010.
4	Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003,
Textbooks:	
1	Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press.
2	Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press
3	Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Alexander Battler.

Web resources:	
1	https://www.genome.gov/27569223/gene-editing
2	https://www.isscr.org
3	https://www.ema.europa.eu/en/human-regulatory/overview/advanced-therapy-medicinal-products-overview
4	https://www.fda.gov/vaccines-blood-biologics/cellular-gene-therapy-products
5	https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=85915

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	2	3	2	2	2	2	2	2	2
CO2	3	3	3	3	2	2	2	2	2	2	3
CO3	3	2	3	3	2	3	3	3	3	3	1
CO4	3	1	2	2	2	3	3	2	2	3	3
CO5	3	3	3	3	3	3	3	3	3	3	2
Total	15	10	13	14	11	13	13	12	12	13	11
Average	3	2	2.6	2.8	2.2	2.6	2.6	2.4	2.4	2.6	2.2

3 – Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC42	Core – Advanced Molecular Endocrinology	Core	3	1	2	0	5	6	25	75	100

Learning Objectives	
LO1	To explore the genetic and biochemical basis of the synthesis and formation of polypeptide and glycoprotein hormones.
LO2	To study the fundamental principles of hormone signal transduction and second messenger systems.
LO3	To understand the chemistry, secretion, and physiological roles of pituitary, thyroid, and parathyroid hormones.
LO4	To analyze the interrelationships between pancreatic, adrenal, and renal endocrine functions in maintaining homeostasis.
LO5	To explain the functions of gonadal hormones in the development, maturation, and regulation of reproductive processes.

Unit	Content	Hours
I	**UNIT-I :** Hormones - definition, classification based on receptors, hormone cascade system involving CNS, hypothalamus, anterior pituitary, target gland, feedback mechanisms, classification of hormones (polypeptides, glycoproteins and POMC peptides), genes and formation of polypeptide hormones.	18
II	**UNIT-II :** Synthesis of amino acid derived hormones- epinephrine and thyroxine, inactivation and degradation of hormones, signal transduction and second messengers - adenylate cyclase system, cAMP, adrenalin and glycogen degradation. G-protein as cellular transducer, inositol triphosphate and calcium release, glycogen phosphorylase kinase, DAG and protein kinase C-pathway.	18
III	**Unit III:** Pituitary hormones- Chemistry, Secretion, Functions and Regulation. Anterior Pituitary hormones–GH, Pituitary tropic hormones (LH, TSH and ACTH) and Posterior Pituitary hormones (Vasopressin andOxytocin). Thyroid and Parathyroid Hormones–Chemistry, Synthesis, Secretion, Functions and Regulations.	18
IV	**Unit IV**: Pancreatic Hormones-Chemistry, Secretion, Functions and Regulations (Insulin and Glucagon). Adrenal gland hormones-Chemistry, Secretion, Functions and Regulations of Adrenal Cortex hormones (glucocorticoids and mineralocorticoids) and Adrenal Medullary hormones	18

	(Epinephrine and Nor-Epinephrine). Renin-angiotensin system.	
V	**Unit V**: Chemistry, Secretion, Functions and Regulations of Gonadal hormones− Testosterone, Estrogen and Progesterone. Ovarian cycle and its regulation. Pregnancy and Parturition,Placenta and its Functions, Pregnancy Tests, Mammary Glands and Lactation.	18
CO	**Course Outcomes** **The student will be able to**	
CO1	Interpret the genetic control and biosynthetic pathways responsible for the production of polypeptide hormones.	
CO2	Illustrate the steps involved in hormone signal transduction through the adenylate cyclase–cAMP pathway.	
CO3	Describe the chemical nature, secretion, and regulation of anterior and posterior pituitary hormones.	
CO4	Analyze the integration of endocrine pathways among pancreas, adrenal glands, and kidneys in maintaining metabolic equilibrium.	
CO5	Describe the chemistry, synthesis, secretion, and regulation of gonadal hormones—testosterone, estrogen, and progesterone.	

Textbooks:	
1	Textbook of biochemistry (with clinical correlation) by Devlin, Wiley-Liss; 6 edition (2005) .
2	Wilson and Foster," Endocrinology", 4th edition, W.B. Saunders Co, 2005.
3	Textbook of Endocrinology,1st edition,I.Niyas Ahamed, (Association of Indian Biologists publications.)
4	Textbook of endocrinology by Wilson and Foster, W.B. Saunders Co.
5	Lohar, S.Prakasa, Endocrinology- Hormones & human health, MJP Publishers, 2006.
Reference Books:	
1	Endocrinology – Mac E. Hadley and Jon E. Levine, 7th Edition, Pearson Education.
2	Medical Biochemistry – John W. Baynes and Marek H. Dominiczak, Elsevier.
3	Molecular Cell Biology – Harvey Lodish et al., W.H. Freeman and Company.
4	Human Reproductive Biology – Richard E. Jones and Kristin H. Lopez, Academic Press.
5	Textbook of Medical Physiology – A.K. Jain or Sembulingam&Sembulingam.

Webresources:	
1	https://www.ncbi.nlm.nih.gov/books/
2	https://www.khanacademy.org/science/biology/human-biology
3	https://openstax.org/books/anatomy-and-physiology/pages/1-introduction
4	https://medlineplus.gov/hormones.html
5	https://biologynotesonline.com/gonadal-hormones-secretion-functions-mechanism-regulation/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	3	3	3	3	2	2
CO2	2	3	3	3	3	3	3	3	3	2	2
CO3	2	2	3	3	3	3	3	3	3	2	2
CO4	2	2	3	3	3	3	3	3	3	2	2
CO5	2	2	3	3	3	3	3	3	3	2	2
Total	10	9	15	15	15	15	15	15	15	10	10
Average	2	2	3	3	3	3	3	3	3	2	2

3 – Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE41	**EC – Research Methodology**	**Core**	**3**	**1**	**2**	**0**	**4**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	Understand the fundamentals of research design, types of research, and the importance of literature review in identifying research problems.
LO2	Identify major national and international funding agencies and outline the key components of a research proposal.
LO3	Apply knowledge of biological databases and sequence analysis tools such as BLAST and ClustalW for analyzing biological data.
LO4	Explain the ethical principles and CPCSEA guidelines governing animal and human experimentation.
LO5	Design a well-structured scientific paper with proper format and references.

Unit	Content	Hours
I	**Research Foundations and Literature Search** Types of research, Various Steps in Research Process, Postulating a hypothesis, developing a research question, "Choice of a problem; surveying, synthesizing, critically analyzing reading materials; reviewing, rethinking, critically evaluating and interpreting, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Role of computers in biology. Useful search engines - Boolean searching, search engine algorithms. Finding scientific articles - PubMed.	20
II	**Research Project Funding and Proposal Preparation** Funding Agencies for R&D Projects: National funding agencies and international funding agencies. Preparation of R&D Projects for Funding: Steps in writing a research proposal – identifying the research problem and gap areas, defining aims and objectives, expected outcomes, review of literature, methodology, and timeline.	10
III	**Biological Databases and Sequence Analysis** Overview of biological databases, nucleotide databases (GenBank, DDBJ, ENA) Protein structure databases (PDB, SCOP, CATH), Organism specific databases, Bibliographic databases. Sequence analysis: pair wise alignment, multiple sequences alignment, scoring matrices, Phylogenetic trees. Sequence similarity search, BLAST, FASTA, ClustalW.	20

IV	**Ethics in Animal and Human Research** Ethics in animal experimentation. CPCSEA guidelines - Animal care and technical personnel environment, animal husbandry, feed, bedding, water, sanitation and cleanliness, waste disposal, anesthesia and euthanasia. Composition of (Human) institutional Ethical Committee (IEC) - General ethical issues. Specific principles for chemical evaluation of drugs, herbal remedies and human genetics research.	20
V	**Scientific Writing and Publication** Scientific writing - Characteristics - Logical format for writing thesis and papers. Essential features of abstract, introduction, review of literature, materials and methods, and discussion. Effective illustration - tables and figures. Reference styles - Harvard and Vancouver systems. Publication in Peer-reviewed journals.	20

CO	**Course Outcomes**
CO1	Explain the process of research design, hypothesis formulation, and the use of literature databases for effective research planning.
CO2	Develop a structured research proposal for submission to suitable funding agencies.
CO3	Utilize biological databases and sequence alignment tools to retrieve and interpret molecular data.
CO4	Apply ethical standards and regulatory guidelines in designing and conducting biomedical research involving animals and humans.
CO5	Students will be able to present research findings effectively following standard scientific writing and publication guidelines..

Textbooks:	
1	Kothari, C. R., & Garg, G. (2019). *Research methodology: Methods and techniques* (4th ed.). New Age International Publishers.
2	Glaser, A. N., & Natarajan, R. (2016). *High-yield biostatistics, epidemiology, and public health* (4th ed.). Wolters Kluwer India.
3	Rastogi, S. C. (2020). *Bioinformatics: Methods and applications* (4th ed.). PHI Learning Pvt. Ltd.
4	Ghosh, B. N. (2021). *Scientific methods and social research* (2nd ed.). Sterling Publishers Pvt. Ltd.
5	Day, R. A., & Gastel, B. (2012). *How to write and publish a scientific paper* (7th ed.). Cambridge University Press.
Reference Books:	
1	Subramanian, N. (2018). *Introduction to research methods and report writing*. Atlantic Publishers.
2	Lesk, A. M. (2019). *Introduction to bioinformatics* (5th ed.). Oxford University Press.
3	Beall, J. (Ed.). (2015). *Predatory publishing: What authors need to know*. Scholarly Open Access.
4	Smith, R. (2006). *Research misconduct: The poisoning of the well*. Journal of the Royal Society of Medicine, 99(5), 232–237.
5	National Research Council. (2011). *Guide for the care and use of laboratory animals* (8th ed.). The National Academies Press.

Webresources:	
1	PubMed – https://pubmed.ncbi.nlm.nih.gov
2	National Center for Biotechnology Information (NCBI) – https://www.ncbi.nlm.nih.gov
3	Council for Scientific and Industrial Research (CSIR) – https://www.csir.res.in
4	Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) – https://cpcsea.nic.in
5	Directory of Open Access Journals (DOAJ) – https://www.doaj.org

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	2	3	3	3	3
CO3	3	2	3	2	3	3	2	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	2	3
CO5	3	3	2	3	3	3	3	3	3	3	3
Total	15	13	13	13	15	15	13	15	15	15	15
Average	3	2.6	2.6	2.6	3	3	2.6	3	3	2.6	3

3 – Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE43	**EC – Phytomedicine**	**EC**	**2**	**1**	**1**	**0**	**3**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To gain knowledge of Indian systems of medicine
LO2	To understand morphological and histological characteristics of medicinal plants
LO3	To understand the source, morphology, and uses of flower drugs
LO4	To understand the clinical relevance and potential toxicities
LO5	To gain knowledge about the herbal drug industry

Unit	Content	Hours
I	**UNIT I: PHYTO PHARMACOLOGY** Definition and history, Indian systems of medicine - Siddha, ayurvedha, and Unani systems. Taxonomy of locally available medicinal plants, their chemical constituents and medicinal uses - Classification of Crude drugs - Chemistry of Drugs - Future of pharmacognosy	12
II	**UNIT II : CLASSIFICATION OF MEDICINAL PLANTS** Vernacular name and family - Geographical source, cultivation, collection, and processing for market and commerce in crude drugs. Morphological and histological studies, chemical constituents - Therapeutic and other pharmaceutical uses. Underground stem - ginger, Alpinia - Roots - Rauolfia - Belladona – Aerial parts - Bark - Cinchona.	12
III	**UNIT III: BIOMEDICAL IMPORTANCE OF MEDICINAL PLANTS** Leaves - Adathoda, Eucalyptus - Flower - Clove fruits seeds - Nux vomica Nutmegs, Gooseberry - unorganized drugs - Gum - Acacia - Resin - Turpentine, fixed oil - castor oil.	12
IV	**UNIT IV: HERBAL MEDICINES FOR HUMAN AILMENTS** Drugs Acting on Cardiac Diseases, Cerebral Diseases, Nasal diseases - Blood pressure Drugs acting on Nervous system – Depressants, Stimulants. Respiration and Drugs - Urogenital system and drugs - Psychoactive plants.	12
V	**UNIT V**: **PROPAGATION OF MEDICINAL PLANTS** Micro and macro propagation, conservation of rare medicinal plants, Role of biotechnology in medicinal plant's banks, cultivation of medicinal and aromatic plants. Drug adulteration - methods of Drug evaluation. Herbal food - Food processing - packaging - Herbal sale and Export of medicinal plants - marketing - Intellectual property rights - Export laws.	12

CO	The student will be able to Course Outcomes
CO1	Explain the fundamental concepts and therapeutic principles of Indian systems of medicine such as Siddha, Ayurveda, and Unani.
CO2	Identify and analyze the morphological and histological characteristics of medicinal plants for authentication and quality evaluation
CO3	Describe and differentiate the source, morphology, chemical constituents, and therapeutic uses of flower drugs
CO4	Evaluate the clinical relevance and potential toxicities of natural drugs and plant-derived compounds used in various disease conditions
CO5	Discuss and apply knowledge about the herbal drug industry.

Text Books	
1	George Edward Trease and W.C. Evans - Pharmacognosy 12th edition, English Language Books Society, Baelliere Tindall.
2	Handa, S.S. and Kapoor, V.K. Pharamcognosy - 2nd Edition, Vallabh Prakashan Publishers, New Delhi.
3	Indian Medicinal plants - Jain, S.K,1980.
4	Kokate, C.K., Durohit, A.P. and Gokhale, S.R., Pharmacognosy - 12th edition - Nirali Prakasham Publishers, Pune
5	Bioactive Compounds in Phytomedicine, edited by Iraj Rasooli. IntechOpen (2012)
Reference Books:	
1	An Introduction to Medical Botany and Pharmacognosy - Kumar N.C., 1993.
2	Indian Materia Medica – Nadkarni, 1981.
3	A text book of Pharmacognosy - Shah, S.C. and Qudary, 1990.
4	Text book of pharmacognosy , 5th edition -Wallis, T.E, CBS publishers and distributors, New Delhi

Web resources:

1.https://ccrum.res.in/writereaddata/UploadFile/The%20Science%20of%20Health%20and%20Healing01076_1861.p

2.**https://www.scribd.com/document/481786497/classificationsofmedicinalandaromaticplants-190722230043**

3. https://en.wikipedia.org/wiki/Medicinal_plants

4. https://www.healthline.com/nutrition/herbal-medicine

5. https://plantcelltechnology.com/blogs/blog/blog-seven-methods-of-plant-propagation?srsltid=AfmBOoq7Rpi2NEAJhA9owyQsIMs5ARoO94ykKHWa1-7V1u29Mnce0Bky

Mapping with Programme Outcomes and Programme Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	3	2	2	3
CO2	3	2	3	3	2	2	1	3	3	3	2
CO3	3	3	3	3	2	2	2	3	2	2	3
CO4	3	3	3	3	2	2	2	3	2	3	3
CO5	3	3	3	2	3	2	3	3	3	2	3
Total	15	14	15	13	12	11	10	15	12	12	14
Average	3.0	2.8	3.0	2.6	2.4	2.2	2.0	3.0	2.4	2..4	2.8

3– Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCF41	PEC – 1 Personality Development and Leadership Skills	Core	1	1		-	2	2	25	75	100

Learning Objectives	
LO1	To enable students to develop a confident and dynamic personality.
LO2	To foster interpersonal and communication skills essential for leadership roles.
LO3	To inculcate leadership values, ethics, and team management skills.
LO4	To prepare students for professional success through self-awareness.
LO5	To prepare students for personal success through self-awareness.

Unit	Content	Hours
I	**Introduction to Personality Development** Definition and dimensions of personality, Self-concept, self-awareness, and self-esteem, SWOT analysis – self-assessment Goal setting and time management, Overcoming shyness, stage fear, and inertia	6
II	**Communication and Interpersonal Skills** Verbal and non-verbal communication, Active listening, assertive communication, Public speaking, group discussion, and debate skills, Conflict resolution and interpersonal harmony, Presentation skills and use of technology	6
III	**Leadership and Team Building** Types and traits of leaders, Leadership styles: visionary, Autocratic, coaching, transformational, transactional, democratic, laissez-Faire, situational etc. Role of motivation and inspiration, Team dynamics and collaboration	6
IV	**Emotional Intelligence and Stress Management** Components of Emotional Intelligence (EQ), Managing emotions and empathy in relationships, Stress and Anxiety- management techniques, Work-life balance and self-care practices, Mindfulness and meditation	6
V	**Professional and Social Etiquette** Workplace manners and ethics, Dress code, grooming, and hygiene, Interview preparation and resume building, Email, phone, and social media etiquette, Time and digital discipline.	6

CO	The student will be able to Course Outcomes
CO1	Identify and enhance key personality traits for self-development
CO2	Communicate effectively and confidently in various contexts.
CO3	Demonstrate leadership qualities and manage teams efficiently
CO4	Apply decision-making and problem-solving skills in real-life situations
CO5	Practice emotional intelligence and professional etiquette in personal and social life

Textbooks:	
1	Swami Vivekananda,Personality Development, Advaita Ashrama., New Delhi, 2002
2	Shiv Khera, You Can Win: A Step-by-Step Tool for Top Achievers, Bloomsbury Publishing India Pvt. Ltd., New Delhi, 2014
3	Daniel Goleman, Emotional Intelligence: Why It Can Matter More Than IQ, Bantam Books, New York (Reprint by Bloomsbury India)2006
4	Dr. Alex K. and S. Chandran Soft Skills: Know Yourself & Know the WorldS. Chand Publishing, New Delhi, 2011
5	Dale Carnegie, How to Win Friends and Influence PeopleSimon & Schuster, New York (India edition by Fingerprint Publishing), 2016
Reference Books:	
1	Stephen R. Covey, The 7 Habits of Highly Effective People: Powerful Lessons in Personal Chang,Simon & Schuster, New York (India edition by Pocket Books) 2020
2	Peter G. Northouse, Leadership: Theory and Practice, SAGE Publications, California, 2021.
3	John C. Maxwell, Developing the Leader Within You 2.0, HarperCollins Leadership, Nashville 2018
4	Barun K. MitraPersonality Development and Soft Skills, Oxford University Press, New Delhi, 2012
5	Suzanne C. de Janasz, Karen O. Dowd, and Beth Z. Schneider, Interpersonal Skills in Organizations, McGraw-Hill Education, New York, 2018

Webresources:	
1	https://www.7habits.com
2	https://www.mkgandhi.org/ebks/personality_development.pdf
3	https://www.golemanEI.com
4	https://opentextbc.ca/leadership/
5	https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=85915

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	3	3	3	3	2	2
CO2	2	3	3	3	3	3	3	3	3	2	2
CO3	2	2	3	3	3	3	3	3	3	2	2
CO4	2	2	3	3	3	3	3	3	3	2	2
CO5	2	2	3	3	3	3	3	3	3	2	2
Total	10	9	15	15	15	15	15	15	15	10	10
Average	2	2	3	3	3	3	3	3	3	2	2

3 – Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	CourseName	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCL41	**SLC 1 Biotechnology**	**SLC**	**-**	**-**	**1**	**3**	**2**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	Understand the fundamental concepts, scope, and significance of biotechnology and identify the tools and enzymes used in genetic engineering.
LO2	Demonstrate knowledge of various cloning vectors used in genetic engineering
LO3	Able to demonstrate the principles and methodologies of DNA sequencing,
LO4	Apply the principles of constructions of vectors and gene transfer methods
LO5	Illustrate the use of Genetic Engineering for Human Welfare

Unit	Content	Hours
I	**Introduction to Biotechnology and Genetic Engineering Tools**– Biotechnology – definition, Scope, importance. Genetic engineering - Tools- enzymes used in genetic engineering – Endonucleases, Exonucleases, DNA ligase, Alkaline phosphatase, Reverse transcriptase, DNA polymerase, Terminal transferase, Use of linkers, adapters.	12
II	**Genetic Engineering Tools - Vectors** Vectors – Plasmid (pBR322, pUC), Bacteriophage Vector (Phage λ), Cosmid, Yeast artificial chromosome vector, bacterial artificial vector.	12
III	**Basic techniquesof Genetic Engineering and requirements**: DNA sequencing -Maxam and Gilbert method, Sanger and Coulson method. Chemical synthesis of oligonucleotides. Amplification of DNA - PCR.Sterilization techniques, laminar Air flow, CO2 incubator	12
IV	**Construction and expression of recombinant DNA molecules** Preparation of desired DNA - Genomic DNA library, cDNA library. Gene transfer methods – Transformation, Transfection, Electroporation, Microinjection, Particle Bombardment, Liposome fusion.	12
V	**Screening methods &Genetic Engineering for Human Welfare** Screening methods – insertional selection inactivation, Blue white	12

	selection, colony hybridization. Genetic Engineering for Human Welfare – production of tissue plasminogen activator, Insulin, somatropin	

CO	The student will be able to Course Outcomes
CO1	Explain the concepts, scope, and significance of biotechnology and describe the various enzymes used as tools in genetic engineering.
CO2	Illustrate the structure, types, and functions of different cloning vectors such as plasmids, bacteriophages, cosmids, and artificial chromosomes
CO3	Apply fundamental genetic engineering techniques such as DNA sequencing, PCR etc.
CO4	Analyze the strategies involved in the construction and expression of recombinant DNA, including gene transfer methods and library preparation.
CO5	Evaluate screening and selection techniques for recombinant clones and assess the applications of genetic engineering in human welfare

Textbooks:	
1	Biotechnology, U Satyanarayanan .U, (2008), Books and Allied (p)Ltd.
2	A Textbook of BiotechnologyR.C. Dubey S. Chand Publishing 6th Ed. 2014 / Latest
3	Plant Biotechnology, Dr. A. Arumugam, Saras Publication, Chennai
4	Molecular Biology and Genetic Engineering, P.K. Gupta,Rastogi Publications, 2020
5	Plant Biotechnology – B.D. Singh, Kalyani Publishers
Reference Books:	
1	Molecular Biology of the Gene. James D. Watson, Tania A. Baker, et al., Pearson Education, 2017 (7th Edition)
2	Genes XII, Benjamin Lewin, Jones & Bartlett Learning, 2017 (12th Edition)
3	Molecular Cloning: A Laboratory Manual, Michael R. Green and Joseph Sambrook, Cold Spring Harbor Laboratory Press, 2012 (4th Edition)
4	Genetic Engineering, Smita Rastogi and Neelam Pathak, Oxford University Press, 2009
5	Biotechnology: Fundamentals and Applications, S.S. Purohit, Agrobios (India), 2019

Webresources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link– eBooks google drive
2	https://tvuni.academia.edu/mvinayagam - Educational networks to share research, knowledge, teaching documents, chapters, e-notes, e-books, thesis, materials.
3	https://ncert.nic.in/textbook.php
4	National Digital Library -https://ndl.iitkgp.ac.in/
5	https://cec.nic.in/cec/ - e-Content courseware in UG/PG subjects

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	3	3
CO3	3	2	3	2	3	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	13	15	13	15	15	13	15	15	15	15
Average	3	2.6	3	2.6	3	3	2.6	3	3	3	3

3 – Strong, 2- Medium, 1- Low