Marudhar Kesari Jain College for Women (Autonomous)

Vaniyambadi- 635751

PG & Research Department of Biochemistry

For

Postgraduate Programme

Master of Science in Biochemistry

From the Academic Year 2026-2027

Course Code	Course Category	Title of the Course	Ins. Hrs/ Week	Credit	Marks		Total
					CIA	ESE	
Semester – I							
26PBCC11	Core – 1	Biomolecules	6	5	25	75	100
26PBCC12	Core – 2	Biochemical Techniques	6	5	25	75	100
26PBCC13P	Core – 3	Biomolecules and Biochemical Techniques - Practical	5	3	25	75	100
26PBCE11/ 26PBCE12	DCE – 1	Advanced Cell Biology/ Quality Control and Quality Assurance	5	3	25	75	100
26PBCE13/ 26PBCE14	DCE – 2	Plant Physiology/ Stem Cell Technology	4	3	25	75	100
26PBCA11	AECC-1	Biostatistics and Data Science	2	2	25	75	100
26PCHR11	HR	Human Rights	2	2	25	75	100
			30	**23**	**175**	**525**	**700**
Semester – II							
26PBCC21	Core – 4	Enzymology	6	5	25	75	100
26PBCC22	Core – 5	Research Methodology	6	5	25	75	100
26PBCC23P	Core – 6	Enzymology - Practical	5	3	25	75	100
26PBCE21/ 26PBCE22	DCE – 3	Human Physiology / Molecular Biology Techniques	5	3	25	75	100
26PBCE23/ 26PBCE24	DCE – 4	Microbiology/ Nanotechnology	5	3	25	75	100
26PBCS21	SEC-1	Computer-Aided Drug Design	3	2	25	75	100
			30	**21**	**150**	**450**	**600**
Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, within the third 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*.							

CC: Core Course
DCE: Discipline Centric Elective
SEC: Skill Enhancement Course
PEC: Professional Enhancement Course
SLC: Self Learning Course
IKS: Indian Knowledge System (Non- Credit Course)
AECC: Ability Enhancement Compulsory Course

Ist Year: First Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-2027							CIA	ESE	Total
Course Code	Title of the Course								
26PBCC11	CC – 1 Biomolecules	5	1	0	5	6	25	75	100
Category	Core Course	Theory-100%							

Learning Objectives

LO1	To understand the structure, functions, and biological significance of chemical compounds in living systems.
LO2	To explain the concepts of protein structure and its role in biological processes.
LO3	To illustrate the structure, properties, and biological importance of lipids.
LO4	To explore the structure, functions, and significance of nucleic acids.
LO5	To analyze the biochemical functions, deficiency disorders, and treatment of water-soluble vitamins and fat- soluble vitamins.

Unit	Content	Hours
1	**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.	18
2	**Amino Acids and Protein:** Amino acids–classification, structure and physicochemical properties, chemical synthesis of peptides – solid phase peptide synthesis. Proteins – classification, purification, and criteria of homogeneity. Structural organization, sequence determination and characterization of proteins. Confirmation of proteins – Ramachandran plots. Denaturation of proteins. Apoprotein and Prosthetic group- Porphyrins – Structure and properties of porphyrins – heme, Chlorophyll and Cytochromes.	18
3	**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, and leukotrienes. Lipoproteins – Classification, structure, transport(endogenous and exogenous pathways) and their biological significance.	18
4	**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, components of coenzymes, and second messengers. Forces stabilizing nucleic acid structure. C- value, C-value paradox, Cot curve. Structure and role of nucleotides in cellular communications.	18

5	**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. Minerals - Macro-minerals- Sodium, Potassium, Chlorine, Calcium and Phosphorus. Microminerals -Chromium, Cobalt, Copper, Iodine, and Iron sources, structure, biochemical functions, deficiency diseases and daily requirements. Porphyrins – Porphyrin ring system, Chlorophyll, Haemoglobin, Myoglobin and Cytochrome.	18

CO	Course Outcomes Students will be able to	Knowledge Level
1	Understand the structure, classification, and types of polysaccharides.	K1, K2
2	Explain the structure, properties, and characterization of amino acids and Proteins.	K1, K2
3	Acquire the classification, functions, and biological roles of lipids.	KI, K2, K3
4	Analyse the structural and functional properties of nucleic acids in biological systems.	K1, K3, K4
5	Evaluate the functions, significance, and disorders associated with vitamins and porphyrins.	K1, K2, K3, K5

Textbooks:	
1	J. L. Jain, Sunjay Jain & Nitin Jain. Fundamentals of Biochemistry. 7th Edition. S. Chand Publishing. 2022.
2	D. Voet and J. G. Voet, Biochemistry, (4th Edition), Wiley & Sons, 2011.
3	Zubay G.L, Biochemistry, (4th ed), McGraw-Hill, 1999
4	Lubert Stryer, Biochemistry, (7th ed), W.H.Freeman, 2010.
5	Satyanarayan,U, Biochemistry (4th ed), Arunabha Sen Books & Allied (P)Ltd, Kolkata. 2014.

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: A problem approach, (2nd Edition), Benjamin/Cummins Publishing Company, 1981.
4	Garrett, R. and Grisham, C. Biochemistry,4th Edition, Saunders College Publishing. 2010.
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

I[st] Year: First Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27									
Course Code	Title of the Course						CIA	ESE	Total
26PBCC12	CC-2 Biochemical Techniques	5	1	0	5	6	25	75	100
Category	Core Course	Theory-100%							

Learning Objectives	
LO1	To understand the electromagnetic spectrum and spectroscopic techniques
LO2	To explain chromatographic principles
LO3	To demonstrate the principles and applications of ultracentrifugation and radioactivity in biological sciences.
LO4	To analyze the electrophoresis of proteins and nucleic acids
LO5	To apply immunological techniques for biomolecular analysis and detection.

Unit	Content	Hours
1	**Spectroscopy** Electromagnetic spectrum-Regions. Definitions for wavelength, wavenumber and frequency, Stokes' 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, NMR.	18
2	**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, GCMS, HPLC, HPTLC.	18
3	**Ultracentrifugation and Radioactivity** 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.	18
4	**Electrophoresis** General principles. Support media. Electrophoresis of proteins -SDS - PAGE, 2D - PAGE, native gels, isoelectric focusing. Cellulose acetate electrophoresis. Electrophoresis of nucleic acids - agarose gel electrophoresis, pulsed field gel electrophoresis	18
5	**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.	18

CO	Students will be able to Course Outcomes	Knowledge Level
1	Understand and analyze the electromagnetic spectrum and spectroscopic principles, applications.	K2, K4
2	Explain the principles underlying chromatographic separation methods	K2, K4
3	Apply electrophoresis techniques for the separation of proteins and nucleic acids.	K3, K4
4	Analyse the radioactivity using GM counters and scintillation counters.	K3, K4.
5	Evaluate the immunological techniques for the detection and analysis of biomolecules.	K3, K4, K5

Textbooks:	
1	P. Asokan – Analytical Biochemistry – China Publications – 2003
2	David L. Nelson & Michael M. Cox – Lehninger Principles of Biochemistry (7th Edition) – W.H. Freeman and Company – 2017
3	Keith Wilson & John Walker – Principles and Techniques of Biochemistry and Molecular Biology (7th Edition) – Cambridge University Press – 2010
4	Douglas A. Skoog**,** F. James Holler & Stanley R. Crouch – Principles of Instrumental Analysis (7th Edition) – Cengage Learning – 2018
5	Donald Voet & Judith G. Voet – Biochemistry (4th Edition) – John Wiley & Sons – 2011
Reference Books:	
1	K. Wilson & I. Walker – Practical Biochemistry (5th Edition*)* – Cambridge University Press – 2000
2	David Frifelder – Physical Biochemistry (2nd Edition) – W.H. Freeman – 1982
3	Galen Wood Ewing – Instrumental Methods of Chemical Analysis (5th Edition) – McGraw-Hill College – 1985
4	George G. Guilbault – Chromatography: A Laboratory Handbook of Chromatographic and Electrophoretic Methods (2nd Edition) – *Springer – 1976* (commonly cited edition year)
5	Jeremy M. Berg, John L. Tymoczko & Lubert Stryer – *Biochemistry (8th Edition)* – W.H. Freeman and Company – 2015

Web resources:	
1	https://onlinecourses.nptel.ac.in/noc26_cy01/preview?utm_source=chatgpt.com
2	https://www.classcentral.com/course/swayam-interpretative-molecular-spectroscopy-269721?utm_source=chatgpt.com
3	https://en.wikipedia.org/wiki/Analytical_ultracentrifugation?utm_source=chatgpt.com
4	https://epgp.inflibnet.ac.in/?utm_source=chatgpt.com
5	https://byjus.com/biology/difference-between-elisa-and-western-blot/?utm_source=chatgpt.com

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

I[st] Year: First Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-2027							CIA	ESE	Total
Course Code	Title of the Course								
26PBCC13P	CC - 3 Laboratory Course on Biomolecules and Biochemical Techniques - Practical	0	0	5	3	5	25	75	100
Category	Core Practical	Problem-100%							

Learning Objectives	
LO1	To isolate and estimate the nucleic acids using standard biochemical methods. (DNA and RNA).
LO2	To quantitatively estimate inorganic phosphorus, pyruvate, tryptophan, and total protein in samples
LO3	To determine the levels of essential minerals such as calcium and iron.
LO4	To separate and identify lipids, plant pigments, sugars, and amino acids using chromatography techniques.
LO5	To qualitatively identify phytochemicals present in plant extracts.

Unit	Content	Hours
1	**Biochemical studies and estimation of macromolecules** **Isolation, Characterization Techniques** 1. Isolation and estimation of DNA from a plant. 2. Isolation and estimation of RNA from yeast.	15
2	**Quantitative Analysis** 1. Estimation of inorganic phosphorus by the Fiske and Subbarow method. 2. Estimation of Pyruvate 3. Estimation of Tryptophan 4. Estimation of protein by Lowry's method.	15
3	**Estimation of Minerals** 1. Estimation of calcium 2. Estimation of iron	15
4	**Separation Techniques** 1. Separation and identification of lipids by thin-layer chromatography. 2. Separation of plant pigments from leaves by column chromatography 3. Identification of Sugars by Paper Chromatography 4. Identification of Amino Acids by Paper Chromatography 5. Qualitative analysis of Phytochemical Screening	15

CO	Students will be able to Course Outcomes	Knowledge Level
1	Understand the isolation and estimation of DNA and RNA using standard laboratory techniques.	K2, K3
2	Explain the accurately determine and calculate the concentrations of inorganic phosphorus, pyruvate, tryptophan, and total protein in samples	K2, K3, K4
3	Apply the concentration of essential minerals such as calcium and iron in samples.	K2,K3, K4
4	Examine to effectively separate, identify, and analyze lipids, plant pigments, sugars, and amino acids using chromatographic techniques	K3, K4

5	Evaluate the presence of various phytochemicals in plant extracts through qualitative analysis.	K4, K5

Textbooks:	
1	Principles and Techniques of Biochemistry and Molecular Biology" by Keith Wilson and John Walker. Publication: Cambridge University Press; 7th Edition.
2	Experimental Biochemistry" by Wilson, Walker, and Cox Publication: Oxford University Press; 4th Edition.
Web Resources:	
1	https://youtu.be/2XBVUKn_I5w?si=8Zjw1yooSWHwAn3v
2	https://www.promega.in/resources/guides/nucleic-acid-analysis/dna-purification/
3	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	2	3	3	3	3	3	3	3	2	3
CO2	3	2	3	2	2	3	3	3	3	3	2
CO3	2	3	3	2	2	2	2	2	3	2	2
CO4	3	3	3	3	2	2	2	3	2	3	2
CO5	2	2	2	3	2	2	3	2	2	3	3
Total	13	12	14	13	11	12	12	13	13	13	12
Average	2.6	2.4	2.8	2.6	2.2	2.4	2.4	2.6	2.6	2.6	2.4

3 – Strong, 2- Medium, 1- Low

Ist Year: First Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27							CIA	ESE	Total
Course Code	Title of the Course								
26PBCE11	DCE-I Advanced Cell Biology	4	1	0	3	5	25	75	100
Category	Discipline Centric Elective	Theory -100%							

Students will be able to	Learning Objectives
LO1	To understand the structure and functions of subcellular organelles.
LO2	To explain cellular transport and cellular communication mechanisms.
LO3	To illustrate the organization of chromosomes within the cell.
LO4	To analyze the stages of the cell cycle, including the steps of cell division in somatic cells.
LO5	To evaluate the mechanisms underlying cell growth, the transformation of normal cells into cancer cells, and the metastasis of cancer cells.

Unit	Content	Hours
1	**Structural Organization and Function of Intracellular Organelles. Structure** and function of prokaryotic and eukaryotic cells. Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, vacuoles, chloroplasts, structure & function of cytoskeleton and its role in motility). Cytoskeleton - Microtubules and Microfilaments.	**15**
2	**Membrane Structure, Transport and Cellular Communication:** Structure of biological membranes – lipid bilayer, membrane proteins. Transport mechanisms – diffusion, osmosis, active transport, ion channels, membrane pumps (Na^+/K^+, Ca^{2+}, proton). Intracellular transport, vesicular trafficking, and electrical properties of membranes. Cellular communication – signal transduction pathways. Cell–cell interaction, cell adhesion proteins, cell junctions – tight junction, gap junction. Cell surface features of plant cells and cancer cells.	**15**
3	**Genes and Chromosome Organization** Genes and chromosomes; types of DNA (unique and repetitive DNA); gene structure including interrupted genes (introns and exons); chromatin organization (nucleosomes, histones, non-histone proteins); higher-order chromatin structure (euchromatin and heterochromatin); transposons; gene regulation in prokaryotes (lac and trp operons); chromosome mapping techniques including chromosome mapping, chromosome walking, and chromosome jumping**.**	**15**
4	**Cell Cycle and Its Regulation** Overview of cell cycle (G1, S, G2, M phases) and comparison of mitosis and meiosis; G1 phase cell growth and preparation followed by G1 checkpoint (restriction point) regulated by Cyclin D–CDK4/6, Cyclin E–CDK2, Rb–E2F and p53/p21; progression to S phase for DNA replication; G2 phase for further growth and preparation; entry into M phase (mitosis) involving prophase, metaphase, anaphase, and telophase; M phase checkpoint (spindle assembly checkpoint) controlled by APC/C–Cdc20, Cyclin B–CDK1 and Mad/Bub proteins ensuring proper chromosome segregation; followed by cytokinesis for cell division; overall regulation of cell division and growth through cyclins, CDKs and checkpoint controls ensuring genomic stability.	**15**
5	**Apoptosis and Cancer Biology** Apoptosis: differences from necrosis; morphological and biochemical features; molecular mechanisms including intrinsic and extrinsic pathways, caspase cascade, Bcl-2 family (pro- and anti-apoptotic), cytochrome c, and p53 regulation. Cancer biology: definition, types, benign vs malignant tumors, and hallmarks of	**15**

	cancer. Molecular basis: role of oncogenes and tumor suppressor genes (RAS, p53). Carcinogenesis: stages (initiation, promotion, progression) and carcinogens (chemical, physical, biological). Tumor progression and management: angiogenesis, tumor microenvironment, metastasis, diagnosis (biopsy, imaging), therapy (chemotherapy, radiotherapy, immunotherapy, targeted therapy), and prevention (lifestyle, screening, vaccination).	

CO	Students will be able to Course Outcomes	Knowledge Level
1	Understand the structural organization and function of intracellular organelles	K1, K2, K4
2	Explain the membrane structure and transport	K2, K3
3	Apply the knowledge on the organization of Genes and Chromosomes	K1, K2,K3
4	Analyze the Cell Division and Cell Cycle	K2, K4
5	Evaluate knowledge on cancer and cell death.	K1, K2, K4, K5

Textbooks:	
1	N. Arumugam – Cell Biology and Molecular Biology, Saras Publication, 9th Edition, 2019.
2	P. S. Verma & V. K. Agarwal, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. Chand Publishing-Multicolour Edition, 2010
3	Harvey Lodish et al., Molecular Cell Biology, Macmillan Learning, 9th Edition, 2021.
4	James D. Watson et al., Molecular Biology of the Gene, Pearson Education, 7th Edition, 2013.
5	Gerald Karp, Cell and Molecular Biology: Concepts and Experiments, Wiley India, 9th Edition, 2021.
Reference Books:	
1	S. C. Rastogi, Cell Biology- New Age Publishers, 2nd Edition-2008
2	E. D. P. De Robertis & E. M. F. De Robertis Cell and Molecular Biology Lippincott Williams & Wilkins, Philadelphia 8th Edition 2006
3	Stephen R. Bolsover, Jeremy S. Hyams, Elizabeth A. Shephard, Hugh A. White & Claudia G. Wiedemann – Cell Biology: A Short Course (3rd ed.) – Wiley-Blackwell – 2013
4	Albert G. Moat, John W. Foster & Michael P. Spector – Microbial Physiology (4th ed.) – Wiley-Liss – 2002
5	James M. Orten & Otto W. Neuhaus – Human Biochemistry (10th ed.) – The C.V. Mosby Company – Year not specified
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	2	1	2	1	1	2	3	1	1
CO2	3	2	3	2	2	2	1	2	3	2	1
CO3	3	2	3	2	2	2	1	3	3	2	2
CO4	3	2	3	3	2	2	1	3	2	2	2
CO5	3	2	3	3	2	2	2	3	2	2	3
Total	15	10	14	11	10	9	6	13	13	9	9
Average	3.0	2.0	2.8	2.2	2.0	1.8	1.2	2.6	2.6	1.8	1.8

3 – Strong, 2- Medium, 1- Low

Ist Year: First Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-2027							CIA	ESE	Total
Course Code	Title of the Course								
26PBCE12	DCE-I Quality Control & Quality Assurance	4	1	0	3	5	25	75	100
Category	Core Course	Theory-100%							

Learning Objectives

LO1	To understand the cGMP aspects followed in the pharmaceutical industry.
LO2	To distinguish the importance of documentation in the pharmaceutical industry.
LO3	To determine the scope of quality certifications applicable to the pharmaceutical industry.
LO4	To compare the responsibilities of Quality Assurance (QA) and Quality Control (QC) departments.
LO5	To evaluate pharmaceutical operations and control procedures in industrial practice.

Unit	Content	Hours
1	**QA and QC guidelines** Concept and evolution and scopes of Quality Control and Quality Assurance, Good Laboratory Practice, GMP, Overview of ICH Guidelines - QSEM, with special emphasis on Q- series guidelines. Scope of GLP, Definitions, Quality assurance unit, protocol for conduct of non-clinical testing, control on animal house, report preparation and documentation. CPCSEA guidelines	15
2	**cGMP Facility** cGMP guidelines according to schedule M, USFDA (inclusive of CDER and CBER), Pharmaceutical Inspection Convention (PIC), WHO and EMEA covering: Organization and personnel responsibilities, training, hygiene and personal records, drug industry location, design, construction and plant lay out, maintenance, sanitation.	15
3	**Quality control tests** Analysis of raw materials, finished products, packaging materials, in process quality control (IPQC). Developing specification (ICH Q6 and Q3), purchase specifications and maintenance of stores for raw materials. In process quality control and finished products quality control for following dosage forms in Pharma industry according to Indian, US and British pharmacopoeias: tablets.	15
4	**Documentation in the Pharmaceutical Industry** Three-tier documentation, Policy, Procedures and Work instructions. Records (Formats) Basic principles- How to maintain, retention etc. Standard operating procedures (How to write), Master Batch Record, Batch Manufacturing Record, Quality audit plan and reports. Specification and test procedures, Protocols and reports. Distribution Records.	15

5	**Manufacturing Operations and Controls** Sanitation of manufacturing premises, mix-ups and cross-contamination. Processing of intermediates and bulk products. Packaging operations. IPQC. Release of finished product, process deviations, and charge-in of components. Time limitations on production and drug product inspection.	15

CO	Course Outcomes: Students will be able to	Knowledge Level
1	Understand the principles of Quality Assurance (QA) and Quality Control (QC) in the pharmaceutical industry.	K1, K2, K3
2	Explain cGMP facility requirements across global regulatory guidelines.	K1, K2, K4
3	Apply and analyze pharmacopoeia standards and ICH guidelines to perform quality control testing of raw materials, in-process samples, and finished pharmaceutical dosage forms.	K2, K3, K4, K5
4	Apply pharmaceutical documentation systems, including preparation of SOPs, batch records, CTD/eCTD submissions, and regulatory compliance requirements.	K1, K2, K5
5	Evaluate key manufacturing controls, including IPQC, deviation handling, and product release procedures.	K1, K2, K3, K5

Textbooks:	
1	Sandy Weinberg, Good Laboratory Practice Regulation, Publisher: Marcel Dekker Series, Year: 1995
2	B. N. Sahay, Quality Assurance and Quality Management in Pharmaceutical Industry, CBS Publishers & Distributors 1st Edition 2008
3	P. P. Sharma, How to Practice GMP's, Publisher: Vandana Publications, Agra Year: 1991
4	Sidney H. Willig, Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control, Publisher: Marcel Dekker Series, Year: 3rd Edition
5	Manohar A. Potdar, Pharmaceutical Quality Assurance, Publisher: Pragati Books Pvt. Ltd. Year: 2006.

Reference Books:	
1	Sidney H. Willig, Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control by (Marcel Dekker Series, Vol. 52) was published in 1995.
2	Steinborn L. GMP/ISO Quality Audit Manual for Healthcare Manufacturers and Their Suppliers, (Volume 1 - With Checklists and Software Package), Taylor & Francis. 2019.
3	Sarker DK. Quality Systems and Controls for Pharmaceuticals, John Wiley & Sons. 2008.
4	Charles Forbes Ross, Packaging of Pharmaceuticals – Packaging of Pharmaceuticals by Newnes-Butterworths, 1975
5	P. P. Sharma, How to Practice GMPs – Vandana Publications, Agra. 2015.

Web resources:	
1	https://www.ich.org/page/quality-guidelines
2	https://www.fda.gov/drugs/pharmaceutical-quality-resources/current-good-manufacturing-practice-cgmp-regulations
3	https://www.bputevaluation.com/assets/subject_pdfs/MPA203T.pdf
4	https://bspublications.net/downloads/068034049e66e5
5	https://vignan.ac.in/r18/bpharmel/18BP104.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

Ist Year: First Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27							CIA	ESE	Total
Course Code	Title of the Course								
26PBCE13	DCE – 2 Plant Physiology	3	1	0	3	4	25	75	100
Category	Discipline Centric Elective	Theory -100%							

Learning Objectives

Students will be able to

LO1	Understand water relations, mineral nutrition, and ion transport in plants.
LO2	Explain photosynthesis, carbon fixation, and food transport in plants.
LO3	Describe nitrogen metabolism and the role of plant hormones.
LO4	Explain plant responses to light and environmental stresses.
LO5	Apply knowledge of secondary metabolites in plant-based applications.

Unit	Content	Hours
1	**Plant Water Relations and Mineral Nutrition** **Water Potential & Transport** - Concepts of water potential; Diffusion, Osmosis, imbibition and Plasmolysis. Water potential and its components (Ψs, Ψp, Ψw). Mechanism of water uptake by roots; Apoplast and symplast pathways, Root pressure vs transpiration pull, Xylem transport and Cohesion-Tension theory. **Transpiration** - Mechanism of stomatal movement. Factors affecting Transpiration. **Mineral Nutrition** - Essential macro and micro-nutrients; Deficiency symptoms in local crops. Role of mycorrhiza in nutrient uptake. **Transport of Ions** - Active and passive transport; Ion channels (Ca^{2+} & K^{+}), Pumps (H+-ATPase).	12
2	**Photosynthesis and Carbon Metabolism** **Light Reactions** - Structure of photosynthetic apparatus (Chloroplast); Photosystem I & II; Photophosphorylation (Cyclic and Non-cyclic); Z-scheme. **Carbon Fixation** - C3, C4, and CAM pathways; Photorespiration (C2 cycle) and its significance. **Synthesis & Transport** - Starch and Sucrose biosynthesis; Phloem loading and unloading (Pressure Flow Hypothesis).	12
3	**Nitrogen Metabolism and Plant Hormones** **Nitrogen Cycle** - Biological Nitrogen Fixation (BNF); Nif genes and Nod factor signaling; Nitrate and Ammonium assimilation. **Plant Hormones** - Biosynthesis, transport, and molecular mechanism of action of Auxins, Gibberellins, Cytokinins, ABA, and Ethylene. **Newer Growth Regulators** - Brief introduction to Brassinosteroids, Jasmonic acid, and Salicylic acid. **Senescence & Abscission** - Physiological and biochemical changes during plant aging. **Sensory Photobiology and Stress Physiology** **Photoreceptors** - Structure and function of Phytochromes, Cryptochromes, and Phototropins; Photomorphogenesis.	12

4	**Photoperiodism & Flowering** - Florigen concept; Vernalization; Biological clocks and circadian rhythms. **Abiotic Stress** - Biochemistry of plant responses to Drought, Salinity, and Temperature stress; Role of Osmolytes (Proline, Glycine betaine). **Biotic Stress** - Plant defense mechanisms; SAR (Systemic Acquired Resistance) and Induced Systemic Resistance (ISR).	12
5	**Secondary Metabolites and Applied Plant Biochemistry** **Secondary Metabolites** - Biosynthetic pathways and functions of Terpenes, Phenolics (Flavonoids, Tannins), and Nitrogen-containing compounds (Alkaloids, Cyanogenic glycosides). **Industrial Applications** - Production of secondary metabolites through Plant Tissue Culture (Alkaloids & Flavonoids). Molecular markers in plant breeding; Transgenic plants (Bt-Cotton, Bt Brinjal, Golden Rice). The "Herbal Entrepreneur": Biochemistry of local medicinal plants (Neem, Turmeric, Aloe); Methods for essential oil extraction and value addition for self-help groups (SHGs) from Moringa.	12

CO	Course Outcomes Students will be able to	Knowledge Level
1	Explain concepts of plant water relations, mineral nutrition, and ion transport mechanisms	K1, K2, K3
2	Analyze photosynthesis, carbon fixation pathways, and assimilate transport in plants	K1, K2, K3, K4
3	Describe nitrogen metabolism and evaluate the role of plant hormones in plant growth and development	K2, K3
4	Interpret plant responses to light signals and environmental (biotic and abiotic) stresses	K1, K2, K3, K4
5	Apply knowledge of secondary metabolites for biotechnological, industrial, and entrepreneurial applications	K1, K2, K3, K5

Textbooks:

1	S.N. Pandey & B.K. Sinha, Plant Physiology, Vikas Publishing House
2	A. Bhattacharya & Vijaylaxmi, Biochemical Aspects of Plant Physiology, New India Publishing Agency, 2015.
3	Hans-Walter Heldt & Birgit Piechulla, Plant Biochemistry, Academic Press (Elsevier), 2021.
4	Manju Bala, Sunita Gupta, Practicals in Plant Physiology and Biochemistry, Scientific Publishers, 2024.
5	Satish C. Bhatla & Manju A. Lal, Plant Physiology, Development and Metabolism, Springer, 2023.

Reference Books:	
1	Lincoln Taiz & Eduardo Zeiger, Plant Physiology and Development, Sinauer Associates / Oxford University Press.
2	Bob B. Buchanan, Wilhelm Gruissem & Russell L. Jones, Biochemistry & Molecular Biology of Plants, Wiley Blackwell, 2025.
3	S. L. Kochhar & Sukhbir Kaur Gujral, Plant Physiology: Theory and Applications, Cambridge University Press, 2020.
4	William G. Hopkins & Norman P. A. Hüner, Introduction to Plant Physiology, Wiley, 2024.
5	V.K. Jain, Fundamentals of Plant Physiology, S. Chand Publishing.
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	ICAR e-Courses, https://ecourses.icar.gov.in
5	Khan Academy, https://www.khanacademy.org

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

Ist Year: First Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27							CIA	ESE	Total
Course Code	Title of the Course								
26PBCE14	DCE-2 Stem Cell Technology	3	1	0	3	4	25	75	100
Category	Discipline Centric Elective – II	Theory-100%							

Learning Objectives	
LO1	To explain the fundamental concepts of stem cells and their types.
LO2	To describe the principles of *in vivo* and *in vitro* differentiation of stem cells.
LO3	To apply the limitations and challenges associated with cloning.
LO4	To analyze the characteristics and functions of hematopoietic stem cells.
LO5	To evaluate the role and significance of skeletal muscle stem cells.

Unit	Content	Hours
1	**Stem Cell Biology and Therapy** Definition, properties, proliferation, culture of stem cells, medical applications of stem cells, and ethical and legal issues in the use of stem cells. Stem Cell Biology and Therapy, Types of Embryonic Stem Cells, Adult Stem Cell, Stem Cell Biology and Therapy, Embryonic Stem Cells, Culture, and the potential benefits of stem cell technology	12
2	**Overview of Stem Cell** Stem Cells and their developmental potentials, Characteristics of stem cells, Tran's differentiation of stem cells. Controlled differentiation of human embryonic stem cells. In vivo and in vitro differentiation of stem cells. Application of stem cells.	12
3	**Cloning, Stem Cell Derivation, and Ethics** Therapeutic cloning strategies, derivation and propagation of human embryonic stem cells. Reproductive cloning by Somatic Cell Nuclear Transfer. Use of SCNT. Limitations of cloning – Hurdles to improve the efficiency of therapeutic cloning. Stem cell research and ethics – translational medicine ethics.	12
4	**Hematopoietic stem cells (HSC)** Basics, Development and Regulation of HSC. Clinical Application of HSC – Gene Therapy: Introduction, History and evolution of Gene therapy, optimal disease targets, Failures and successes with gene therapy and prospects, Genetic Perspectives for Gene Therapy, Gene Delivery methods: Viral vectors and Non-viral Vectors	12
5	**Skeletal Muscle Stem Cells** Development and functions. Liver stem cells –Organisation and functions. Tumour stem cells – Basic differences and Similarities of cancer stem cells and stem cells. Cancer stem cell signalling – NOTCH pathway. Canonical Wnt signalling pathways in hematopoietic stem cells. Stem cell therapies in animal models. Use and benefits of stem cells for human beings. Canonical Wnt signalling pathways in hematopoietic stem cells. Stem cell therapies in animal models. Use and benefits of stem cells for human beings.	12

CO	Course Outcomes **Students will be able to**	Knowledge Level
1	Understand the basics, classification, sources, and properties of stem cells	K1, K2, K3
2	Describe embryonic development, blastocyst culture, and stem cell derivation methods.	K1, K2, K3, K4
3	Apply stem cell culture, cryopreservation, and characterization techniques.	K2, K3
4	Analyse stem cell differentiation, developmental potential and regulatory mechanisms.	K1, K2, K3, K4
5	Evaluate cloning strategies and ethical issues in stem cell research.	K1, K2, ,K4,K5

Textbooks:	
1	Atala, Anthony – Handbook of Stem Cells (2nd Edition) – Academic Press – 2013
2	Shi, Yanhong – Stem Cell Research and Therapeutics (1st Edition) – Springer (SIE) – 2009
3	Mummery, Christine – Stem Cells: Scientific Facts and Fiction (1st Edition) – Academic Press – 2011
4	Knoepfler, Paul – Stem Cells: An Insider's Guide *(1st Edition)* – World Scientific Publishing – *2013*
5	Atala, Anthony – Principles of Regenerative Medicine (2nd Edition) – Academic Press – 2011
Reference Books:	
1	Potten, C.S. – Stem Cells – Academic Press – 1st Edition – 1996
2	Turksen, Kursad – Adult Stem Cells – Humana Press (Springer) – 2nd Edition – 2014
3	Sullivan, Stephen – Human Embryonic Stem Cells: The Practical Handbook – Wiley-Blackwell – 1st Edition – 2007
4	Marshak, Daniel R. – Stem Cell Biology – Cold Spring Harbor Laboratory Press – 1st Edition – 2001
5	Pelayo, Rosana – Hematopoietic Stem Cell Biology – Springer – 1st Edition – 2015
Web resources:	
1	https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_hs05
2	https://onlinecourses.nptel.ac.in /preview/noc25
3	www.london womens clinic.com/fertility-treatments / blastocyst-culture-implantation/
4	https://www.nature.com/articles/cr200761
5	https://www.nature.com/scitable/topicpage/karyotyping-for-chromosomal-abnormalities-298/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	3	3	2	2
CO2	3	2	2	2	2	1	2	3	3	2	3
CO3	3	3	3	1	2	2	1	3	3	3	2
CO4	3	3	3	2	2	1	2	3	3	3	3
CO5	2	3	2	3	2	3	3	2	2	2	2
Total	14	13	12	10	10	8	9	14	14	12	12
Average	2.8	2.6	2.4	2.0	2.0	1.6	1.8	2.8	2.8	2.4	2.4

3 – Strong, 2- Medium, 1- Low

Ist Year: First Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27									
Course Code	Title of the Course						CIA	ESE	Total
26PBCA11	AECC-1 Biostatistics and Data Science	1	1	0	2	2	25	75	100
Category	Ability Enhancement Core Course	Theory-60% & Problem-40%							

Learning Objectives

LO1	To understand the data and extract salient features from large datasets.
LO2	To explain various measures of dispersion for effective data analysis and interpretation.
LO3	To explain and apply sampling concepts and tests of significance to draw meaningful conclusions from data.
LO4	To apply various attributes and their relevance to biological studies.
LO5	To evaluate SPSS software for graphical representation and accurate statistical analysis of data.

Unit	Content	Hours
1	**Biological Data** 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 Central Tendency and Dispersion** Measures of Dispersion for biological characters – Quartile deviation, Mean Deviation, Standard deviation and coefficient of variation. Measures of skewness and kurtosis. Correlation and regression (Simple problems).	6
3	**Correlation and Regression** Basic concepts of sampling- Simple random sample, stratified sample and systematic. Sampling. Sampling distribution and standard error.	6
4	**Sampling Techniques and Statistical Tests** Small sample tests – Students' test for the mean. Chi-square test for the goodness of a Non-independence of attributes. ANOVA- one-way and two-way (Simple problems)	6
5	**Data Science and Artificial Intelligence** Definition of 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	**Students will be able to Course Outcomes**	**Knowledge Level**
1	Understand statistical population, sample, variables, attributes, and data representation methods.	K1, K2
2	Explain measures of central tendency, dispersion, skewness, kurtosis, consistency, and independence of data.	K2, K3, K4
3	Apply sampling methods to evaluate statistical significance in research data.	K3, K4)
4	Analyze research data using Student's t-test, ANOVA, and Chi-square test.	K2,K3, K4
5	Understand data science, machine learning, artificial intelligence, big data, and their clinical and pharmaceutical applications.	K1,K2, K3, K4

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.
4	https://stats.libretexts.org/Bookshelves/Introductory_Statistics/Introductor.

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

I[st] Year: Second Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27									
Course Code	Title of the Course						CIA	ESE	Total
26PBCC21	CC 4 – Enzymology	5	1	0	5	6	25	75	100
Category	Core Course	Theory-100%							

Learning Objectives	
LO1	To understand the systematic naming and classification of enzymes based on reaction type.
LO2	To realize the principles, models, and analytical methods of enzyme kinetics for single-substrate, allosteric, and multi-substrate enzyme-catalyzed reactions.
LO3	To explain the mechanisms of enzyme action and inhibition, including catalytic mechanisms of key enzymes and types of reversible and irreversible inhibition.
LO4	To comprehend the structure, classification, and functional roles of coenzymes, prosthetic groups, and isoenzymes in enzymatic reactions.
LO5	To know the sources, properties, industrial and clinical applications of enzymes, including immobilization techniques.

Unit	Content	Hours
1	**Introduction and Classification of Enzymes** Nomenclature and classification of enzymes, Isolation and purification of enzymes, and criteria of purity. Enzyme units - Katal, Turnover Number, IU and Specific Activity. 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. Investigation of the 3-D structure of the active site.	18
2	**Enzyme Kinetics** Kinetics of single-substrate enzyme-catalyzed reactions - Michaelis - Menten equation (MM equation), Importance of Vmax and Km. Lineweaver-Burk plot, Eadie-Hofstee plot, Pre-steady-state kinetics and relaxation kinetics. Kinetics of Allosteric enzymes - MWC and KNF models.Hill's equation coefficient. Kinetics of multi - substrate enzyme – catalysed reactions - Ping-pong bi-bi, random order and compulsory order mechanism	18
3	**Mechanism of Enzyme Action** Mechanism of enzymic action, mechanism of serine proteases - chymotrypsin, lysozyme, carboxypeptidase A and ribonuclease. Reversible inhibition- competitive, uncompetitive, noncompetitive, mixed, substrate and allosteric inhibition. Irreversible inhibition.	18
5	**Application of Enzymes** Industrial uses of enzymes - sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose-degrading enzymes, lipases, pectinases, and Invertases. Proteolytic enzymes in the meat and leather industry, detergents and cheese production. Clinical enzymology - Enzymes as thrombolytic agents, anti- Inflammatory agents. Immobilization of enzymes and their applications.	18

CO	Students will be able to Course Outcomes	Knowledge Level
1	Classify enzymes and interpret enzyme nomenclature using EC numbering.	K1,K2, K3
2	Examine enzyme kinetics and regulatory behavior.	K3, K4
3	Differentiate enzyme mechanisms and types of inhibition.	K2, K3,
4	Describe the mechanisms and biological roles of major coenzymes.	K2, K4
5	Evaluate the industrial and medical applications of enzymes and the significance of enzyme immobilization.	K1,K2,K4, K5

Textbooks:

1	Palmer T and Bonner P, Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Affiliated East-West Press Pvt. Ltd., 2nd edition, 2007.
2	Price NC and Stevens L, Fundamentals of Enzymology, Oxford University Press, 3rd edition, 2003.
3	Nelson DL and Cox MM, Lehninger Principles of Biochemistry, W.H. Freeman & Co., 8th edition, 2021.
4	Berg JM, Stryer L and Gatto GJ, Biochemistry, W.H. Freeman & Co., 8th edition, 2015.
5	Satyanarayana U, Biochemistry, Books and Allied (P) Ltd., 4th edition, 2014.

Reference Books:	
1	Berg JM, Tymoczko JL and Stryer L Biochemistry, W.H. Freeman, 9th edition, 2019.
2	Voet D and Voet JG, Voet's Biochemistry, Wiley India, Adapted edition, 2011.
3	Wood WB, Wilson JH, Benbow RM and Hood LE, Biochemistry: A Problem Approach, Benjamin/Cummings Publishing Company, 2nd edition, 1981.
4	Garrett RH and Grisham CM, Biochemistry, Saunders College Publishing, 4th edition, 2010.
5	Cook PF and Cleland WW, Enzyme Kinetics and Mechanism, Garland Science, 2007.

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	2	3	3	2	3
CO2	3	3	3	3	2	2	1	3	2	3	2
CO3	3	3	2	3	2	2	2	3	3	3	3
CO4	3	2	2	3	2	2	2	3	2	2	3
CO5	3	3	2	2	2	1	2	3	3	3	3
Total	15	13	12	12	10	10	09	15	13	13	14
Average	3	2.6	2.4	2.4	2	2	1.8	3	2.6	2.6	2.8

3 – Strong, 2- Medium, 1- Low

Ist Year: Second Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27									
Course Code	Title of the Course						CIA	ESE	Total
26PBCC22	CC– 5 Research Methodology	4	2	0	5	6	25	75	100
Category	Core Course	Theory -100%							

Learning Objectives

Students will be able to

LO1	Understand basic concepts of research, formulate research problems and hypotheses, and recognize the role of research in society and interdisciplinary contexts.
LO2	Search, evaluate, and organize scientific literature using databases, citation styles, and reference management tools.
LO3	Design a basic research study by selecting appropriate research methods, sampling techniques, and ensuring validity and reliability.
LO4	Apply ethical principles in research and understand intellectual property rights and funding opportunities in science.
LO5	Prepare scientific documents, including research papers, proposals, and presentations, with proper referencing and ethical practices.

Unit	Content	Hours
1	**Foundations of Research** Meaning, objectives, and types of research (basic, applied, action, descriptive, experimental, longitudinal). Research process: identification of the problem, formulation of objectives. Objectives and scope of a study: broad vs specific objectives. Hypothesis - concept, types (null, alternate, directional, non-directional), characteristics of a good hypothesis. Role of research in national development and women's empowerment in science. Interdisciplinary research & societal impact. Use of AI tools in research – connected papers, Grammarly / Quillbot, Elicit, Chatpdf, Semantic Scholar.	18
2	**Literature Review & Information Sources** Primary vs secondary vs tertiary sources of information. Scientific databases: PubMed, Google Scholar, ScienceDirect, Scopus, Web of Science. Boolean operators and advanced search strategies for effective literature search. Journals in biochemistry: impact factor, h-index, journal ranking (SJR, Q1–Q4). Writing a literature review: structure, critical analysis, synthesis of sources. Evaluating source credibility; identifying predatory journals (Beall's list concept).	18
3	**Research Design, Sampling & Experimental Methods** Types of research design: experimental, quasi-experimental, observational, case study. Variables: independent, dependent, confounding, operationalisation of variables. Controls in biochemical experiments: negative, positive, reagent blank, internal standards. Sampling methods: random, stratified, systematic, convenience, purposive; sample size concept. Validity and reliability: internal and external validity; reproducibility and repeatability. Data types: qualitative vs quantitative; primary and secondary data. Data collection tools: questionnaires, structured interviews, laboratory protocols, case records. Common sources of experimental error and bias; methods to minimise them.	18
4	**Research Ethics, IPR & Funding:** Ethics in biological and biomedical research: principles of bioethics (autonomy, beneficence, justice).	18

	Institutional review/ethics committee: IRB, IAEC. Informed consent, animal ethics (3Rs principle), human subject research. Data integrity and responsible conduct of research (RCR). Intellectual Property Rights: patents, copyrights, and trade secrets relevant to biotechnology. Science funding in India: DST, DBT, ICMR, UGC schemes for women scientists (WOS-A, KIRAN). Open access publishing: preprints, repositories, Creative Commons licensing.	
5	**Scientific Writing & Documentation** Structure of a research paper: IMRAD format (Introduction, Methods, Results, Discussion). Writing thesis, dissertation, and reports. Abstract writing: structured and unstructured abstracts. Writing materials and methods for biochemical experiments. Visual presentation (figures, graphs, tables). Referencing and citation styles: APA, Vancouver; use of reference managers (Mendeley, Zotero). Plagiarism: definition, types, consequences, tools for detection (Turnitin, iThenticate). Seminar presentation skills: oral presentation, poster presentation. Research Proposal Component.	18

CO	Course Outcomes Students will be able to	Knowledge Level
1	Explain the basic concepts of research, types, and objectives, and formulate simple research problems and hypotheses	K1,K2, K3
2	Identify, search, evaluate, and organize scientific literature using databases, citation styles, and reference management tools	K2, K3, K4
3	Apply appropriate research designs, sampling methods, and ensure validity and reliability in designing basic research studies	K3, K4
4	Explain and apply research ethics, intellectual property rights, and awareness of funding agencies in scientific research	K1,K2, K4
5	Prepare and present scientific documents such as research papers, proposals, and reports using proper structure, referencing, and ethical practices	K1,K3, K4, K5

Textbooks:	
1	Kothari, C.R., Research Methodology: Methods and Techniques, New Age International Publishers, 2004.
2	Gurumani, N., Research Methodology for Biological Sciences, MJP Publishers, 2009.
3	Day, R.A. & Gastel, B., How to Write and Publish a Scientific Paper, Cambridge University Press, 2012.
4	Daniel, W.W. & Cross, C.L., Biostatistics: A Foundation for Analysis in the Health Sciences, Wiley, 2018
5	Sateesh, M.K., Bioethics and Biosafety, I.K. International Publishing House, 2008.

Reference Books:	
1	Walker, J.M. (Ed.), Methods in Molecular Biology, Humana Press (Springer), 1983–Present.
2	Sahay, V., Encyclopaedia of Research Methodology in Life Sciences, Arts & Science Academic Publishing, 2009.
3	Narayana, P.S., Pullaiah, T. & Varalakshmi, D., Research Methodology in Biochemistry, Scientific Publishers, 2024.
4	Laake, P., Benestad, H.B. & Olsen, B.R., Research Methodology in the Medical and Biological Sciences, Elsevier, 2007.
5	Narayana, P.S., Varalakshmi, D., Pullaiah, T. & Sambasiva Rao, K.R.S., Research Methodology in Zoology, Scientific Publishers, 2018
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	PubMed, U.S. National Libraryof Medicine, Available at: https://pubmed.ncbi.nlm.nih.gov
5	e-PG Pathshala, UGC-INFLIBNET, Available at: https://epgp.inflibnet.ac.in

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	2	3	3	3	3	3	3	3	3	3
CO3	3	2	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	12	15	15	15	15	15	15	15	15	15
Average	3	2.4	3	3	3	3	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

I[st] Year: Second Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27							CIA	ESE	Total
Course Code	Title of the Course								
26PBCC23P	CC-6 Enzymology Practical	0	0	5	3	5	25	75	100
Category	Core Course	Problem-100%							

Learning Objectives

LO1	To understand the factors affecting enzyme activity and experimentally determine optimal conditions and activity of alkaline phosphatase.
LO2	To describe the factors influencing salivary amylase activity under different conditions.
LO3	To analyze the principles and perform the assay of serum acid phosphatase and analyze factors affecting its activity.
LO4	To explain the principles and perform the assay of serum transaminases (SGOT and SGPT) and their clinical significance.
LO5	To apply the principle and perform the assay of urease activity by measuring the rate of urea hydrolysis.

Unit	Content	Hours
1	**Assay of 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	15
2	**Assay of 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	15
3	**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	15
4	**Assay of serum Transaminases** a. SGOT- Serum glutamic-oxaloacetic transaminase activity b. SGPT- Serum glutamic-oxaloacetic transaminase activity	15

5	**Assay of Urease Activity**	15
CO	**Students will be able to Course Outcomes**	**Knowledge Level**
1	Determine enzyme activity by determining the optimum pH and temperature, assessing substrate concentration effects, and measuring alkaline phosphatase activity.	K1, K3, K4, K5
2	Estimate the effects of pH, temperature, and substrate concentration on salivary amylase activity through experimental methods.	K3, K4, K5
3	Estimate serum acid phosphatase activity and evaluate the influence of pH, temperature, and substrate concentration on enzyme function.	K3, K4, K5
4	Estimate and interpret serum transaminase (SGOT and SGPT) activities as indicators of liver function.	K3, K4
5	Quantitatively estimate urease activity and interpret its enzymatic significance in biochemical processes.	K3, K4, K5

Textbooks:	
1	Voet D and Voet JG, Biochemistry, John Wiley & Sons, 4th edition, 2011.
2	Jayaraman J, Laboratory Manual in Biochemistry, New Age International Pvt. Ltd. Publishers, 2011.
3	Sawhney SK and Singh R, Introductory Practical Biochemistry, Alpha Science International Ltd., 2nd edition, 2005.
4	Gowenlock AH, Varley's Practical Clinical Biochemistry, CBS Publishers and Distributors, 6th edition, 1988.
5	Wilson K and Walker I, Practical Biochemistry, Cambridge University Press, 5th edition, 2000.
Reference Books:	
1	Mukherjee KL, Medical Laboratory Technology (Vol. I, II & III), Tata McGraw-Hill, 2000.
2	Sadasivam S and Manickam A, Biochemical Methods, New Age International, 2008.
3	Sawhney SK, Practical Biochemistry, Pearson Education, 2006.
4	Gupta, Practical Biochemistry, Tata McGraw-Hill, 3rd edition, 2017.
5	Berg JA and McKenzie RMRC, Practical Biochemistry: Principles and Techniques, Springer, 2nd edition, 2018.
Web resources:	

1	https://labpedia.net/alkaline-phosphatase-alp/
2	iubmb.onlinelibrary.wiley.com/doi/10.1002/bmb.2005.494033022439
3	https://www.sigmaaldrich.com/IN/en/technical-documents/protocol/protein-biology/enzyme-activity-assays/enzymatic-assay-of-acid-phosphatase
4	https://www.himedialabs.com/media/TD/HTBC009.pdf
5	https://microbenotes.com/urease-test-principle-procedure-and-result/

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

Ist Year: Second Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27									
Course Code	Title of the Course						CIA	ESE	Total
26PBCE21	DCE-3 Human Physiology	4	1	0	3	5	25	75	100
Category	Core Course	Theory -100%							

Learning Objectives	
LO1	To understand the composition, functions, and circulation of blood.
LO2	To explain the processes of digestion, absorption, and excretion in humans.
LO3	To study the structure and physiology of the respiratory system and acid-base balance.
LO4	To understand the structure and functions of the nervous system and nerve transmission.
LO5	To explain the molecular organization and mechanism of muscle contraction.

Unit	Content	Hours
1	**Blood and circulation** Composition and functions of blood and plasma. Blood groups. Blood coagulation - mechanism, fibrinolysis, anticoagulants. Hemoglobin - structure, abnormal types, anemia. Structure of heart, cardiac cycle, E.C.G blood pressure.	15
2	**Digestive system and excretion system** Digestive secretions - composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestions and absorption of carbohydrates, lipids, proteins and nucleic acids. Excretory system - structure of nephron. Formation of urine - glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion.	15
3	**Respiratory system** Structure of lungs, mechanism and regulation of respiration. Transport of blood gases - O2 and CO2. Acid-base balance - role of buffers, erythrocytes, respiratory system. Acidosis and alkalosis – metabolic pathway of respiratory system.	15
4	**Nervous system** Structure and function of nerves, neurons, resting and action potential, transmission of nerve impulses, synaptic transmission, compounds affecting synaptic trans mission, neuromuscular junction, composition and functions of cerebrospinal fluid, brain - chemical composition and metabolic adaptation, neurotransmitters and cAMP,	15

5	**Muscular System** Structure of muscle cells and muscle contraction, molecular organization of muscle, proteins of contractile element - their organization and role in contraction, energy for contraction.	15

CO	Students will be able to Course Outcomes	Knowledge Level
1	Understand the composition and physiological functions of the blood and the heart.	K1,K2, K3
2	Explain the digestion, absorption, and urine formation processes.	K2, K3, K4
3	Illustrate the mechanism of respiration and maintenance of acid-base balance.	K2, K3
4	Discuss nerve impulse transmission, synaptic function, and neurotransmitter action.	K2, K4
5	Explain the structure, organization, and contraction mechanism of muscles.	K1,K2, K3, K5

Textbooks:	
1	Sembulingam & Prema Sembulingam – Essentials of Medical Physiology (7th Edition) – Jaypee Brothers Medical Publishers (P) Ltd. – 2016
2	C. C. Chatterjee – Human Physiology, Vol. I & II (1st Edition) – Medical Allied Agency 1988
3	A. C. Guyton & John E. Hall, Textbook of Medical Physiology, Elsevier, 14th Edition, 2021.
4	Lauralee Sherwood, Human Physiology: From Cells to Systems, Cengage Learning, 10th Edition, 2019.
5	G. K. Pal & Pravati Pal, Textbook of Medical Physiology by Universities Press, 3rd Edition, 2015.

Reference Books:	
1	M. N. Chatterjee & Rana Shinde – Textbook of Medical Biochemistry Physiology (7th Edition) – Jaypee Brothers Medical Publishers – 2007
2	Meyer, Meyer & Meij – Human Physiology (3rd Edition) – A.I.T.B.S Publishers – 2002
3	Arthur C. Guyton & John E. Hall – Textbook of Medical Physiology (12th Edition) – W.B. Saunders Company – 2011
4	Lauralee Sherwood Cengage Learning- Human Physiology (7th Edition)-2017
5	Elaine N. Marieb – Human Anatomy and Physiology (3rd Edition) – Benjamin/Cummings (Pearson Education) – 1995
Web resources:	
1	https://www.ncbi.nlm.nih.gov/books/NBK541090/
2	https://onlinecourses.nptel.ac.in/noc25_bt22/preview?utm_source=chatgpt.com
3	https://my.clevelandclinic.org/health/body/21887-muscle
4	https://www.ncbi.nlm.nih.gov/books/NBK279001/
5	https://www.ncbi.nlm.nih.gov/books/NBK526069/

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

I[st] Year: Second Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-2027									
Course Code	Title of the Course						CIA	ESE	Total
26PBCE22	DCE-3 Molecular Biology Techniques	3	2	0	3	5	25	75	100
Category	Core Course	Theory-100%							

Learning Objectives	
LO1	To understand the basic problem-solving skills in diagnostic molecular biology and diagnostic techniques.
LO2	To explain the analytical decision-making processes in laboratory and research-based diagnostic practices.
LO3	To apply critical thinking and problem-solving skills in molecular diagnostics.
LO4	To analyze the laboratory tests while ensuring equipment maintenance and quality control.
LO5	To evaluate the proper handling and processing techniques for blood, bone marrow, and tissue specimens.

Unit	Content	Hours
1	**Introduction to Molecular Biology Laboratory and Techniques.** Introduction to Molecular Biology, Basics of DNA Replication and Central Dogma of Molecular Biology. Overview of Laboratory and Introduction to Laboratory Equipment and Basic Techniques (Pipetting, Centrifugation, etc.). Good Laboratory Practice in Molecular Laboratory. Principles of Nucleic Acid Isolation and Purification. Quality check: Nucleic acid extraction and Quantification of Nucleic acids. Storage of Nucleic acids.	15
2	**PCR and Real-Time PCR.** Introduction to Polymerase Chain Reaction (PCR). Different applications of PCR and different Modifications of PCR. Gel electrophoresis and Nucleic acid visualization. Basic PCR – AS-PCR/RT-PCR. Interpretation of Basic PCR gel electrophoresis. Tutorial: Presentation by student – PCR and its application. Principle of Real-time PCR. Applications of Real-time PCRs. Data analysis and interpretation of Real-Time PCR.	15
3	**Molecular Diagnostics Techniques – Sequencing.** Nucleic Acid Sequencing (Sanger Sequencing) and Applications. Gene Scan Fragment Analysis and Applications. Interpretation of Sanger Sequencing and different types of mutations.	15
4	**Basic Bioinformatics in the Molecular Biology Laboratory.** Introduction to Bioinformatics Tools for Molecular Data Analysis. Sequence Alignment and Basic Bioinformatics Analysis. Primer synthesis tools. Overview of NGS and ddPCR.	15

5	**Basics of Cloning in the Molecular Biology Laboratory** Basic principles of Cloning in the molecular laboratory. Different techniques for Cloning (Plasmid Preparation, Transformation). Quality control and assessment in the Molecular Pathology Laboratory. Overview of Laboratory Safety Practices.	15

CO	**Students will be able to Course Outcomes**	**Knowledge Level**
1	Understand and apply fundamental molecular biology concepts and basic laboratory techniques.	K1,K2, K3
2	Explain the principles, applications, modifications, and data interpretation of PCR and Real-Time PCR, including gel electrophoresis and nucleic acid analysis.	K2, K3
3	Apply molecular diagnostic techniques, including Sanger sequencing and Gene Scan fragment analysis.	K3, K4, K5
4	Analyze and apply basic bioinformatics tools a n d create sequence alignment methods.	K2, K3, K4
5	Evaluate the basic principles of molecular cloning and apply laboratory safety practices in a molecular biology laboratory.	K2, K3, K5

Textbooks:	
1	Handar, N., & Viselli, S. M. Lippincott Illustrated Reviews: Cell and Molecular Biology – 3rd ed. – Wolters Kluwer 2022.
2	McPherson, M., & Møller, S. G. PCR – BIOS Scientific Publishers. 2000
3	Ding, Y., & Zhang, L. – n.d. – Practical Oncologic Molecular Pathology – Publisher not specified.
4	Glick, B. R., Pasternak, J. J., & Patten, C. L. Molecular Biotechnology: Principles and Applications of Recombinant DNA – 6th ed. – ASM Press. 2021
5	Collee, J. G., Fraser, A. G., Marmion, B. P., & Simmons, A. Mackie & McCartney Practical Medical Microbiology – 14th ed. – Churchill Livingstone/Elsevier. (Eds.) – 2006.
Reference Books:	

1	Coleman, W. B., & Tsongalis, G. J. (Eds.) – 2017 – Molecular Pathology: The Molecular Basis of Human Disease – 2nd ed. – Elsevier.
2	Coleman, W. B., & Tsongalis, G. J. (Eds.) – 2019 – Essential Concepts in Molecular Pathology – 2nd ed. – Elsevier.
3	Leonard, D. G. B. (Ed.) – 2016 – Molecular Pathology in Clinical Practice – Springer.
4	Allen, T. C., & Cagle, P. T. (Eds.) – 2009 – Basic Concepts of Molecular Pathology – Springer.
5	Cheng, L., Zhang, D. Y., & Eble, J. N. (Eds.) – 2013 – Molecular Genetic Pathology – 2nd ed. – Springer.

Web resources:

1	https://swayam.gov.in/
2	https://www.jrfadda.com/exams/ugc-net/ugc-net-study-material-2026/
3	https://www.slideshare.net/patholab/introduction-to-pathology-40787522
4	https://link.springer.com/book/10.1007/978-0-387-89626-7
5	tps://www.slideserve.com/leane/molecular-pathology-and-the-molecular-diagnostics-lab

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

I[st] Year: Second Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27									
Course Code	Title of the Course						CIA	ESE	Total
26PBCE23	DCE- 4 Microbiology	4	1	0	3	5	25	75	100
Category	Discipline Centric Elective 4	Theory-100%							

Learning Objectives	
LO1	To understand the classification, morphology, and structural organization of microorganisms.
LO2	To explain microbial growth, cultivation methods, and microbiological techniques.
LO3	To describe microbial diversity and the characteristics of extremophiles.
LO4	To explain microbial metabolism and ecological interactions in different environments.
LO5	To analyze microbiological concepts in nitrogen fixation, methanogenesis, and environmental microbiology.

Unit	Content	Hours
1	**Classification of Micro-Organism** History of bacterial classification. Haeckel's three kingdoms concept, Whittaker's five kingdom concept, the three domain concept of Carl Woese; Basis of microbial classification, molecular approaches in microbial classification, concept of microbial species; Principle and classification of bacteria based on Bergey's manual of Determinative bacteriology; Cyanobacteria and Prochlorons.	15
2	**Morphology and Fine Structure Of Bacteria** Morphological types – size, shape, and arrangements; cell walls of archaea, Gram-negative, Gram-positive eubacteria, eukaryotes; L forms – cell wall synthesis, antigenic properties, cell membranes – structure, composition, and properties. Reserve materials, inorganic and organic inclusions.	15
3	**Microbiological Techniques** Aerobic, anaerobic, shaking, static cultures, nutritional types, culture media, culture methods, pure culture techniques, Growth curve, generation time, synchronous, batch and continuous culture; Measurement of growth and factors affecting growth, Sterilization and disinfection- heat, UV radiation, ionizing radiation, filtration. Chemical disinfectants.	15
4	**Microbial Diversity and Extremophiles** Microbial diversity, distribution, ecological niche, abundance, and density. Extremophiles – Psychrophiles, acidophiles, alkaliphiles, thermophiles, barophiles	15

	etc., non-culturable bacteria (Metagenomics). Methanogens, Methanotrophs and Methylotrophs.	
5	**Applications Microbiology** Design a mechanism that would allow a bacterium to protect its nitrogenase from oxygen. Analyze the symbiotic relationship that some N2-fixing bacteria have with plants. Identify what the bacteria contribute and what the plant contributes. Describe the process of methanogenesis in terms of electron transport and energy generation. The interactions of microorganisms among themselves and with their environment are determined by their metabolic abilities (e.g. quorum sensing, oxygen consumption, nitrogen transformations).	15

CO	Students will be able to Course Outcomes	Knowledge Level
1	Classify microorganisms and explain their taxonomic organization and diversity.	K1, K2, K3
2	Describe bacterial morphology, fine structure, and cellular components.	K2, K4
3	Apply microbiological techniques for cultivation, growth analysis, sterilization, and disinfection.	K3, K4
4	Analyze microbial diversity, extremophiles, and their ecological significance.	K2, K3, K4
5	Evaluate microbial applications in nitrogen fixation, methanogenesis, and environmental interactions.	K4, K5

Textbooks:	
1	Brooks, G.F., Butel, J.S., and Ornston, L.N. – Jawetz, Melnick and Adelberg's Medical Microbiology – *Lange Medical Books* – 21st Edition – 1998
2	Davis, B.D., Dulbecco, R., Eisen, H.N., and Ginsberg, H.S. – Microbiology – Lippincott Williams and Wilkins – 4th Edition – 1989
3	Joklik, W.K., Willett, H.P., Amos, D.B., and Wilfert, C.M. – Zinsser Microbiology – McGraw-Hill Professional – 20th Edition – 1995
4	Madigan, M.T., Martinko, J.M., and Parker, J. – Brock Biology of Microorganisms – *Prentice Hall* – 10th Edition – 2002
5	Prescott, L.M., Harley, J.P., and Klein, D.A. – Microbiology – McGraw-Hill – 5th Edition – 1999
Reference Books:	
1	Madigan, M.T., Martinko, J.M., and Parker, J. – Brock Biology of Microorganisms – Prentice Hall – 10th Edition – 2002
2	Glazer, A.N., and Nikaido, H. – Microbial Biotechnology – Cambridge University Press – 2nd Edition – 2007
3	Frazier, W.C., and Westhoff, D.C. – Food Microbiology – Tata McGraw-Hill – 4th Edition – 1988
4	Murray, P.R., Rosenthal, K.S., and Pfaller, M.A. – Medical Microbiology – Elsevier – 6th Edition – 2009
5	Pepper, I.L., Gerba, C.P., and Gentry, T.J. – *Environmental Microbiology* – Academic Press – 2nd Edition – 2011

Web resources:	
1	https://www.pearson.com/channels/microbiology/study-guides/introduction-to-microbiology-basic-principles-and-history?utm_source=chatgpt.com
2	https://www.researchgate.net/publication/334975999_History_of_Microbiology
3	https://learnmicrobiology.com/general-microbiology-notes/?utm_source=chatgpt.com
4	https://www.atcc.org/resources/culture-guides/introduction-to-microbiology?utm_source=chatgpt.com
5	https://www.microrao.com/notes.htm?utm_source=chatgpt.com

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

Ist Year: Second Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27									
Course Code	Title of the Course						CIA	ESE	Total
26PBCE24	DCE 4 Nanotechnology	3	2	0	3	5	25	75	100
Category	Discipline Centric Elective-4	Theory-100%							

Learning Objectives	
LO1	To understand the knowledge of nanoscale science and quantum phenomena.
LO2	To explain sophisticated synthesis techniques of nanomaterials.
LO3	To demonstrate advanced characterization tools and data interpretation.
LO4	To explore nanotoxicology, regulatory, and ethical issues in nanotechnology research.
LO5	To evaluate interdisciplinary applications in biomedical, environmental, and industrial sectors.

Unit	Content	Hours
1	**Fundamentals of Nanoscience**: Nanoscale dimensions, quantum confinement, density of states, surface energy, plasmon resonance, electronic and optical properties of nanomaterials.	15
2	**Advanced Synthesis Techniques**: Bottom-up (sol-gel, hydrothermal, solvothermal, self-assembly), top-down (e-beam lithography, nanolithography), chemical vapor deposition (CVD), green synthesis using biological systems.	15
3	**Advanced Characterization Methods**: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), High-Resolution Transmission Electron Microscopy (HRTEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), X-ray Diffraction (XRD), X-ray Photoelectron Spectroscopy (XPS), Fourier Transform Infrared Spectroscopy (FTIR), Raman Spectroscopy, Dynamic Light Scattering (DLS).	15
4	**Nanotoxicology & Regulatory Aspects**: Mechanisms of nanoparticle toxicity, bioaccumulation, environmental impact, risk assessment models, Ethical concerns, regulatory frameworks, future trends.	15
5	**Nanotechnology Applications**: Targeted drug delivery, nanomedicine, biosensors, nanoelectronics, environmental remediation, nano catalysis, energy systems (fuel Cells, supercapacitors, and nanotechnology in agriculture.	15

CO	Students will able to Course Outcomes	Knowledge Level
1	Explain nanoscale phenomena and quantum effects in materials.	K1,K2, K3,
2	Demonstrate advanced synthesis techniques for nanomaterials.	K3, K4, K5
3	Examine data obtained from sophisticated characterization tools.	K2, K3, K4
4	Evaluate nanotoxicology and regulatory frameworks.	K2, K3, K4
5	Analyze interdisciplinary applications of nanotechnology.	K4, K5

Textbooks:	
1	Charles P. Poole Jr. & Frank J. Owens, Introduction to Nanotechnology, Wiley India, 2nd Edition, 2007.
2	Sulabha K. Kulkarni, Nanotechnology: Principles and Practices, Springer, 3rd Edition, 2015.
3	V. S. Muraleedharan & A. Subramania, Nanoscience and Nanotechnology: Fundamentals to Frontiers, Ane Books, 1st Edition, 2013.
4	M. A. Shah & K. A. Shah, Nanotechnology: The Science of Small, Wiley India, 2nd Edition, 2019.
5	B. S. Murty, P. Shankar, Baldev Raj & B. B. Rath, Textbook of Nanoscience and Nanotechnology, Springer, 1st Edition, 2013.
Reference Books:	
1	Bharat Bhushan, Springer Handbook of Nanotechnology, Springer, 4th Edition, 2017.
2	Hari Singh Nalwa, Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers, 1st Edition, 2004.
3	Chris Binns, Introduction to Nanoscience and Nanotechnology, Wiley, 2nd Edition, 2021.
4	Gabor L. Hornyak, John J. Moore, H. F. Tibbals & Joydeep Dutta, Fundamentals of Nanotechnology, CRC Press, 1st Edition, 2009.
5.	Marc J. Madou, Fundamentals of Microfabrication and Nanotechnology, CRC Press, 3rd Edition, 2011.
Web Resources:	
1	https://lecture-notes.tiu.edu.iq/wp-content/uploads/2023/10/Lec3.-Nano-Properties.pdf
2	https://onlinecourses.nptel.ac.in/noc26_bt25/preview
3	https://www.youtube.com/watch?v=4uTWTQ_cs3U
4	https://tkiet.digimat.in/nptel/courses/video/118102003/L03.html?utm_source=chatgpt. com
5	Nanotoxicology & Regulatory Aspects: Mechanisms of nanoparticle toxicity, bioaccumulation, environmental impact, risk assessment models, Ethical concerns,

	regulatory frameworks, future trends-web resource - - Video Search Results

apping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	2	2	1	1
CO2	3	2	3	2	2	2	1	2	3	2	1
CO3	3	2	3	2	3	2	1	3	3	3	2
CO4	2	2	3	3	2	2	2	3	1	2	3
CO5	2	3	2	3	2	2	2	2	2	2	2
Total	13	11	13	11	11	9	7	12	11	10	9
Average	2.6	2.2	2.6	2.2	2.2	1.8	1.4	2.4	2.2	2.0	1.8

3 – Strong, 2- Medium, 1- Low

I[st] Year: Second Semester

Department of Biochemistry		L	T	P	Credit	Hours	Marks		
Regulation 2026-27							CIA	ESE	Total
Course Code	Title of the Course								
26PBCS21	SEC-1 Computer-Aided Drug Design	3	0	0	2	3	25	75	100
Category	Skill Enhancement Course	Theory-100%							

Learning Objectives	
LO1	To understand the drug structure, pharmacokinetics, drug metabolism, and drug–receptor interactions.
LO2	To explain the structure–activity relationships using SAR and QSAR principles.
LO3	To acquire ADMET concepts and drug discovery stages in evaluating drug candidates.
LO4	To analyze computational drug design strategies, including virtual screening and structure-based and ligand-based approaches.
LO5	To evaluate molecular docking methods and protein–ligand interactions in drug design

Unit	Content	Hours
1	**Drug Structure and Drug–Receptor Interactions** Drug definition and structural features; prodrug concept. Mechanism of drug absorption, including first-pass effect; drug metabolism and role of cytochrome P450 enzymes. Introduction to pharmacodynamics. Drug receptors: types and models of drug–receptor interaction; agonists and antagonists.	**09**
2	**Quantitative Structure–Activity Relationship (QSAR)** Concept of SAR and QSAR; physicochemical parameters influencing biological activity, including lipophilicity, electronic and steric effects. Basic QSAR approaches. Applications and limitations of QSAR in drug design.	**09**
3	**ADMET and Drug Discovery Process** Concept of absorption, distribution, metabolism, excretion, and toxicity (ADMET) and their importance in drug development. Computational prediction of ADMET properties. Overview of drug discovery and development; key stages and role of computer-aided drug design (CADD).	**09**
4	**Computational Drug Design Strategies** Sources of lead compounds, including natural and synthetic compounds and database screening. Structure-based and ligand-based drug design; pharmacophore concept. Virtual screening techniques, including similarity-based and docking-based approaches. De novo drug design.	**09**
5	**Molecular Docking and Applications** Basics of molecular docking and protein–ligand interactions. Protein and ligand preparation. Docking using AutoDock, AutoDock Vina, or PyRx. Analysis of binding interactions and applications in drug design.	**09**

CO	Course Outcomes Students will be able to	Knowledge Level
1	Explain drug structure, pharmacokinetics, metabolism, and drug–receptor interactions.	K1,K2, K3,
2	Describe structure–activity relationships using QSAR methods in drug design.	K2, K3, K4
3	Apply ADMET principles and drug discovery concepts in evaluating drug candidates.	K3, K4, K5
4	Analyze computational drug design techniques, including virtual screening, for lead identification.	K3, K4, K5
5	Evaluate molecular docking results to interpret protein–ligand interactions and binding affinity.	K4, K5

Textbooks:	
1	V. Ganesan & R. Xavier Arulappa, Computer Aided Drug Design – Revised Edition, Thakur Publications, Latest PCI Syllabus Edition.2020
2	Mohini Gore & Umesh B. Jagtap Computational Drug Discovery and Design – (Editors), 2nd Edition, Springer Nature, 2024
3	V. Alagarsamy & V. Raja Solomon, Textbook of Computer Aided Drug Design, CBS Publishers & Distributors, 1st Edition, 2022.
4	Dev Bukhsh Singh, Computer-Aided Drug Design, Springer Singapore, 1st Edition, 2020.
5	Charles P. Poole Jr. & Frank J. Owens, Introduction to Nanotechnology, Wiley India, 2nd Edition, 2007
Reference Books:	
1	Silverman, R. B., & Holladay, M. W. The organic chemistry of drug design and drug action (3rd ed.). Academic Press. (2014).
2	Martin, Y. C. Quantitative drug design: A critical introduction (2nd ed.). CRC Press. (2010).
3	Höltje, H. D., Sippl, W., Rognan, D., & Folkers, G. (2008). Molecular modeling: Basic principles and applications (3rd ed.). Wiley-VCH.
4	Doble, M., & Kruthiventi, A. K. Drug design: Structure-based and ligand-based approaches. Springer India. (2007).
5	Thomas, G. Medicinal chemistry: An introduction (2nd ed.). Wiley India. (2009).
Web Resources:	
1	https://nptel.ac.in/courses/102106065
2	https://nptel.ac.in/courses/102103044
3	https://nptel.ac.in/courses/104106090
4	https://nptel.ac.in/courses/102106079
5	https://onlinecourses.nptel.ac.in/noc23_bt20/preview

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