MARUDHAR KESARI JAIN COLLEGE FOR WOMEN (AUTONOMOUS)

Vaniyambadi – 635 751

PG Department of Biochemistry

for

Postgraduate Programme

Master of Science in Biochemistry

From the Academic Year 2024 - 2025

CONTENT

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION

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

L-Lecture T-Tutorial P-Practical S-Seminar C-Credit

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*.

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