M.Sc. BIOCHEMISTRY

(Effective from the academic year 2024 - 2025)

Vision of the Department:

To be a premier Department by fostering and conducting leading-edge course and providing quality training in updating life science culture, inculcating the idea of research programmes for human welfare, and identifying themselves as the power governing the future's medical trend.

Objectives:

1. To inculcate the concepts of biochemistry and understanding of the biochemical principles and their applications in a systematic, scientific, evidence-based process.
2. To learn the major metabolic pathways, Bioenergetics and Enzyme Catalysis and to understand the molecular concepts of body defenses and its mechanisms.
3. To gain knowledge in Pharmaceutical and Industrial Biochemistry.
4. To acquire skills by hands on experience in Laboratory Experiments.
5. To develop the knowledge of ethical and good laboratory practices, health and biohazard regulations, and intellectual property rights related issues practiced in modern era of scientific investigation.

Eligibility for admission to M.Sc. Biochemistry:

Students who have completed B.Sc. in anyone of the following subjects like Biochemistry, Chemistry, Botany and Zoology with minimum aggregate marks of 55% and above from a reputed university.

Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill development modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application-oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, practical training, catering to the needs of stakeholders with research aptitude.
- The curriculum is designed to strengthen the industry-academia interface and provide more job opportunities for the students.
- The Internship during the third semester will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective and Skill enhancement courses, covering conventional topics to the application oriented.
- Human rights course allows individual in being a responsible citizen that remains as a requisite to the possibility of a just society.
- MOOC course is prescribed to reinforce self-learning and to instill the value of life-long learning in students
- Project with viva-voce component in the fourth semester enables the students to apply their conceptual knowledge to practical situations which will help to improve healthcare, nutrition and the environment.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I, II, III, IV	**Core Courses in Biochemistry**	Students from Biochemistry Major get a stronger footing in the subject, while students from Non-biochemistry Majors are initiated with the grass-root founding in mastering the discipline
I, II, III, IV	**Elective papers -** An open choice of topics categorized under Generic and Discipline Centric	● Strengthening the domain knowledge ● Introducing the stakeholders to the state-of art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature ● Emerging topics related to industry are introduced to facilitate advanced learning in the respective domains
II, III, IV	**Skill Enhancement papers / Professional competency skills** (Discipline centric / Generic / Entrepreneurial)	● Industry ready graduates ● Skilled human resource ● Students are equipped with essential skills to make them employable ● Entrepreneurial skill training will provide an opportunity for independent livelihood generates small scale entrepreneurs ● Discipline centric skill will improve the technical knowhow of solving real life problems
Semester III (Vacation activity)	Internship / Industrial Training	● Practical training at the Industry/ Microbiology & Biotechnology research concerns/ Hospitals/ Educational institutions, enable the students gain professional experience and become responsible citizens.
Semester IV	Project with Viva - voce	● Self-learning, critical thinking, problem-solving and research acumen is enhanced ● Application of the concept to real situation is conceived resulting in tangible outcome

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

TANSCHE BASED PROGRAMME STRUCTURE FOR M.Sc. BIOCHEMISTRY (For the candidates admitted from the academic year 2024-2025)									
Sem	**Part**	**Category**	**Paper Code**	**Title**	**Hours / Week**	**Exam**		**Credits**	**Marks**
						Th	Pr		
I	I	Core I	PCBCA24	Basics of Biochemistry	7	3	-	5	40+60
		Core II	PCBCB24	Biochemical and Molecular Biology Techniques	6	3	-	5	40+60
		Core III	PCBCC24	Laboratory course on Biomolecules and Biochemical Techniques	5	-	6	4	40+60
		Elective I (Discipline Centric)	PEBCA24	Elective – I A- Microbiology & Immunology	5	3	-	3	40+60
			PEBCB24	Elective – I- B: Herbal Therapy					
		Elective II (Generic)	PEBCC24	Elective – II A - Energy and Drug metabolism	5	3	-	3	40+60
			PEBCD24	Elective – II - B Ecology and Evolution					
	II			Human Rights	1	-	-	-	-
				Value Education	1	-	-	-	-
				Total	**30**			**20**	**500**
II	I	Core IV	PCBCD24	Enzymology	6	3	-	5	40+60
		Core V	PCBCE24	Cellular Metabolism	6	3	-	5	40+60
		Core VI	PCBCF24	Laboratory course in Enzymology, Microbiology and Cell Biology	6	-	6	4	40+60
		Elective III (Discipline Centric)	PEBCE24	Elective – III A- Biostatistics and Data Science	4	3	-	3	40+60
			PEBCF24	Elective – III B Horticulture					
		Elective IV (Generic)	PEBCG24	Elective - IV- A -Biosafety, Lab Safety and IPR	4	3	-	3	40+60
			PEBCH24	Elective - IV- B Psychology					
	II	Skill Enhancement Course[SEC I]	PSBC124	SEC: Nutritional Biochemistry	2	-	-	2	100
			PNHRA24	Human Rights	1	2	-	2	40+60
				Value Education	1	-	-	-	-
			POBC24	MOOC (4 Weeks)	-	-	-	1	-
				Total	**30**			**25**	**700**

Sem	Part	Category	Paper Code	Title	Hours / Week	Exam		Credits	Marks
						Th	Pr		
III	I	Core VII	PCBCG24	Physiology and Cell Biology	6	3	-	5	40+60
		Core VIII	PCBCH24	Clinical Biochemistry	6	3	-	5	40+60
		Core IX	PCBCI24	Laboratory course on Clinical Biochemistry	6	-	6	5	40+60
		Core X [Industry Module]	PCBCJ24	Molecular Biology	6	3	-	4	40+60
		Elective V	PEBCI24	Elective - V- A Biochemical Toxicology	3	3	-	3	40+60
			PEBCJ24	Elective - V- B Nanotechnology					
	II	Skill Enhancement Course [SEC II]	PSBC224	SEC: Molecular Basis of Diseases and Therapeutic strategies	2	-	-	2	100
			PIBC24	Internship	-	-	-	2	
				Value Education	1	-	-	-	-
Total					**30**			**26**	**600**
IV	I	Core XI	PCBCK24	Gene editing, Cell and Gene therapy	6	3	-	5	40+60
		Core XII	PCBCL24	Pharmaceutical Biochemistry	6	3	-	5	40+60
		Project	PCBCM24	Project	10	-	-	7	40+60
		Elective VI	PEBCK24	Elective - VI- A Industrial Microbiology	4	3	-	3	40+60
			PEBCL24	Elective - VI- B Research Methodology					
	II	Professional Competency Skill	PPBC24	Developmental Biology and Endocrinology	3	-	-	2	100
				Value Education	1	-	-	-	-
	III		Extension Activity (30 hours)		-	-	-	1	-
Total					**30**			**23**	**500**
Grand Total					**120**			**94 +2***	**2300**

- Any one course of the following to be completed during III semester (15 hours teaching and 15 hours activities):
  - i) Teaching and Research Aptitude
  - ii) Artificial Intelligence Tools
  - iii) Entrepreneur Skill
  - iv) Photography

Methods of Evaluation						
S. No.	**Category**	**Assessment Tool**	**Maximum Marks**	**Exam Theory**	**Weightage**	
1	Core Courses/Generic & Discipline Specific Electives	I Continuous Assessment (ICA)	50	1 ½ h	35	40
		II Continuous Assessment (IICA)	50	1 ½ h		
		Innovative Component (IC)	5	-	5	
		End Semester Examination	100	3 h		60
2	Professional Competency	I Continuous Assessment (ICA)	30	1 h	35	40
		II Continuous Assessment (IICA)	30	1 h		
		Innovative Component (IC)	5	-	5	
		End Semester Examination	60	2 h		60
3	HR	Continuous Assessment (IICA)	25	1 h		40
		Innovative Component (IC)	25	-		
		End Semester Examination	60	2 h		60

Activity-based Assessment for Skill Enhancement Courses:

Activity 1 for Unit I: (Nature of Activity) – 20 marks
Activity 2 for Unit II: (Nature of Activity) – 20 marks
Activity 3 for Unit III: (Nature of Activity) – 20 marks
Activity 4 for Unit IV: (Nature of Activity) – 20 marks
Activity 5 for Unit V: (Nature of Activity) – 20 marks

Nature of Activity – Field visit/Industrial visit/Project (individual or group)/Exhibits/Model making/Hands on training/Lab practice/Product making/Extempore/Block and Tackle/Debate/Report writing/Case study/Interpretation of data or results/Transcription/Quiz (LMS)/Problem solving/ Designing/Role play/Start-up proposal/Research proposal/Poster presentation/Oral presentation (live or video recorded)/Survey (Field or Online)/Group discussion/Problem solving/Problem formulation/Interviews/Concept mapping/Mind mapping /Promoting public awareness etc.

Record of Assessment will be maintained by the course instructors and verified by the Head of the department.

Cognitive Levels 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

PROGRAMME OUTCOMES (PO)

On completion of the PG Programme, students will be able to:

PO1: Attain an in-depth knowledge in the respective domains augmented through self-learning.

PO2: Assimilate and apply principles and concepts towards skill development and employability.

PO3: Apply critical and scientific approaches to address problems and find solutions.

PO4: Develop research skills through multi/inter/trans-disciplinary perspectives.

PO5: Integrate issues of social relevance in the field of study.

PO6: Persist in life-long learning for personal and societal progress.

PROGRAMME SPECIFIC OUTCOMES (PSO)

On completion of the PG Programme in Biochemistry, students will be able to;

PSO1: Attain an in-depth knowledge on advanced concepts in various branches of chemistry augmented through self-learning, persist in life-long learning for personal and societal progress.

PSO2: Demonstrate an ability to conduct experiments and perform accurate quantitative measurements with an understanding of the theory and develop practical skills in handling analytical instruments.

PSO3: Interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions.

PSO4: Assimilate and apply principles and concepts towards skill development, employability, critical and scientific approaches to address the problems and find solutions.

PSO5: Develop research skills through multi/inter/trans-disciplinary perspectives and to qualify CSIR-NET and other competitive examinations.

PSO6: Communicate effectively through report writing, documentation and effective presentations and integrate the knowledge in chemistry for sustainable environment.

PSO/PO	PO1	PO2	PO3	PO4	PO5	PO6
PSO1	H	H	H	M	M	L
PSO2	H	H	H	H	M	L
PSO3	H	H	H	H	H	L
PSO4	H	M	H	H	H	H
PSO5	M	M	H	H	H	H
PSO6	L	L	H	H	H	H

(HIGH - 3, MODERATE - 2, LOW - 1)

<table>
<tr><td>Title of the Course</td><td colspan="7">BASICS OF BIOCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core 1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">PCBCA24</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>6</td><td>1</td><td colspan="3">-</td><td colspan="2">7</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• Students will be introduced to the structure of biomolecules.
• The significance of carbohydrates in biological processes will be understood.
• The structure, properties and biological significance of lipids in the biological system will be studied.
• Students will learn about the concepts of protein structure and their significance in biological processes and creatively comprehend the role of membrane components with their biological significance.
• Students will gain knowledge about the structures and functional roles of nucleic acids in the biological system.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3, K4, K5 & K6)
1.1 Carbohydrates- Classification, structure (configurations and conformations, anomeric forms), function and properties of monosaccharides, mutarotation.
1.2 Disaccharides and oligosaccharides with suitable examples.
1.3 Polysaccharides - Homopolysaccharides (starch, glycogen, cellulose, inulin, dextrin, agar, pectin, dextran).
1.4 Heteropolysaccharides - Glycosaminoglycans– source, structure, functions of hyaluronic acid, chondroitin sulphates, heparin, keratan sulphate.
1.5 Glycoproteins - proteoglycans. O- Linked and N-linked glycoproteins. Biological significance of glycan.
1.6 Blood group polysaccharides. Bacterial cell wall (peptidoglycans, teichoic acid) and plant cell wall carbohydrates.</td></tr>
<tr><td></td><td colspan="7">Unit II (18 hours) (K1, K2, K3, K4, K5 & K6)
2.1 Lipids – Classification of lipids.
2.2 Structure, properties and functions of fatty acids, triacylglycerols, phospholipids – Biological importance.
2.3 Structure, properties and functions of - glycolipids, sphingolipids and steroids – Biological importance.
2.4 Eicosanoids- classification, structure and functions of prostaglandins, thromboxanes, leukotrienes.
2.5 Lipoproteins – Classification, structure.
2.6 Lipoproteins – Transport (endogenous and exogenous Pathway) and their biological significance.</td></tr>
</table>

	UNIT-III: (18 hours) (K1, K2, K3, K4, K5 & K6) 3.1 Overview of Aminoacids - classification, structure and properties of amino acids - Biological role. Non- Protein aminoacids and their biological significance. 3.2 Proteins – classification based on composition, structure and functions. Primary, secondary, super secondary (motifs) (Helix-turn –helix, helix-loop-helix, Beta-alpha-beta motif, Rosemann Rossmann fold, Greek key), tertiary and quaternary structure of proteins. 3.3 Structural characteristics of collagen and hemoglobin. 3.4 Determination of amino acid sequence. Chemical synthesis of a peptide, Forces involved in stabilization of protein structure. 3.5 Ramachandran plot. Folding of proteins. 3.6 Molecular chaperons – Hsp 70 and Hsp 90 - Biological role.
	UNIT-IV: (18 hours) (K1, K2, K3, K4, K5 & K6) 4.1 Membrane Proteins - Types and their significance. 4.2 Cytoskeleton proteins – actin. 4.3 Cytoskeleton proteins – tubulin. 4.4 Cytoskeleton proteins – Intermediate filaments 4.5 Biological role of cytoskeletal proteins. 4.6 Membrane structure-fluid mosaic model.
	UNIT-V: (18 hours) (K1, K2, K3, K4, K5 & K6) 5.1 Nucleic acids – types and forms (A, B, C and Z) of DNA. Watson- Crick model - Primary, secondary and tertiary structures of DNA. Triple helix and quadruplex DNA. 5.2 Mitochondrial and chloroplast DNA. 5.3 DNA supercoiling (calculation of Writhe, linking and twist number). 5.4 Determination of nucleic acid sequences by Maxam Gilbert and Sanger's methods. 5.5 Forces stabilizing nucleic acid structure. Properties of DNA and RNA. C-value, C-value paradox, Cot curve. 5.6 Structure and role of nucleotides in cellular communications. Major and minor classes of RNA, their structure and biological functions.

Extended Professional Component (is apart of internal component only, not to be included in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. David L Nelson and Michael M. Cox, 2012, Lehninger Principles of Biochemistry, 6th ed, W.H. Freeman. 2. Satyanarayan U, 2014, Biochemistry, 4th ed, Arunabha Sen Books & Allied (P) Ltd, Kolkata.
Reference books	1. Voet D & Voet JG, 2010, Biochemistry, 4th ed, John Wiley & Sons, Inc. 2. Metzler DE, 2003, The chemical reactions of living cells, 2nd ed, Academic Press. 3. Zubay GL, 1999, Biochemistry, 4th ed, Mc Grew-Hill. 4. Lubert Stryer, 2010, Biochemistry, 7th ed, W. H. Freeman.

	5. Peter J. Kennelly, Kathleen M. Botham, Owen P. McGuinness, Victor W. Rodwell, and P. Anthony Weil, 2023, Harper's Illustrated Biochemistry, 32nd ed, McGraw Hill.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://bio.libretexts.org/Bookshelves/Biochemistry/Book%3A Biochemistry Online (Jakubowski). 3. https://www.thermofisher.com/in/en/home/life-science/protein-biology/protein-biology-learning-center/protein-biology-resource-library/pierce-protein-methods/protein-glycosylation.html. 4. https://ocw.mit.edu/courses/biology/7-88j-protein-folding-and- human-disease-spring-2015/study-materials/ 5. https://www.open.edu/openlearn/science-maths-technology/science/biology/nucleic-acids-and-chromatin/content-section- 3.4.2 6. https://www.genome.gov/genetics-glossary/Cell-Membrane 7. https://nptel.ac.in/content/storage2/courses/102103012/pdf/mod3.pdf

CO	**Course Outcomes**
On completion of the course, the students should be able to:	
CO1	Explain the chemical structure and functions of carbohydrates
CO2	Using the knowledge of lipid structure and function, explain how it plays a role in signaling pathways
CO3	Describe the various levels of structural organization of proteins and the role of proteins in biological system.
CO4	Apply the knowledge of proteins in cell-cell interactions.
CO5	Applying the knowledge of nucleic acid sequencing in research and diagnosis.

CO/PSO	**PSO 1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	L	H	H	H	H
CO2	H	M	M	H	M	M
CO3	H	L	L	H	H	H
CO4	H	M	H	H	H	H
CO5	H	H	L	H	L	H

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	M	H	H	L	H
CO2	H	M	H	H	M	M
CO3	H	M	M	H	M	H
CO4	H	M	M	H	L	M
CO5	H	M	M	H	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">BIOCHEMICAL AND MOLECULAR BIOLOGY TECHNIQUES</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>PCBCB24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To understand the various techniques used in biochemical investigation and microscopy.
• To explain chromatographic techniques and their applications
• To explain electrophoretic techniques.
• To comprehend the spectroscopic techniques and demonstrate their applications in biochemical investigations.
• To acquire knowledge of radio labelling techniques and centrifugation.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3, K4, K5 & K6)
1.1 General approaches to biochemical investigation, cell culture techniques and microscopic techniques.
1.2 Organ and tissue slice technique, cell distribution and homogenization techniques.
1.3 Cell sorting, and cell counting, tissue culture techniques. Cryopreservation.
1.4 Biosensors- principle and applications. Principle, working and applications of light microscope.
1.5 Principle, working and applications of Dark field, phase contrast and fluorescent microscope.
1.6 Electron microscope- Principle, instrumentation of TEM and SEM, Specimen preparation and applications - shadow casting, negative staining and freeze fracturing.</td></tr>
<tr><td></td><td colspan="7">UNIT II (18 hours) (K1, K2, K3, K4, K5 & K6)
Chromatographic Techniques:
2.1 Basic principles of chromatography- adsorption and partition techniques. Chiral Chromatography and counter current Chromatography.
2.2 Adsorption Chromatography – Hydroxy apatite chromatography and hydrophobic interaction Chromatography. Affinity chromatography.
2.3 Gas liquid chromatography- principle, instrumentation, column development, detectors and applications.
2.4 Low pressure column chromatography – principle, instrumentation, column packing, detection, quantitation and column efficiency.
2.5 High pressure liquid chromatography- principle, instrumentation, delivery pump, sample injection unit, column packing, development, detection and application.
2.6 Reverse HPLC, capillary electro chromatography and perfusion chromatography.</td></tr>
<tr><td></td><td colspan="7">UNIT III (18 hours) (K1, K2, K3, K4, K5 & K6)
Electrophoretic Techniques:
3.1 General principles of electrophoresis, supporting medium, factors affecting electrophoresis.
3.2 Isoelectric focusing-principle, ampholyte, development of pH gradient and application.
3.3 PAGE-gel casting-horizontal, vertical, slab gels, sample application,</td></tr>
</table>

	detection-staining using CBB, silver, fluorescent stains. 3.4 SDS PAGE-principle and application in molecular weight determination, principle of disc gel electrophoresis, 2D PAGE. Electrophoresis of nucleic acids-agarose gel electrophoresis of DNA. 3.5 Pulsed field gel electrophoresis- principle, apparatus, application. Electrophoresis of RNA, curve. 3.6 Microchip electrophoresis and 2D electrophoresis, Capillary electrophoresis.
	UNIT IV (18 hours) (K1, K2, K3, K4, K5 & K6) **Spectroscopic techniques:** 4.1 Basic laws of light absorption- principle, instrumentation and applications of UV-Visible, IR. 4.2 Principle, instrumentation and applications of ESR, NMR, Mass spectroscopy. 4.3 Principle, instrumentation and applications of Turbidimetry and Nephelometry. 4.4 Luminometry (Luciferase system, chemiluminescence). 4.5 X - ray diffraction. 4.6 Atomic absorption spectroscopy - principle and applications - Determination of trace elements
	UNIT V (18 hours) (K1, K2, K3, K4 K5 & K6) **Radiolabeling Techniques and Centrifugation:** 5.1 Nature of radioactivity-detection and measurement of radioactivity. 5.2 Methods based upon ionization (GM counter) and excitation (scintillation counter). 5.3 Autoradiography and applications of radioactive isotopes, biological hazards of radiation and safety measures in handling radioactive isotopes. 5.4 Basic principles of Centrifugation. Preparative ultra centrifugation 5.5 Differential centrifugation, Density gradient centrifugation. 5.6 Analytical ultracentrifugation - Molecular weight determination.

Extended Professional Component (is apart of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. Keith Wilson and John Walker, 2010, Principles and Techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press. 2. David Sheehan, 2009, Physical Biochemistry: Principles and Applications 2nd Edition, Wiley-Blackwell.
Reference books	1. Kaloch Rajan, 2011, Analytical techniques in Biochemistry and Molecular Biology, Springer. 2. Robyt JF, 2015, Biochemical techniques: Theory and Practice, 1st Edition, CBS Publishers & Distributors & Co. 3. Lehninger, 2021, Principles of Biochemistry, 8th Edition, New York. 4. David M. Freifelder, 1982, Physical Biochemistry: Applications to Biochemistry and Molecular Biology, W.H.Freeman. 5. Rodney F.Boyer, 2012, Biochemistry Laboratory: Modern Theory and techniques, 2nd Edition, Prentice Hall.

	6. Wilson And Walkers, 2018, Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition, Cambridge University Press.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.kau.edu.sa/Files/0017514/Subjects/principals%20and%20tech 3. https://www.youtube.com/watch?v=U_AhGJQl__Q&ab_channel=SiguChannel 4. https://www.youtube.com/watch?v=ujm_5GoI8jA&list=PLAi3JSYaGnl537S5U3f2roZztUP_LZdmu&ab_channel=CONCEPTSbyArchita 5. https://www.youtube.com/@Biochemistrybasics

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	L	H	L	M
CO2	H	H	L	M	L	H
CO3	H	H	H	H	M	H
CO4	H	M	L	H	L	H
CO5	H	L	M	H	L	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	M	H	H	H	M
CO2	H	L	M	M	M	H
CO3	H	M	H	H	H	M
CO4	H	H	L	H	M	H
CO5	H	H	M	M	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">LABORATORY COURSE ON BIOMOLECULES AND BIOCHEMICAL TECHNIQUES</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core Practical</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td>PCBCC24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">5</td><td colspan="2">5</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To instill skill in students enabling them to apprehend the wider knowledge about principles and techniques to be employed for the biomolecules under investigation.
• To inculcate the knowledge of various isolation and purification techniques of macromolecules like DNA, RNA, Glycogen and Starch.
• To perform colorimetric estimations to quantify important metabolites like lactate and tryptophan and minerals like calcium and iron from various sources.
• To achieve training in subcellular fractionation and to identify them by markers, various chromatographic techniques, isolation and identification of the organelles of a cell using differential centrifugation.
• To perform phytochemical screening and quantification enabling them to give an insight on phytochemicals this will be useful for future research.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Biochemical studies and estimation of macromolecules (15 hours) (K1, K2, K3, K4, K5 & K6)
1. Isolation and estimation of glycogen from liver.
2. Isolation and estimation of DNA from animal tissue.
3. Isolation and estimation of RNA from yeast.
4. Purification of Polysaccharides –Starch and assessment of its purity.</td></tr>
<tr><td></td><td colspan="7">UV absorption (15 hours) (K1, K2, K3, K4 K5 & K6)
1. Denaturation of DNA and absorption studies at 260nm.
2. Denaturation of Protein and absorption studies at 280nm.</td></tr>
<tr><td></td><td colspan="7">Colorimetric estimations (15 hours) (K1, K2, K3, K4 & K5)
1. Estimation of Pyruvate
2. Estimation of tryptophan.</td></tr>
<tr><td></td><td colspan="7">Estimation of minerals (15 hours) (K1, K2, K3, K4 K5 & K6)
1. Estimation of calcium
2. Estimation of iron.</td></tr>
<tr><td></td><td colspan="7">Plant Biochemistry (15 hours) (K1, K2, K3, K4 & K5)
1. Qualitative analysis Phytochemical screening.
2. Estimation of Flavonoids -Quantitative analysis.</td></tr>
<tr><td></td><td colspan="7">Group Experiments (15 hours) (K1, K2, K3, K4 K5 & K6)
1. Fractionation of sub-cellular organelles by differential centrifugation-Mitochondria and nucleus
2. Identification of the separated sub-cellular fractions using marker enzymes (any one)
3. Separation of identification of lipids by thin layer chromatography.
4. Separation of plant pigments from leaves by column Chromatography.
5. Identification of Sugars by Paper Chromatography.</td></tr>
</table>

	6. Identification of Amino acids by Paper Chromatography.
Self - study	1. Laboratory Safety Rules, Requirements and Regulations. 2. Preparation of standard solutions and reagent.
Text books	1. David Plummer, 2001, An Introduction to Practical Biochemistry, 3rd ed, McGraw Hill Education (India) Private Ltd. 2. Jayaraman J, 2011, Laboratory Manual in Biochemistry, New age publishers**.**
Reference books	1. Varley H, 2006, Practical Clinical Biochemistry, 6th ed, CBS Publishers 2. Debiyi O, Sofowora FA, 1978, Phytochemical screening of medical plants, Iloyidia, Vol. 3, pp. 234–246. 3. Sarin A. Chavhan, Sushil Kumar A. Shinde, 2019, A Guide to Chromatography Techniques, 1st e d , Notion Press. 4. Katoch, Rajan, 2014, Analytical techniques in Biochemistry and Molecular Biology, 2011 ed, Springer. 5. Kanai L Mukerjee, 1996, Medical Lab Technology Vol I& II, New Delhi: Tata Mcgraw Hill Publishing Company.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.researchgate.net/publication/313745155_Practical_Biochemistry_A_Student_Companion. 3. https://doi.org/10.1186/s13020-018-0177-x 4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5368116/ 5. https://www.life.illinois.edu/biochem/455/Lab%20exercises/2Photometry/spectrophotometry.pdf 6. https://ijpsr.com/bft-article/determination-of-total-flavonoid-and- phenol-content-in-mimusops-elengi-linn/?view=fulltext 7. https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry.pdf

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	M	M	H
CO2	H	H	H	L	H	H
CO3	H	M	L	H	H	H
CO4	H	H	M	M	M	H
CO5	H	H	M	M	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	M	M	H	H	H
CO2	H	H	H	M	M	M
CO3	H	L	L	M	H	H
CO4	H	M	H	M	M	H
CO5	H	H	M	H	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE IA: MICROBIOLOGY AND IMMUNOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective I-A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>PEBCA24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To appreciate the classification of microorganisms based on their structure, size and shape with an insight into the ancient scriptures about microbes.
• To recognize the possible contamination of foods by microorganisms, to learn about counteracting preservative measures and to know about probiotic nature of microorganisms.
• To gain knowledge on pathogenic mediation by microorganisms and preventive measures as well.
• To comprehend the features of antimicrobial agents, their mechanism of action along with the side effects and also to explore natural remedial measures against microbes.
• To be able to exploit the various features of microorganisms for the beneficial industrial production.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3, K4, K5 & K6)
Taxonomical classification
1.1 Taxonomical classification - bacteria, viruses (DNA, RNA), algae, fungi and protozoa.
1.2 Distribution and role of microorganisms in soil, water and air.
1.3 Charaka’s classification of microbes. Lytic cycle and lysogeny.
1.4 Types of culture media.
1.5 Isolation of pure culture.
1.6 Growth curve and the measurement of microbial growth.</td></tr>
<tr><td></td><td colspan="7">UNIT II (18 hours) (K1, K2, K3, K4, K5 & K6)
Food Spoilage and Preservation
2.1 Contamination and spoilage of foods – cereals, cereal products.
2.2 Fruits, vegetables, meat, fish, poultry, eggs, milk and milk products.
2.3 General principles of traditional and modern methods of food preservation - Removal or inactivation of microorganisms, boiling, steaming, curing, pasteurization.
2.4 Low-temperature preservation - cold processing, freeze drying.
2.5 Irradiation, vacuum packing, control of oxygen and enzymes.
2.6 Microbes involved in the preparation of fermented foods - cheese, yoghurt, curd, pickles, rice pan cake, appam, ragi porridge and bread</td></tr>
<tr><td></td><td colspan="7">UNIT III (18 hours) (K1, K2, K3, K4, K5 & K6)
Food poisoning
3.1 Food poisoning- bacterial food poisoning, Salmonella, Clostridium blotulinum (botulism), Staphylococcus aureus, Fungal food poisoning – aflatoxin.
3.2 Food infection – Clostridium, Staphylococcus and Salmonella.
3.3 Pathogenic microorganisms, E. coli, Pseudomonas, Klebsilla, Streptococcus, Haemophilus, & Mycobacterium, causes, control, prevention, cure and</td></tr>
</table>

	safety. 3.4 Food microbiological screening- Real-time PCR, ELISA. 3.5 Aerobic and anaerobic Plate Count, dye reduction method, anaerobic lactic acid bacteria, anaerobic spore formers. 3.6 Hazard analysis critical control point (HACCP)
	UNIT IV (18 hours) (K1, K2, K3, K4, K5 & K6) **Antimicrobial agents** 4.1 Antimicrobial chemotherapy, General characteristics of antimicrobial agents. 4.2 Mechanism of action – sulfonamides, sulphones and PAS. 4.3 Penicillin - spectra of activity, mode of administration, mode of action, adverse effects and sensitivity test. 4.4 Streptomycin- spectra of activity, mode of administration, mode of action, adverse effects and sensitivity test. 4.5 Antiviral and antiretroviral agents. 4.6 Antiviral RNA interference, natural intervention (Natural immunomodulators routinely used in Indian medical philosophy).
	UNIT V (18 hours) (K1, K2, K3, K4, K5 & K6) **Immunology** 5.1 Immune system- definition and properties. Cells of the immune system – neutrophils, eosinophils, basophils, mast cells, monocytes, macrophages, dendritic cells, natural killer cells, and lymphocytes (B cells and T cells). 5.2 Lymphoid organs- Primary and Secondary; structure and functions. 5.3 Antigens and Complement System: definition, properties- antigenicity and immunogenicity, antigenic determinants and haptens. Antigen - antibody interactions - molecular mechanism of binding. Affinity, avidity, valency, cross reactivity and multivalent binding. 5.4 Immunoglobulins & Immune Response: Structure, classes and distribution of antibodies. Antibody diversity. Immune system in health & disease. 5.5 Transplantation immunology- graft rejection and HLA antigens. 5.6 Immunological techniques, Flow cytometry and its application

Extended Professional Component (is apart of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsNET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text Books	1. Kanunga R, 2017, Ananthanarayanan and Panicker's Text book of Microbiology,10th Edition, Universities Press (India) Pvt. Ltd. 2. Chan ECS, Pelczar M. J. and Krieg N. R, 2010, Microbiology 5th Edition, Mc. Graw Hill. Inc, New York. 3. Prescott LM, Harley JP and Klein DA, 2004, Microbiology, 6th Edition, McGraw - Hill company, New York. 4. White D. Drummond J and Fuqua C, 2011, The Physiology and Biochemistry of Prokaryotes, Oxford University Press, Oxford, New York. **5.** Dubey RC and Maheshwari DK, 2009, Textbook of Microbiology. S. Chand, Limited.

Reference Books	1. Tortora GJ, Funke BR and Case CL, 2015, Microbiology: An Introduction,12th Edition, Pearson, London, United Kingdom. 2. Webster J. and Weber RWS, 2007, Introduction to Fungi, 3rd Edition, Cambridge University Press, Cambridge. 3. Schaechter M and Leaderberg J, 2004, The Desk encyclopedia of Microbiology. Elseiver Academic Press, California. 4. Ingraham JL and Ingraham CA, 2000, Introduction to Microbiology, 2nd Edition, Books / Cole Thomson Learning, UK. 5. Madigan MT, Bender KS, Buckley DH, Sattley WM and Stahl, 2018, Brock Biology of Microorganisms,15th Edition, Pearson.
Web resources	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://microbenotes.com/types-of-culture-media/ 3. https://www.intechopen.com/chapters/86251 4. https://microbenotes.com/salmonellosis/ 5. https://www.slideshare.net/ShruthiRammohan/sulfonamides111115212 6. https://microbenotes.com/lymphatic-system-organs/

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	L	H	M	M
CO2	H	H	L	M	L	H
CO3	H	H	H	H	M	H
CO4	H	M	L	H	L	H
CO5	H	L	M	H	L	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	L	M	L	M
CO2	H	H	H	M	M	M
CO3	H	H	L	M	M	M
CO4	H	M	M	H	L	M
CO5	H	M	M	H	L	M

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE I B: HERBAL THERAPY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective I-B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>PEBCB24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To identify and classify the plants used for their medicinal value.
• To learn the principles and basic concepts in Pharmacognosy.
• To learn basic phytopharmacology, herb-herb interactions, herb-drug interactions and other aspects of herbal medicine safety.
• To analyze the Indian traditional medicine systems and modernize herbal remedy.
• To involve in critical thinking about infusing herbal formulations in diet and health.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (7 hours) (K1, K2, K3, K4 & K5)
1.1 Pharmacognosy - Definition and history.
1.2 Indian systems of medicine - Siddha, Ayurveda, and Unani systems.
1.3 Taxonomy of locally available medicinal plants (Tulsi, Aloe vera, Neem), their chemical constituents and medicinal uses.
1.4 Classification of Crude drugs.
1.5 Chemistry of Drugs - Future of pharmacognosy.
1.6 Quality control of drugs of natural origin.</td></tr>
<tr><td></td><td colspan="7">UNIT II (7 hours) (K1, K2, K3, K4 K5 & K6)
2.1 Classification of medicinal plants - Vernacular name and family.
2.2 Geographical source, cultivation, collection, and processing of crude drugs.
2.3 Morphological, histological studies and chemical constituents of crude drugs.
2.4 Therapeutic and other pharmaceutical uses of underground stem – ginger and Alpinia.
2.5 Therapeutic and other pharmaceutical uses of Roots - Rauwolfia – Belladonna.
2.6 Therapeutic and other pharmaceutical uses of Aerial parts - Bark – Cinchona.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (7 hours) (K1, K2, K3, K4 & K5)
3.1 Leaves - Adathoda, Eucalyptus - Flower - Clove fruits seeds.
3.2 Nux vomica, Nutmegs and Gooseberry.
3.3 Unorganized drugs - Gum, Acacia and Resin.
3.4 Turpentine, fixed oil and castor oil.
3.5 Propagation of medicinal plants – Micropropagation.
3.6 Macro propagation conservation of rare medicinal plants.</td></tr>
</table>

	UNIT-IV: (7 hours) (K1, K2, K3, K4 K5 & K6) 4.1 Herbal medicines for Human ailments. 4.2 Drugs Acting on Cardiac Diseases, Cerebral Diseases, Nasal disease. 4.3 Depressants. - Stimulants - Respiration and Drugs. 4.4 Urogenital system and drugs - Psychoactive plants. 4.5 Preparation of herbal infusion. 4.6 Toxicity in herbal drugs and their interactions.
	UNIT-V: (7 hours) (K1, K2, K3, K4 & K5) 5.1 Role of biotechnology in medicinal plants banks. 5.2 Cultivation of medicinal and aromatic plants. 5.3 Drug adulteration - methods of Drug evaluation. 5.4 Herbal food - Food processing – packaging. 5.5 Herbal sale and Export of medicinal plants. 5.6 Marketing, Intellectual property rights and Export laws.

Extended Professional Component (is apart of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. Goodwin TW, 2007, Introduction to Plant Biochemistry, 3rd Edition, Pergamon Publishers. 2. Kumar NC, 2005, An Introduction to Medical Botany and Pharmacognosy, 3rd Edition, EMKAY Publications.
Reference books	1. Evans, 2009, Trease and Evans Pharmacognosy, 16th Edition, Elsevier Health UK Publications. 2. Handa SS and Kapoor VK, 2004, Pharamcognosy, 2nd Edition, Vallabh Prakashan Publishers. 3. Jain SK, 2004, Indian Medicinal plants, 4th Edition, National book trust. 4. Kokate CK, Durohit AP and Gokhale SR, 2011, Pharmacognosy, 12th Edition, Nirali Prakasham Publishers. Wallis TE, 2008, Text book of pharmacognosy, 5th Edition, CBS publishers.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.youtube.com/watch?v=rde0RSFNuu8 3. https://www.youtube.com/watch?v=QPQ9sZuiOb8 4. https://www.youtube.com/watch?v=5p4NOvF5EX4 5. https://www.youtube.com/watch?v=dOlkogaWF3M 6. https://www.youtube.com/watch?v=fhkvXf5t9l

CO	**Course Outcomes**
On completion of the course, the students should be able to:	
CO1	Describe the concepts of Pharmacognosy.
CO2	Explain the classification of medicinal plants.
CO3	Outline the different parts of plant.
CO4	Predict the Herbal medicines for Human ailments.
CO5	Apply the knowledge on the important metabolic pathways in plants.

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	M	M	H
CO2	H	L	M	H	H	H
CO3	H	L	H	M	H	M
CO4	H	M	L	M	L	M
CO5	H	M	M	H	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	M	H	L	H	M
CO3	H	M	L	M	H	M
CO4	H	H	L	H	H	L
CO5	H	M	H	H	M	H

<table>
<tr><td>Title of the Course</td><td colspan="8">ELECTIVE II A: ENERGY AND DRUG METABOLISM</td></tr>
<tr><td>Paper No.</td><td colspan="8">Elective II- A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td colspan="2">PEBCC24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="3">5</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">• Familiarize on concepts of enthalpy, entropy, free energy, redox system, biological oxidation and high energy compounds.
• Provide an insight into the relationship between electron flow and phosphorylation.
• Inculcate knowledge on processes involved in converting light energy to chemical energy and associated food production by autotrophs.
• Provide a platform to understand the versatile role of Krebs cycle, transport of NADH across mitochondrial membrane and energetics.
• Educate on the various phases xenobiotic metabolism.</td></tr>
<tr><td>Course Outline</td><td colspan="8">UNIT I (15 hours) (K1, K2, K3, K4, K5 & K6)
Thermodynamics
1.1 Thermodynamic- principles in biology.
1.2 Concept of entropy, enthalpy and free energy change.
1.3 Redox systems. Redox potential and calculation of free energy.
1.4 Biological oxidation – Oxidases, dehydrogenases, hydroperoxidases, oxygenases.
1.5 Energy rich compounds – phosphorylated and non-phosphorylated.
1.6 High energy linkages.</td></tr>
<tr><td></td><td colspan="8">Unit II (15 hours) (K1, K2, K3, K4 K5 & K6)
Electron transport chain and Oxidative phosphorylation
2.1 Electron transport chain-various complexes of ETC, Q-cycle.
2.2 Inhibitors of ETC.
2.3 Oxidative phosphorylation-P/O ratio, chemiosmotic theory.
2.4 Mechanism of ATP synthesis - role of F0-F1 ATPase, ATP-ADP cycle.
2.5 Inhibitors of oxidative phosphorylation ionophores, protonophores.
2.6 Regulation of oxidative phosphorylation.</td></tr>
<tr><td></td><td colspan="8">UNIT-III: (15 hours) (K1, K2, K3, K4, K5 & K6)
Photosynthesis
3.1 Light reaction-Hills reaction, absorption of light, photochemical event.
3.2 Photo ETC-cyclic and non-cyclic electron flow.
3.3 Photophosphorylation- role of CF0-CF1 ATPase.
3.4 Dark reaction- Calvin cycle, control of C3 pathway, and Hatch-Slack pathway (C4 pathway).
3.5 Photorespiration.
3.6 Synthesis and degradation of starch.</td></tr>
</table>

	UNIT-IV: (15 hours) (K1, K2, K3, K4 K5 & K6) **Metabolic pathways** 4.1 Interconversion of major food stuffs. 4.2 Energy sources of brain, muscle, liver, kidney and adipose tissue. 4.3 Amphibolic nature of Citric acid cycle, Anaplerotic reaction. 4.4 Krebs cycle, Inhibitors and regulation of TCA cycle. 4.5 Transport of extra mitochondrial NADH – Glycerophosphate shuttle, malate aspartate shuttle. 4.6 Energetics of metabolic pathways – glycolysis, (aerobic and anaerobic), citric acid cycle, beta oxidation.
	UNIT-V: (15 hours) (K1, K2, K3, K4, K5 & K6) **Xenobiotics** 5.1 Activation of sulphate ions – PAPS, APS, SAM and their biological role. 5.2 Metabolism of xenobiotics – Phase I reactions – hydroxylation, oxidation. 5.3 Metabolism of xenobiotics - Phase I reactions - reduction. 5.4 Phase II reactions – glucuronidation, sulphation. 5.5 Phase II reactions – glutathione conjugation, acetylation and methylation. 5.6 Mode of action and factors affecting the activities of xenobiotic enzymes.

Extended Professional Component (is apart of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. David L Nelson and Michael M. Cox, 2012, Lehninger Principles of Biochemistry, 6th ed, W.H. Freeman. 2. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell, 2012, Harper's Illustrated Biochemistry, 29th ed, McGraw-Hill Medical.
Reference books	1. Metzler DE, 2003, The chemical reactions of living cells, 2nd ed, Academic Press. 2. Zubay GL, 1999, Biochemistry, 4th ed, Mc Grew-Hill. 3. Voet D & Voet JG, 2010, Biochemistry, 4th ed, John Wiley & Sons, Inc. 4. Devlin RM, 1983, Plant Physiology, 4th ed, PWS publishers. 5. Taiz L, Zeiger E, 2010, Plant Physiology, 5th ed, Sinauer Associates, Inc.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch21/gibb s.php 3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7767752/#:~:text=The%20mitochondrial%20electron%20transport%20chain,cellular%20ATP%20through%20oxidative%20phosphorylation. 4. https://www.researchgate.net/figure/Oxidative-phosphorylation-in-mitochondrial-electron-transport-chain-ETC-and proton_fig1_230798915 5. https://www.lyndhurstschools.net/userfiles/84/Classes/851/photosynthesis%20light%20&%20dark%20reactions%20ppt.pdf?id=560837 6. https://bajan.files.wordpress.com/2010/05/amphibolic-nature-of- krebs-

	cycle.pdf 7. https://www.sciencedirect.com/topics/medicine-and-dentistry/xenobioticmetabolism#:~:text=Xenobiotic%20metabolism%20can%20be%20defined,more%20readily%20excreted%20hydrophilic%20metabolites.

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	H	H	H	H
CO2	H	L	H	L	M	M
CO3	H	H	L	M	H	L
CO4	H	M	M	H	M	M
CO5	H	M	M	M	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	L	M	M	H	H
CO2	H	H	M	H	H	M
CO3	H	L	H	L	M	L
CO4	H	M	L	M	H	H
CO5	H	H	M	H	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE II B: ECOLOGY AND EVOLUTION</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective II-B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>PEBCD24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To understand the vital relationship between plants, animals and the environment around them.
• To introduce habitats, organisms, approaches and the methodology of ecological research on the field course and through project work.
• To learn the basics of mathematical and statistical aspects in ecology.
• To demonstrate a broad understanding of the processes that shape the distribution and abundance of organisms from the micro-habitat to the globe.
• To evaluate the relationships among ecological interactions, habitat context and the evolution of organism form and function.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (7 hours) (K1, K2, K3, K4 & K5)
Ecology:
1.1 Fundamental concepts: Abiotic and biotic components; scales (population, species, community, ecosystems, biomes); niches and habitats.
1.2 Population ecology: Population growth rates (density dependent/independent).
1.3 Metapopulation ecology (colonization, persistence, extinction, patches, sources, sinks); age- structured populations.
1.4 Interactions: Types (mutualism, symbiosis, commensalism, competition, parasitism, predation, etc); ecophysiology (physiological adaptations to abiotic environment); prey- predator interactions (Lotka-Voltera equation etc).
1.5 Community ecology: Community assembly, organization and succession; species richness, evenness and diversity indices, species-area relationships; theory of island biogeography.
1.6 Ecosystems structure and function: trophic levels and their interactions; nutrient cycles; primary and secondary productivity.</td></tr>
<tr><td></td><td colspan="7">Unit II (7 hours) (K1, K2, K3, K4 K5 & K6)
Evolution
2.1 History of Evolutionary thought: Lamarckism; Darwinism; Modern Synthesis, Fundamentals: Variation; heritability; natural selection; fitness and adaptation; types of selection (stabilizing, directional, disruptive).
2.2 Diversity of life: Origin and history of life on earth; diversity and classification of life; systems of classification (cladistics and phenetics). Life history strategies: Allocation of resources; trade offs; r/K selection; semelparity and iteroparity.
2.3 Interactions: Coevolution (co-adaptations, arms race, Red Queen hypothesis, co- speciation); prey-predator interactions (mimicry, crypsis, etc).
2.4 Population and Quantitative genetics: Origins of genetic variation;</td></tr>
</table>

	Mendelian genetics; Hardy-Weinberg equilibrium; drift; selection (one-locus two-alleles model); population genetic structure (panmixia, gene flow, FST); polygenic traits; gene-environment interactions (phenotypic plasticity); heritability. 2.5 Molecular evolution and phylogenetics: Neutral theory; molecular clocks; rates of evolution; phylogenetic reconstruction; molecular systematics. 2.6 Macroevolution: Species concepts and speciation; adaptive radiation; convergence; biogeography.
	UNIT-III: (7 hours) (K1, K2, K3, K4 & K5) **Mathematics and quantitative ecology** 3.1 Mathematics and statistics in ecology: Simple functions (linear, quadratic, exponential, logarithmic, etc). 3.2 Concept of derivatives and slope of a function; permutations and combinations. 3.3 Basic probability (probability of random events; sequences of events, etc). 3.4 Frequency distributions and their descriptive statistics (mean, variance, coefficient of variation, correlation, etc). 3.5 Statistical hypothesis testing: Concept of p-value; Type I and Type II error. 3.6 Test statistics like t-test and Chi-square test; basics of linear regression and ANOVA.
	UNIT-IV: (7 hours) (K1, K2, K3, K4 K5 & K6) **Behavioral ecology** 4.1 Classical Ethology: Instinct; fixed action pattern; imprinting; learnt behavior; proximate and ultimate questions. 4.2 Sensory ecology: Neuroethology; communication (chemical, acoustic and visual signaling); recognition systems. 4.3 Foraging ecology: Foraging behaviour; optimal foraging theory. 4.4 Reproduction: Cost of sex; sexual dimorphism; mate choice; sexual selection (runaway selection, good-genes, handicap principle, etc); sexual conflict; mating systems; parental care. 4.5 Social living: Costs and benefits of group-living (including responses to predators); effect of competition (scramble and contest) on group formation; dominance relationships; eusociality; kin selection; altruism; reciprocity; human behaviour.
	UNIT-V: (7 hours) (K1, K2, K3, K4 & K5) **Applied Ecology & Evolution** 5.1 Biodiversity and conservation: Importance of conserving biodiversity; ecosystem services; threats to biodiversity. 5.2 Invasive species; in-situ conservation (endemism, biodiversity hotspots, protected areas); ex-situ conservation; conservation genetics (genetic diversity, inbreeding depression). 5.3 DNA fingerprinting and DNA barcoding. 5.4 Disease ecology and evolution: Epidemiology; zoonotic diseases; antibiotic resistance; vector control. 5.5 Plant and animal breeding: Marker assisted breeding; genetic basis of economically important traits. 5.6 Global climate change: Causes; consequences; mitigation.

Extended Professional Component (is apart of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. Lee C Drickamer, 2001, Animal Behavior: Mechanisms, Ecology, Evolution, 5th edition, McGraw-Hill Higher Education. 2. Rudi Jansma, 2024, Global Philosophical and Ecological Concepts: Cycles, Causality, Ecology and Evolution in Various Traditions and their Impact on Modern Biology (2 Vols.), 1st edition, Motilal Banarsidass Publishers.
Reference books	1. Veer Bala Rastogi, 2017, Organic Evolution (Evolutionary Biology), Medtech publications. 2. Tony Juniper, 2019, The Ecology Book, DK publishers. 3. Kailash Choudhary and Ram Prakash Charan, 2024, Ecology Book - Life Science Theory Textbook Useful for CSIR NET, GATE SET, IIT JAM, CUET PG, B.Sc., M.Sc. & Competative Exams, IFAS publications. 4. Karl Sigmund, 2017, Games of Life: Explorations in Ecology, Evolution, and Behavior, Dover Publications.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SAR1614.pdf 3. https://unacademy.com/content/wpcontent/uploads/sites/2/2022/10/Evolution-3-min.pdf 4. https://www.mabs.at/fileadmin/user_upload/p_mabs/Ecology_2019.pdf 5. https://edisciplinas.usp.br/pluginfile.php/7672921/mod_resource/content/1/Krebs%20Davies%20_Behavioral%20Ecology%20_%20Cap%201%20_Sel%20nat%20Comportamento-annotated.pdf 6. https://www.toppersnotes.com/wp-content/uploads/2021/02/7.CSIR-Life-science-sample-Ecology-Evolution-or-Applied-Biology.pdf

CO	Course Outcomes
On completion of the course, the students should be able to:	
CO1	Outline the concept of ecosystem and its interaction.
CO2	The student will be able describe the characteristics of population growth and species interaction.
CO3	Attain an idea on the evolution and population genetics.
CO4	Analyze interactions within the context of specific habitats and judge how the habitat shapes the distribution and abundance of species.
CO5	Gain a solid foundation in basic ecological and evolutionary processes, and a training in modern research methods.

CO/PSO	PSO 1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	M	M	H
CO2	H	L	M	H	H	H
CO3	H	L	H	M	M	M
CO4	H	H	L	M	L	M
CO5	H	M	M	L	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	M	H	L	H	M
CO3	H	L	L	M	H	H
CO4	H	H	L	M	H	L
CO5	H	M	H	H	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ENZYMOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>PCBCD24</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• Students will be introduced to the theory and practice of enzymology.
• Mechanisms of catalysis and factors affecting catalysis will be understood
• The kinetics of enzyme catalyzed reactions in the absence and presence of inhibitors will be studied and the options for applying enzymes and their inhibitors in medicine will be analyzed.
• Students will learn about the applications of enzymes in research, medicine, and industry, which will prepare them for careers in industrial and biomedical research.
• The control of metabolic pathways and cellular responses through enzyme regulation will be emphasized</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3, K4 & K5, K6)
Introduction to enzymes
1.1 Introduction to enzymes and features of catalysis: A short history of the discovery of enzymes and how they became powerful biochemical tools.
1.2 Holoenzyme, apoenzyme, cofactors, coenzyme, prosthetic groups.
1.3 Classification and Nomenclature, Specificity of enzyme action-group specificity, absolute specificity, substrate specificity, stereochemical specificity.
1.4 Active site, Identification of amino acids at the active site- trapping of ES complex, identification using chemical modification of amino acid side chains and by site-directed mutagenesis.
1.5 Mechanisms of enzyme catalysis: acid-base catalysis, covalent catalysis, electrostatic catalysis, metal ion catalysis, proximity and orientation effects.
1.6 Low barrier H-bonds, Structural flexibility Mechanism of action of chymotrypsin.</td></tr>
<tr><td></td><td colspan="7">UNIT II (18 hours) (K1, K2, K3, K4, K5 & K6)
Enzyme techniques:
2.1 Isolation and purification of enzymes - Importance of enzyme purification.
2.2 Methods of purification- choice of source, extraction, fractionation methods-based on size or mass (centrifugation, gel filtration).
2.3 Based on polarity (ion-exchange chromatography, electrophoresis, Isoelectric focusing, hydrophobic interaction chromatography); based on solubility (change in pH, change in ionic strength).
2.4 Based on specific binding sites (affinity chromatography), choice of methods, Criteria of purity of enzymes.
2.5 Enzyme units - Katal, IU. Measurement of enzyme activity - discontinuous, continuous, coupled assays; stopped flow method and its applications.
2.6 Isoenzymes and their separation by electrophoresis with special reference to LDH.</td></tr>
</table>

	UNIT III (18 hours) (K1, K2, K3, K4 & K5, K6) **Enzyme kinetics I:** 3.1 Activation energy, transition-state theory, steady-state kinetics & pre-steady-state kinetics. 3.2 Single substrate enzyme catalyzed reactions -assumptions, Michaelis-Menten, derivation of Michaelis- Menten equation Double reciprocal (Lineweaver-Burk) and single reciprocal (Eadie -Hofstee) linear plots, their advantages and limitations. 3.3 Analysis of kinetic data- determination of Km, Vmax, kcat, and their physiological significance, Importance of kcat/Km. Enzyme inhibition: Irreversible inhibition. Reversible inhibition-Competitive, uncompetitive, noncompetitive, mixed and substrate inhibition. 3.4 Michaelis -Menten equation in the presence of competitive, uncompetitive and non- competitive inhibitors. Graphical analysis – Diagnostic plots for the determination of inhibition type. 3.5 Therapeutic use of enzyme inhibitors- Aspirin, statins (irreversible inhibitors), Methotrexate (competitive inhibitor). 3.6 Etoposide (non-competitive inhibitor), camptothecin (uncompetitive inhibitor).
	UNIT IV (18 hours) (K1, K2, K3, K4, K5 & K6) **Enzyme kinetics II:** 4.1 Allosteric enzymes: Cooperativity, MWC and KNF models of allosteric enzymes, Sigmoidal kinetics taking ATCase as an example. 4.2 Regulation of amount and catalytic activity by – extracellular signal, transcription, stability of mRNA, rate of translation and degradation, compartmentation, pH, temperature, substrate concentration, allosteric effectors, covalent modification. 4.3 Regulation of glycogen synthase and glycogen phosphorylase. 4.4 Feedback inhibition-sequential, concerted, cumulative, enzyme-multiplicity with examples. 4.5 Bi – Substrate reactions: Single Displacement reactions (SDR) (Ordered and Random bi mechanisms), Double Displacement reactions (DDR) (Ping pong mechanism), Examples, Cleland's representation of bisubstrate reactions. 4.6 Graphical analysis (diagnostic plots) to differentiate SDR from DDR.
	UNIT V (18 hours) (K1, K2, K3, K4 & K5, K6) **Enzyme technology:** 5.1 Immobilization of enzymes – methods - Reversible immobilization (Adsorption, Affinity binding). 5.2 Irreversible immobilization (Covalent coupling, Entrapment and Microencapsulation, Crosslinking. 5.3 Advantages and Disadvantages of each method, Properties of immobilized enzymes. 5.4 Designer enzymes- ribozymes and deoxy ribozymes, abzymes, synzymes. 5.5 Enzymes as therapeutic agents-therapeutic use of asparaginase and streptokinase. 5.6 Application of enzymes in industry- Industrial application of rennin, lipases, lactases, invertase, pectinases, papain.

Extended Professional Component (is apart of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. Palmer T and Bonner P, 2007, Enzymes: Biochemistry, Biotechnology and Clinical chemistry, 2nd Edition, Affiliated-East West press private Ltd, New Delhi. 2. Price NC and Stevens L; 2003, Fundamentals of Enzymology, 3rd Edition, Oxford University Press, New York.
Reference books	1. Berg JM, Stryer L, Gatto, G, WH Freeman & Co, 2015, Biochemistry, 8th Edition, New York. 1. Cook PF, Cleland W, 2007, Enzyme Kinetics and Mechanism; Garland Science, London. 2. Voet, D and Voet JG; Wiley, 2011, Voet's Biochemistry, Adapted Edition, India. 3. Nelson DL and Cox MM; WH Freeman & Co, Lehninger, 2021, Principles of Biochemistry, 8th Edition, New York. 4. Punekar NS,2018, ENZYMES: Catalysis, Kinetics and Mechanisms, Springer Nature Singapore Pte Ltd. ISBN 978-981-13-0785-0 (eBook) https://doi.org/10.1007/978-981-13-0785-0.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.youtube.com/watch?v=ozdO1mLXBQE&ab_channel=FreeMedEducation 3. https://www.youtube.com/watch?v=U_AhGJQl__Q&ab_channel=SiguChannel 4. https://www.youtube.com/watch?v=Cck3US2EBmU&ab_channel=QuickBiochemistryBasics 5. https://www.youtube.com/watch?v=CotD9m8Wm78&ab_channel=MedicosisPerfectionalis

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	L	H	L	M
CO2	H	H	L	M	L	H
CO3	H	H	H	H	M	H
CO4	H	M	L	H	L	H
CO5	H	L	M	H	L	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	L	M	L	M
CO2	H	H	H	M	M	M
CO3	H	H	L	M	L	M
CO4	H	M	M	H	L	M
CO5	H	M	M	H	L	M

<table>
<tr><td>Title of the Course</td><td colspan="7">CELLULAR METABOLISM</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>PCBCE24</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• Familiarize on blood glucose homeostasis.
• Provide an insight into the metabolic path way of glycogen, glycoprotein, mucopolysaccharide and peptidoglycan with clinical correlation wherever required.
• Inculcate knowledge on nucleotide metabolism and disorders associated with it.
• Provide a platform to understand the versatile role of PLP in amino acid degradation, formation of specialized products and disorders associated with ammonia detoxification.
• Educate on heme and sulphur metabolism with associated clinical manifestation.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3, K4 & K5)
Glucose metabolism:
1.1 Glycolysis – aerobic and anaerobic, inhibitors, and regulation.
1.2 Galactosemia, fructosuria.
1.3 Pyruvate dehydrogenase complex- mechanism and regulation.
1.4 Glyoxalate cycle and its regulation.
1.5 Gluconeogenesis- source, key enzymes, reaction sequence and its regulation. Pentose phosphate pathway- significance and its regulation.
1.6 Metabolism of glycogen – glycogenesis and Glycogenolysis - its regulation.</td></tr>
<tr><td></td><td colspan="7">UNIT II (18 hours) (K1, K2, K3, K4 K5 & K6)
Lipid metabolism:
2.1 Oxidation of fatty acids-oxidation of saturated and unsaturated fatty acids (α, β & ω oxidation). Regulation of β oxidation.
2.2 Ketogenesis and its regulation.
2.3 Biosynthesis of fatty acid–saturated and unsaturated, chain elongation, regulation. Biosynthesis of prostaglandins, thromboxanes and leukotrienes.
2.4 Biosynthesis and degradation of triacylglycerol, phosphoglycero lipids-lecithin, cephalin, plasmalogens and phosphatidyl inositol, Sphingolipid-sphingomyelin, cerebrosides, sulfatides, and gangliosides.
2.5 Cholesterol biosynthesis and its regulation.
2.6 Lipoprotein metabolism-chylomicrons, VLDL, HDL and LDL.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (18 hours) (K1, K2, K3, K4 & K5)
Nucleic acid metabolism:
3.1 Metabolism of nucleotides- De novo synthesis and salvage pathways of purine nucleotides.
3.2 Metabolism of nucleotides- De novo synthesis and salvage pathways of pyrimidine nucleotides.
3.3 Regulation and inhibitors of nucleotide biosynthesis.
3.4 Role of ribonucleotide reductase and its regulation.</td></tr>
</table>

	3.5 Degradation of purine nucleotides. 3.6 Degradation of pyrimidine nucleotides.
	UNIT-IV: (18 hours) (K1, K2, K3, K4 K5 & K6) **Amino acid metabolism:** 4.1 Biosynthesis of non- essential amino acids. 4.2 Role and biological significance of glutamate dehydrogenase, glutamine and asparagine synthetase, lysine, proline and phenylalanine hydroxylase. 4.3 Interconversion of amino acids - proline to glutamate, methionine to cysteine, serine to glycine. 4.4 Biosynthesis of spermine and spermidine. 4.5 Degradation of amino acids –glucogenic and ketogenic amino acids. 4.6 Formation of acetate from leucine and aromatic amino acid, pyruvate from cysteine, threonine and hydroxy proline, α-ketoglutarate from histidine and proline, succinate from methionine, threonine, valine and isoleucine, Oxaloacetate from aspartate, glycine and serine.
	UNIT-V: (18 hours) (K1, K2, K3, K4 & K5) **Heme and sulphur compounds** 5.1 Biosynthesis and degradation of heme. 5.2 Jaundice - classification, pathology and differential diagnosis. 5.3 Oxidation and reduction of inorganic sulphur compounds by microbes and plants. 5.4 Sulpho transferases and their biological role-rhodanases, sulphatases , 3-mercapto pyruvate sulphur transferases. 5.5 Mucopolysaccharidoses - Hunter syndrome, Sanfilippo syndrome and Maroteaux-Lamy syndrome. 5.6 Oxidation of cysteine to sulphate and inter conversion of sulphur compounds.

Extended Professional Component (is apart of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. David L Nelson and Michael M Cox, 2012, Lehninger Principles of Biochemistry, 6th Edition, W. H. Freeman. 2. Peter J. Kennelly, Kathleen M. Botham, Owen P. McGuinness, Victor W. Rodwell, and P. Anthony Weil, 2023, Harper's Illustrated Biochemistry, 32nd Edition, McGraw Hill.

Reference books	1. Voet D and Voet JG, 2010, Biochemistry, 4th Edition, John Wiley & Sons, Inc. 2. Metzler DE, 2003, The chemical reactions of living cells, 2nd Edition, Academic Press. 3. Zubay GL, 1999, Biochemistry, 4th Edition, Mc Grew-Hill. 4. Thomas M. Devlin (Editor), Textbook of Biochemistry with Clinical Correlations, 7th Edition, Wiley. 5. James M Orten & Otto W Neuhan, Human Biochemistry, 10th Edition, The C. V. Mosby Company.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.embopress.org/doi/full/10.1038/msb.2013.19 3. https://people.wou.edu/~*gural l/450 Glycogen%20 metabolism*.pdf 4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3243375/ 5. https://www.researchgate.net/publication/334458898_Urea_Cycle 6. https://www.researchgate.net/publication/51233381_Heme_biosynthesis_and_its_regulation_Towards_understanding_and_improvement_of_heme_biosynthesis_in_filamentous_fungi. 7. https://www.researchgate.net/publication/349746691_Microbial_Sulfur_Metabolism_and_Environmental_Implications

CO	**Course Outcomes**
On completion of the course, the students should be able to:	
CO1	Appreciate the modes of synthesis and degradation of glucose and will be able to justify the pros and cons of maintain the blood sugar level.
CO2	Gain knowledge on polysaccharide metabolism and glycogen storage disease.
CO3	Acquaint with the making and braking of nucleotides.
CO4	Differentiate the diverse reaction a particular amino acid can experience.
CO5	Correlate the disturbance of metabolic reactions to clinical manifestations with reference to heme and sulphur metabolism.

CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	H	H	H	M
CO2	H	L	M	M	M	H
CO3	H	M	H	H	H	M
CO4	H	H	L	H	M	H
CO5	H	H	M	M	H	H

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	L	H	H	H
CO2	H	M	M	H	M	M
CO3	H	M	H	M	H	L
CO4	H	M	M	M	H	H
CO5	H	L	H	H	L	H

<table>
<tr><td>Title of the Course</td><td colspan="7">LAB COURSE IN ENZYMOLOGY, MICROBIOLOGY AND CELL BIOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core Practical</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td rowspan="2">PCBCF24</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">6</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To inculcate the knowledge of isolation and purification techniques of enzymes using alkaline phosphatase as an example and to perform experiments to study the factors affecting enzyme activity.
• To achieve training in basic microbiological techniques – preparation of culture, sterilization and staining methods.
• To perform the blood grouping test and to prepare blood smear to study different types of blood cells.
• To learn molecular biology techniques like Gel electrophoresis and Blotting techniques.
• To introduce industrial visit so that students may be aware of actual need of the industry and various opportunities available.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Enzymology (15 hours) (K1, K2, K3, K4, K5 & K6)
Alkaline Phosphatase
1. Isolation of Alkaline Phosphatase from goat kidney.
2. Determination of optimum pH and temperature of alkaline phosphatase.
3. Determination of specific activity and Km of alkaline phosphatase.
4. Effect of activators and inhibitors on the activity of alkaline phosphatase.
Assay of enzymes
1. Salivary Amylase
2. Acid Phosphatase</td></tr>
<tr><td></td><td colspan="7">Microbiology (15 hours) (K1, K2, K3, K4, K5 & K6)
1. Safety measures and Good Laboratory Practices in the microbiology laboratory
2. Sterilization, Culture and inoculum preparation
3. Staining of bacteria – Gram Staining</td></tr>
<tr><td></td><td colspan="7">Physiology & Cell Biology (15 hours) (K1, K2, K3, K4, K5 & K6)
1. Test for blood grouping (Haemagglutination).
2. Peripheral Blood smear –Staining and Interpretation.</td></tr>
<tr><td></td><td colspan="7">Group Experiments (15 hours) (K1, K2, K3, K4, K5 & K6)
1. Separation of proteins based on molecular weight by SDS PAGE.
2. Agarose gel electrophoresis of genomic DNA</td></tr>
<tr><td></td><td colspan="7">Industrial visit can be organised to students through the Academia –Industry Collaborative Program.</td></tr>
<tr><td></td><td colspan="7">SELF- STUDY
1. Preparation of Buffers and pH measurement.
2. Michaelis-Menten equation and Lineweaver Burk plot</td></tr>
</table>

Text books	1. David Plummer, 2001, An Introduction to Practical Biochemistry, 3rd Edition, Mc Graw Hill Education (India) Private Ltd. 2. Jayaraman J, 2011, Laboratory Manual in Biochemistry, New age publishers. 3. Dubey R.C. and Maheshwari D. K, 2009, Textbook of Microbiology. S. Chand, Limited.
Reference books	1. Nicholas C, Price and Lewis Stevens, 2012, Fundamentals of Enzymology; 3rd Edition, Oxford University Press. 2. Robert A, Copeland, 2000, Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis, Wiley-VCH Publishers. 3. Cappuccino J. G. & Sherman N, 2005, Microbiology-A Laboratory Manual, Pearson Education Inc. 4. Hans Bisswanger, Wiley–Blackwell (2011). Practical Enzymology, Second Revised Edition. 5. Madigan M. T, Bender K.S, Buckley D. H. Sattley W. M. and Stahl, 2018, Brock Biology of Microorganisms, 15th Edition, Pearson.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.researchgate.net/publication/337146254_Kinetic_studies_with_alkaline_phosphatase 3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/ 4. https://www.ijsr.net/archive/v3i8/MDIwMTU0MDk=.pdf 5. https://www.researchgate.net/publication/349318898_ABC_of_Periheral_smear 6. https://ncdc.gov.in/WriteReadData/l892s/File608.pdf 7. https://www.ncbi.nlm.nih.gov/books/NBK562156

CO	**Course Outcomes**
On completion of this course, students will be able to;	
CO1	The student will be able to employ the relevant techniques for isolation and purification of enzymes and gain skills in kinetic studies which is essential for research activity.
CO2	Students will acquire the ability to perform enzyme assay and explicate the methods that form the basis of enzyme characterization.
CO3	Learn the Basic concepts in microbiology and cell biology which will be helpful for interdisciplinary research work.
CO4	Students will be trained in separation techniques used in molecular Biology which will be supportive in their future research.
CO5	Industrial visits will provide the students with an opportunity to learn practically through interaction, working methods and employment practices. Students will have an exposure to Industrial standard and current work practices.

CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	H	H	M	M
CO2	H	H	L	M	L	H
CO3	H	H	H	H	L	H
CO4	H	M	L	H	M	H
CO5	H	M	M	H	M	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	M	M	M	M
CO2	H	H	H	M	M	L
CO3	H	H	M	L	M	M
CO4	H	M	M	H	M	M
CO5	H	M	M	H	L	M

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE III A: BIOSTATISTICS AND DATA SCIENCE</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective III A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective (Discipline Centric)</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>PEBCE24</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To summarize the data and to obtain its salient features from the vast mass of original data.
• To understand the concept of various measures of dispersion.
• To understand the concepts of sampling and learning test of significance.
• To understand the concept of various attributes and relate to biological studies.
• To gain knowledge in SPSS, a software package which gives a perfect graphical representation and appropriate result for the data that has been entered.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (7 hours) (K1, K2, K3, K4 K5 & K6)
1.1 Nature of biological and clinical experiments.
1.2 Collection of data in experiment- Primary and secondary data.
1.3 Methods of data collection.
1.4 Classification and tabulation. Different forms of diagrams and graphs related to biological studies.
1.5 Measures of Averages- Mean, Median, and mode.
1.6 Use of these measures in biological studies.</td></tr>
<tr><td></td><td colspan="7">Unit II (7 hours) (K1, K2, K3, K4 K5 & K6)
2.1 Measures of Dispersion for biological characters - Quartile deviation, Mean deviation.
2.2 Standard deviation, and coefficient of variation.
2.3 Measures of skewness and kurtosis.
2.4 Correlation - Rank correlation.
2.5 Regression - Regression equation.
2.6 Simple problems based on biochemical data.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (7 hours) (K1, K2, K3, K4 K5 & K6)
3.1 Basic concepts of sampling- Simple random sample.
3.2 Stratified sample and systemic sampling.
3.3 Sampling distribution and standard error.
3.4 Test of significance based on large samples.
3.5 Test for mean, difference of means.
3.6 Proportions and equality of proportions.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: (7 hours) (K1, K2, K3, K4 K5 & K6)
4.1 Small sample tests – Students ‘t’ test for mean
4.2 Difference of two-way means.
4.3 Tests for correlation and regression coefficients.
4.4 Chi-square test for goodness of a non-independence of attributes.
4.5 F test for equality of variances. ANOVA- one way and two ways.
4.6 Basic concept related to biological studies.</td></tr>
<tr><td></td><td colspan="7">UNIT-V: (8 hours) (K1, K2, K3, K4 K5 & K6)
5.1 Definition to Data Science, Algorithms.</td></tr>
</table>

	5.2 Machine Learning Deep Learning. 5.3 Artificial Neural Networks. 5.4 Artificial Intelligence (AI). 5.5 Big Data and their Application in medical. 5.6 Data and their Application in health and pharma industries.

Extended Professional Component (is a part of internal component only, not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. Milton, 1992, Statistical methods in the Biological and Health Sciences, 2nd Edition, Mc Graw Hill. 2. Rosner ,2005, Fundamentals of Biostatistics, Duxbury Press 3. Sundar Rao PSS, Jesudian G and Richard J, 1987, An Introduction to Biostatistics, 2nd Edition, Prestographik, Vellore, India. 4. Warren, Gregory E, Grant R, 2004, Statistical Methods in Bioinformatics,1st edition, Springer. 5. Zar JH, 1984, Bio Statistical Methods, Prentice Hall.
Reference books	1. Bernard Rosner, 2015, Fundamentals of Biostatics, 8th Edition, Cengage Learning. 2. Davy Cielen, Anro DB Meysman, Mohamed Al, 2016, Introducing Data Science, Dreamtech Press. 3. Marcello Pagano , Kimberlee Gauvreau, 2018, Principles of Biostatics, 2nd Edition , Champman and Hall. 4. Harvey Motulsky, 2017, Intuitive Biostatistics, 4th Edition, Oxford University Press. 5. Bratati Banerjee, 2018, Methods in Biostatistics for Medical students and Research workers, 9th Edition, Jaypee Publication.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollaege 2. https://www.ibm.com/docs/en/SSLVMB_28.0.0/pdf/Accessibility.pdf 3. https://pure.tue.nl/ws/portalfiles/portal/19478370/20160419_CO_Mzolo.pdf 4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5453888/ 5. https://home.ubalt.edu/ntsbarsh/excel/excel.htm 6. https://students.shu.ac.uk/lits/it/documents/pdf/analysing_data_using_s pss.pdf 7. https://www.ibm.com/support/pages/ibm-spss-statistics-28-documentation

CO	Course Outcomes
On completion of the course, the students should be able to:	
CO1	To understand Concepts of statistical population and sample, variables, and attributes. Tabular and graphical representation of data based on variables.
CO2	To understand Conditions for the consistency and criteria for the independence of data based on attributes. Measures of central tendency, Dispersion, Skewness and Kurtosis.
CO3	To Learn different sampling methods and analyzing statistical significance.

CO4	To understand students t test, ANOVA, Chi square test analyses the significance of various research.
CO5	To learn data science, algorithm for machine learning, artificial intelligence and big data, their applications in clinical and pharma domain.

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	H	M	H
CO2	H	M	H	H	L	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	L	H
CO2	H	H	H	M	L	H
CO3	H	H	H	M	M	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE III B: HORTICULTURE</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective III- B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>PEBCF24</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To impart knowledge in horticulture science and nursery management.
• To increase the production of quality plants in cost-effective and efficient cropping system.
• To learn the cropping technique and hybrid methods.
• To learn gardening skill in different landscape
• To support skill development and create employment opportunities for youth.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (7 hours) (K1, K2, K3, K4 & K5)
1.1 Horticulture – Definition, scope and importance, Division and classification of horticultural crops.
1.2 Propagation – definition, methods, seed propagation, vegetative propagation, micro propagation.
1.3 Planting systems – Protected cultivation.
1.4 Irrigation systems - Weed management – nutrient application methods in horticultural crops – crop regulation.
1.5 Maturity indices – harvesting methods, pre cooling – packaging.
1.6 Storage of horticultural crops.</td></tr>
<tr><td></td><td colspan="7">Unit II (7 hours) (K1, K2, K3, K4 K5 & K6)
2.1 Soil – definition – components – pedology –Edaphology.
2.2 Physical properties of soil – Color, Texture, structure, Bulk density, Particle density, Pore space; soil water, soil air, soil temperature and their significance in crop production.
2.3 Soil chemical properties – Soil reaction, EC and CEC. Soil Organic Matter and its importance on soil properties – Essential nutrients for crop plants - Major, secondary and micro nutrients -Soils of Tamil Nadu.
2.4 Types – Straight, Complex, Compound, Mixed, Fortified and chelated fertilizers and their reactions in soil.
2.5 Techniques to enhance fertilizer use efficiently.
2.6 Soil fertility – INM and IPNS – Problem soils – acid, saline and alkaline soils- their formation, reclamation and management.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (7 hours) (K1, K2, K3, K4 & K5)
3.1 Morphology and general anatomy of medicinally important plant parts: Roots, Stem and its modifications, Barks, Leaves, Flowers, Fruits, Seeds.
3.2 Study of some medicinally important families (diagnostic features with examples of species of medicinal use): Paparveraceae, Rutaceae.
3.3 Study of some medicinally important families (diagnostic features with examples of species of medicinal use): Rubiaceae, Asteraceae, Solanaceae, Scrophulariaceae.
3.4 Study of some medicinally important families (diagnostic features with examples of species of medicinal use): Lamiaceae, Liliaceae, Fabaceae, Apiaceae.
3.5 Cultivation methods, Herbal pesticides, Harvesting and Storage.</td></tr>
</table>

	3.6 Marketing and general aspects of export of medicinally important plants.
	UNIT-IV: (7 hours) (K1, K2, K3, K4 K5 & K6) 4.1 Dry land horticulture – Importance, scope and distribution- Crops suitable for dry land systems – Important varieties, climate and soil requirements, commercial propagation methods, Organic crop production methods- Mango, Banana. 4.2 Spacing and planting patterns - Cropping systems and intercropping – mulching - Soil and moisture conservation methods. 4.3 Anti transparent – Management of nutrients, water, weeds and problem soils. 4.4 Regulation of cropping – training and pruning methods - top working and rejuvenation. 4.5 Use of plant growth regulators. 4.6 Post harvest handling – Economics of production.
	UNIT-V: (7 hours) (K1, K2, K3, K4 & K5) 5.1 Scope and importance of ornamental gardening and landscaping – principles – formal and informal garden. 5.2 Styles of garden - Features of garden - Garden components and adornments – plant Components - non plant components - garden walls, fencing, steps, garden drives and paths– sunken garden, roof garden, rockeries. 5.3 Operations in planting and maintenance of public garden, institutional garden, Industrial Garden, residential complex garden. 5.4 Operations in landscape maintenance for high ways, bus terminus, airports, city roads and IT park. 5.5 Lawn – types of lawn grasses – criteria for selection- methods of lawn establishment – operation and maintenance – problems and remedial management. 5.6 Flower arrangements and dry flowers – suitable plant.

Extended Professional Component (is a part of internal component only, not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. Kaushal Kumar Mishra and Rajesh Kumar, 2014, Fundamentals of Horticulture. Biotech Books. 2. Prasad, 2012, Principles of Horticulture, 2nd Edition, AGROBIOS publisher.

Reference books	1. Ivan A Ross, 2005, Medicinal Plants of the World, 5th Edition, Humana Publication. 2. Jitendra Singh, 2014, Fundamental to Horticulture. Kalyani Publisher. 3. Charles Adams, Mike Early, Jane Brook and Katherine Bamford, 2014, Principles of Horticulture, Routledge Publication. 4. Kumar N, 2011, Introduction to Horticulture, Oxford and IBH Publication. 5. Robert E White, 2005, Principles and Practice of Soil Science: The soil as a Natural Resource, 4th Edition, Blackwell publishing.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://youtu.be/RTR2RgMbJ 3. https://youtu.be/MUCk9FqjCBc 4. https://youtu.be/AAy5Z4zjgMU 5. https://youtu.be/iqOQTVGoLuI 6. https://youtu.be/K8a1RkIeick

CO	Course Outcomes
On completion of the course, the students should be able to:	
CO1	Recall the significance of horticulture.
CO2	Outline the impact of soil nature on horticulture.
CO3	Apply the concept of hybrid to enhance yield.
CO4	Gain knowledge on cropping techniques and harvesting methods.
CO5	Identify the role of gardening in common places.

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	H	M	H
CO2	H	M	H	H	H	H
CO3	H	M	L	H	H	M
CO4	H	L	H	H	M	H
CO5	H	H	H	H	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	M	H	M	M	H
CO3	H	H	M	M	L	H
CO4	H	L	H	H	H	H
CO5	H	H	H	H	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE IV A: BIOSAFETY, LAB SAFETY AND IPR</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective IV-A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>PEBCG24</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">● To assimilate the hazards associated with the handling of biological and chemical agents.
● To understand how to protect from the hazards by the implementation of various safety measures in biochemical laboratories.
● To implicate the importance of protecting the scientific intellect by filing patents and understand the various offices for filing and maintaining patents.
● To understand the scope of patenting in biological research.
● To create an awareness of ethics associated with used of genetically modified organisms/cells and its rationale for use in living organisms.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (8 hours) (K1, K2, K3, K4, K5 & K6)
Biosafety:
1.1 Historical background - Introduction to biological safety cabinets, Primary containment for biohazards
1.2 Biosafety levels - Recommended biosafety levels for infectious agents and infected animals
1.3 Biosafety guidelines - government of India, roles of IBSC, RCGM, GEAC etc. for GMO
1.4 Applications in food and agriculture.
1.5 Environmental release of GMOs - Risk assessment, Risk management and communication.
1.6 National regulations and international agreements.</td></tr>
<tr><td></td><td colspan="7">UNIT II (7 hours) (K1, K2, K3, K4, K5 & K6)
Laboratory Safety:
2.1 Chemical, Electrical and Fire hazards, Handling and manipulating human or animal cells and tissues, toxic, corrosive or mutagenic solvents and reagents.
2.2 Mouth pipetting, and inhalation exposures to infectious aerosols, Safe handling of syringe needles or other contaminated sharps, spills, and splashes onto skin and mucous membranes.
2.3 Health aspects - Toxicology, Allergenicity, Antibiotic resistance.
2.4 History of biosafety microbiology and molecular biology, Risk assessment, Personal protective equipment.
2.5 Laboratory facilities and safety equipment, Disinfection, decontamination, and sterilization.
2.6 Regulatory compliance, Laboratory security and emergency response, administrative controls.</td></tr>
<tr><td></td><td colspan="7">UNIT III (7 hours) (K1, K2, K3, K4, K5 & K6)
Intellectual Property Rights (IPR):
3.1 Introduction to patents, types of patents, process involved in patenting in India, trademarks, copyright, industrial design.
3.2 Trade secrets, traditional knowledge, geographical indications, history</td></tr>
</table>

	of national and international treaties and conventions on patents, WTO, GATT, WIPO, Budapest Treaty, Patent Cooperation Treaty (PCT) and TRIPS. 3.3 Patent databases - Searching international databases; analysis and report formation. Indian Patent Act 1970; recent amendments. 3.4 Filing of a patent application, precautions before patenting disclosure/non-disclosure; procedure for filing a PCT application. 3.5 The patent ability of microorganisms-claims, Characterization and repeatability disposition in the culture collections. 3.6 Legal protection for plants and other higher organisms, new plant varieties by rights, tissue culture protocols.
	UNIT IV (7 hours) (K1, K2, K3, K4, K5 & K6) **Patent filing and infringement:** 4.1 Patent application- forms and guidelines, fee structure, time frames; types of patent applications: provisional and complete specifications. 4.2 PCT and convention patent applications. 4.3 International patenting-requirement, financial assistance for patenting-introduction to existing schemes. 4.4 Publication of patents-gazette of India. Research Patenting -Patenting by researchers and scientists. 4.5 Patenting by University/organizational and rules in India and abroad. 4.6 Detailed information on patenting biological products, Case studies on Indian patents (basmati rice, turmeric, neem etc.), and patent infringement.
	UNIT V (7 hours) (K1, K2, K3, K4, K5 & K6) **Bioethics:** 5.1 Introduction to bioethics, human genome project and its ethical issues. 5.2 Genetic manipulations and their ethical issues. 5.3 Ethical issues in GMOs, foods, and crops in developed and developing countries. 5.4 Environmental release of GMOs. 5.5 Ethical issues involved in stem cell research and use. 5.6 Use of animals in research experiments.

Extended Professional Component (is a part of internal component only, not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved. (To be discussed during the Tutorial hours)

Text Books	1. Deepa Goel, Shomini Parashar, 2013, IPR, Biosafety and Bioethics, Pearson. 2. Ian Freshney R, 2016, Culture of Animal Cells: A Manual of Basic Technique and Specialized, Applications, 6th Edition, John Wiley & Blackwell. 3. Shree Krishna V, 2007, Bioethics and Biosafety in Biotechnology, New Age International Pvt. Ltd. Publishers. 4. Benjamin RS Veinbjornson, 2022, Handbook for Laboratory Safety, Elsevier. 5. Prathiba M Singh, 2024, Patent Law, Volume 1 and 2, Thomson Reuters.

Reference Books	1. Bareact, 2007, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd. 2. Kandanala C, 2007, Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. 3. Stevon H Voldman, 2018, From Invention to Patent, 1st Edition, ISBN-13:978-1119125259. 4. Vaughan Monamy,2017, Animal Experimentation, A guide to the Issues, 3rd Edition, Cambridge University press. 5. Helena Rocklinsberg , 2017, Animal Ethics in Animal Research, Cambridge University Press.
Web resources	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.researchgate.net/publication/281780737_The_Ethical_Challenges_of_Animal_Research 3. https://patentlawcasebook.com/ 4. https://spicyip.com/2021/06/book-review-patent-law-cases-and-materials-a-synthesis-for-india.html 5. https://open.umn.edu/opentextbooks/textbooks/405 6. https://www.cambridge.org/core/books/animal-ethics-in-the-wild/F9FF5F7415D62DA32C859F581B1E0C8A

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE IV B: PSYCHOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective IV-B</td></tr>
<tr><td>Category</td><td>Generic Elective</td><td>Year
Semester</td><td>I
II</td><td>Credits</td><td>3</td><td>Course Code</td><td>PEBCH24</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To learn the basic concepts in psychology.
• To understand the importance of language and communication in social life.
• To impart knowledge on social behavior, human development, and cognitive functions.
• To describe, explain, predict and change behavior.
• To develop the skill of recognizing the positive aspects of life and grow inner happiness.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (7 hours) (K1, K2, K3, K4, K5 & K6)
1.1 Psychology - Definition and Origin.
1.2 Nature and Scope of Psychology.
1.3 Psychology as a Science.
1.4 Specialties in Psychology.
1.5 Perspectives in Psychology.
1.6 Goals of Psychology.</td></tr>
<tr><td></td><td colspan="7">UNIT II (7 hours) (K1, K2, K3, K4 K5 & K6)
2.1 Methods of assessment in Psychology – Questionnaire.
2.2 Memory – Stages in memory.
2.3 The modal model of memory.
2.4 Forgetting – Types.
2.5 Common causes of forgetfulness.
2.6 Memory disorder.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (7 hours) (K1, K2, K3, K4, K5 & K6)
3.1 Basic elements of thought.
3.2 Types of Concept and Concept formation.
3.3 Reasoning – Types, Decision making and problem solving.
3.4 Creative thinking – Nature and Characteristics.
3.5 Artificial Intelligence.
3.6 Language – Nature and Development of Language.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: (7 hours) (K1, K2, K3, K4 K5 & K6)
4.1 Learning – Nature.
4.2 Classical Conditioning – Principle and Applications.
4.3 Operant Conditioning – Principle and Applications.
4.4 Biological factors in Learning.
4.5 Basic Concepts of Motivation.
4.6 Indicators of Motivation.</td></tr>
<tr><td></td><td colspan="7">UNIT-V: (7 hours) (K1, K2, K3, K4, K5 & K6)
5.1 Emotion – Components of Emotion.
5.2 Characteristics and Functions of Emotion.
5.3 Physiology of Emotion – Expression and Control.
5.4 Personality – Definition – Types.
5.5 Assessment of Personality.</td></tr>
</table>

	5.6 States of Consciousness.

Extended Professional Component (is a part of internal component only, not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved. (To be discussed during the Tutorial hours)

Text books	1. Baron RA, 2016, Psychology, 5th Edition, Pearson. 2. Lahey BB, 2008, Psychology: An Introduction, 10th Edition, Tata Mc Graw Hill.
Reference books	1. Feldman RS, 2019, Understanding Psychology, 14th Edition, Tata Mc Graw Hill. 2. Bootzin RR, Bower GH, Crocker J and Hall E, 1991, Psychology Today: An Introduction, 7th Edition, Mc Graw Hill. 3. Balachandran M, 2016, Psychology for Nursing Students, 1st Edition, Maanas Publishers. 4. Parameshwaran, EG and Beena C, 2016, An Invitation to Psychology, 1st Edition, Neelkamal.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://youtu.be/H3BGRuqRceU 3. https://youtu.be/yuZAUJbjgLU 4. https://youtu.be/Z8Duz6MzB1U 5. https://youtu.be/H6LEcM0E0io 6. https://youtu.be/NXcWZnQPUXw

CO	**Course Outcomes**
On completion of the course, the students should be able to:	
CO1	Apply the principles of psychology in day-to-day life for a better understanding of oneself and others.
CO2	Compare and contrast the biological basis of memory and forgetting.
CO3	Describe Language acquisition and the role Language plays in Communication and Thought.
CO4	Recognize the importance of Learning and Motivation.
CO5	Critically evaluate the fundamental processes underlying human behavior.

CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	M	M	M	H
CO2	H	M	L	H	M	L
CO3	H	L	L	M	L	M
CO4	H	L	H	M	M	H
CO5	H	H	M	H	H	H

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	M	M	H	M	M
CO3	H	H	H	M	H	M
CO4	H	L	M	L	H	L
CO5	H	M	H	H	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">SEC: NUTRITIONAL BIOCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Skill Enhancement Course-I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>I</td><td>Credits</td><td>2</td><td>Course Code</td><td>PSBC124</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>1</td><td>1</td><td colspan="3">-</td><td colspan="2">2</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To understand basic concepts involved in growth, health, nutrition, physiology and metabolism.
• To discuss the concepts and applications of nutrition in correlation with biochemistry.
• To define nutritional needs in healthy individuals and modification of diet during illness.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (10 hours) (K1, K2, K3, K4, K5 & K6)
Basic concepts - Nutrition - Food groups and balanced diet. Novel Foods. Calorific value of foods: Direct and indirect calorimetry. Empty calories. Basal metabolic rate: Factors affecting BMR. SDA and physical activity. Calculation of day's energy requirement. Assessment of nutritional status. Lactose intolerance. Nutritional requirement and biochemical changes in different physiological states -infancy, childhood, pregnancy, lactation, and ageing. Sports nutrition.</td></tr>
<tr><td></td><td colspan="7">Unit II (10 hours) (K1, K2, K3, K4, K5 & K6)
Elements of nutrition - Plant and animal sources of simple and complex carbohydrates, fats and proteins and their requirement. Biological significance, deficiency and toxicity of macronutrients and micronutrients. Role of dietary fibre. Protein sparing action of carbohydrates and fats. Essential amino acids. Essential fatty acids. Effects of naturally occurring food toxins, preservatives, additives, alcohol and tobacco on health.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (10 hours) (K1, K2, K3, K4, K5 & K6)
Vitamins - Dietary sources, classification, biochemical functions, requirements, absorption, metabolism and excretion. Minerals - Dietary sources, classification, biochemical functions, requirements, absorption, metabolism and excretion. Vitamin B complex as coenzyme. Nutritional significance of dietary calcium and phosphorus. Nutritional significance of dietary magnesium and iron. Nutritional significance of dietary iodine, zinc and copper.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: (10 hours) (K1, K2, K3, K4, K5 & K6)
Malnutrition - Diseases arising due to Protein - Calorie Malnutrition and undernutrition (Kwashiorkor and Marasmus). Prevention of malnutrition. Deficiency diseases associated with vitamin B complex and vitamin C. Deficiency diseases associated with vitamin A & D. Deficiency diseases associated with vitamin E & K. Mineral deficiency diseases - aetiology, sign and symptoms and dietary supplementation. Enrichment and fortification (vitamins and minerals).</td></tr>
<tr><td></td><td colspan="7">UNIT-V: (10 hours) (K1, K2, K3, K4, K5 & K5)
Nutrition in diseases - Aetiology, signs and symptoms, treatment and dietary management during fever (Typhoid and Malaria) in adults. Aetiology, signs and symptoms, treatment and dietary management during</td></tr>
</table>

	infectious diseases (COVID-19) and Jaundice in adults. Aetiology, signs and symptoms, treatment and dietary management during hyper acidity (Ulcer), Atherosclerosis, and Hypertension in adults. Aetiology, signs and symptoms, treatment and dietary management during kidney diseases and diabetes in adults. Starvation and Obesity. Inter-relationship of nutrition, infection, immunity and poverty

Extended Professional Component (is a part of internal component only, not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved. (To be discussed during the Tutorial hours)

Text books	1. Srilakshmi E, 2016, Nutrition Science, New Age International Publishers. 2. Mahan, Kathleen L, 2004, Krause's Food, Nutrition and Diet Therapy, 11th Edition, W. B. Saunder.
Reference books	1. Andreas M. Papas, 1998, Antioxidant Status, Diet, Nutrition, and Health, 1st Edition, CRC Press. 2. Swaminathan M,1986, Principles of Nutrition and Dietetics, Bangalore Print. and Publishing Company. 3. Margaret Mc Williams, 2012, Food Fundamentals, 10th Edition, Prentice Hall. 4. Tom Brody, 1998, Nutritional Biochemistry, 2nd ed, Academic Press, USA. 5. Chad L. Cox, 2015, Nutritional Biochemistry – Current topics in nutritional research, 1st Edition, Apple Academic Press Inc.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.jmedscindmc.com/article.asp?issn=1011-4564;year=2014;volume=34;issue=5;spage=211;epage=213;aulast=Shrivastava. 3. https://www.researchgate.net/figure/Relationship-between- malnutrition-infection-and-immunity-Malnutrition-is-considered-the_fig1_280722727. 4. https://en.wikipedia.org/wiki/Novel_food 5. https://www.chemicalsafetyfacts.org/preservatives/ 6. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/food-enrichment.

CO	Course Outcomes
On completion of the course, the students should be able to:	
CO1	Plan a balanced diet based on an individual's energy requirement, Assess nutritional status of an individual.
CO2	Describe the biochemical, physiological and nutritional functions of macronutrients and their integrated role. Understand the role played by anti-nutritional factors.
CO3	Evaluate the functions of vitamins and minerals, and fluids and electrolyte balance in different physiological states and in sports persons.
CO4	Identify nutritional deficiency conditions, its prevention and dietary management.
CO5	Acquire knowledge about the importance of balanced diet and diet therapy.

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	M	M	H
CO2	H	L	H	M	H	H
CO3	H	M	L	H	H	H
CO4	H	L	M	M	M	H
CO5	H	H	M	M	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	M	M	H	H	H
CO2	H	H	H	L	M	M
CO3	H	H	L	M	H	H
CO4	H	M	H	M	M	H
CO5	H	H	M	H	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">PHYSIOLOGY AND CELL BIOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td>PCBCG24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">The main objectives of this course are to
• Aid in understanding the physiology of respiratory and circulatory systems
• Explain the structure and physiology of the nervous and muscular system
• Explicate the functions of digestive and excretory system of the body.
• Impart knowledge about the process of reproduction.
• Emphasize the importance of various endocrine factors that regulate metabolism,growth, homeostasis and reproduction.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3, K4, K5 & K6)
1.1 Major classes of cell junctions- anchoring, tight and gap junctions.
1.2 Major families of cell adhesion molecules (CAMs)- cadherins, integrins.
1.3 Types of tissues. Epithelium- organization and types.
1.4 The basement membrane.
1.5 Cell cycle- mitosis and meiosis, Cell cycle-phases and regulation.
1.6 Cell death mechanisms- an overview-apoptosis, necrosis.</td></tr>
<tr><td></td><td colspan="7">UNIT II (18 hours) (K1, K2, K3, K4, K5 & K6)
2.1 Reproductive system- sexual differentiation and development,
2.2 Sperm transport, sperm capacitation.
2.3 Semen analyses and Acrosome reaction.
2.4 Clinical relevance of female reproductive physiology- menstrual cycle.
2.5 Pregnancy, Menopause.
2.6 Fertilization and infertility issues.</td></tr>
<tr><td></td><td colspan="7">UNIT III (18 hours) (K1, K2, K3, K4, K5 & K6)
3.1 Digestive system- structure and functions of different components of digestive system.
3.2 Digestion and absorption of carbohydrates, lipids and proteins.
3.3 Role of bile salts in digestion and absorption, mechanism of HCl formation in stomach, role of various enzymes and hormones involved in digestive system.
3.4 Composition of blood, lymph and CSF.
3.5 Blood cells - WBC, RBC and energy metabolism of RBC.
3.6 Blood clotting mechanism and blood groups- ABO and Rhesus system.</td></tr>
<tr><td></td><td colspan="7">UNIT IV (18 hours) (K1, K2, K3, K4, K5 & K6)
4.1 Respiratory System-Gaseous transport acid-base homeostasis.
4.2 Mechanism of the movement of O2 and CO2 through lungs, arterial and venous circulation.
4.3 Bohr effect, oxygen and carbon dioxide binding haemoglobin.
4.4 pH maintenance by cellular and intracellular proteins.
4.5 Phosphate and bicarbonate buffers, Metabolic acidosis and alkalosis.
4.6 Respiratory acidosis and alkalosis. Regulation of fluid and electrolyte balance.</td></tr>
</table>

	UNIT V (18 hours) (K1, K2, K3, K4, K5 & K6) 5.1 Sensory transduction, Nerve impulse transmission- nerve cells, synapses, reflex arc structure, resting membrane potential. Nernst equation, action potential, voltage gated ion-channels, impulse transmission, neurotransmission. 5.2 Neurotransmitter receptors, synaptosomes, synaptotagmin, rod and cone cells in the retina, changes in the visual cycle. Photochemical reaction and regulation of rhodopsin, odour receptors, learning and memory. 5.3 Chemistry of muscle contraction – actin and myosin filaments, theories involved in muscle contraction. Mechanism of muscle contraction, energy sources for muscle contraction. 5.4 Hormones – Classification, Biosynthesis, circulation in blood. Modification and degradation. Mechanism of hormone action, Target cell concept. 5.5 Synthesis, secretion, physiological actions and feedback regulation of synthesis of hormones of Hypothalamus, pituitary. Synthesis, secretion, physiological actions and feedback regulation of synthesis of hormones of Pancreatic, thyroid & parathyroid. 5.6 Synthesis, secretion, physiological actions and feedback regulation of synthesis of hormones of adrenal and gonadal hormones.

Extended Professional Component (is a part of internal component only, not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. Karp G, 2010, Cell and Molecular Biology: Concepts and Experiments, 6th Edition, John Wiley & Sons. Inc. 2. Bruce Alberts and Dennis Bray, 2013, Essential Cell Biology, 4th Edition, Garland Science.
Reference books	1. John E. Hall, 2010, Guyton and Hall Textbook of Medical Physiology 12th Edition. 2. Saunders Harrison's, 2016, Endocrinology by Larry Jameson Series: Harrison's Specialty, 19th Edition Publisher: McGraw-Hill. 3. De Robertis EDP and De Robertis EMF, 2010, Cell and Molecular Biology, 8th Edition, Lippincott Williams and Wilkins, Philadelphia. 4. Cooper GM and Hausman RE, 2009, The Cell: A Molecular Approach, 5th Edition, Sunderland, Mass. Sinauer Associates, Inc. 5. Wayne M. Baker, 2008, The World of the Cell, 7th Edition, Pearson Benjamin Cummings Publishing, San Francisco. Cell Biology.

Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.youtube.com/watch?v=6qnSsV2syUE 3. https://www.youtube.com/watch?v=9_h0ZXx1lFw 4. https://slideplayer.com/slide/9431799/https://www.youtube.com/@Biochemistrybasic 5. https://www.youtube.com/watch?v=URUJD5NEXC8&ab_channel=NucleusMedicalMedia

CO	**Course Outcomes**
On completion of this course, students will be able to	
CO 1	Specifically understand the biological and chemical processes within a human cell
CO 2	Identify and prevent diseases
CO 3	Understand defects in digestion, nutritional deficiencies and intolerances, and gastrointestinal pathologies
CO 4	Identify general characteristics in individuals with imbalances of acid-base, fluid and electrolytes.
CO 5	Process the mechanism: the transmission of biochemical information between cell membrane and nucleus.

CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	L	H	L	M
CO2	H	H	L	M	L	H
CO3	H	H	H	H	M	H
CO4	H	M	L	H	L	H
CO5	H	L	M	H	L	H

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	L	M	L	M
CO2	H	H	H	M	M	M
CO3	H	H	L	M	L	M
CO4	H	M	M	H	L	M
CO5	H	M	M	H	L	M

<table>
<tr><td>Title of the Course</td><td colspan="7">CLINICAL BIOCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td>Course Code</td><td>PCBCH24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To understand the need and methods of various biological sample collection.
• To explicitly understand the etiopathogenesis, symptoms and complications of metabolic and hormonal disorders and the relevant diagnostic markers
• To emphasize the diagnostic significance of serum enzymes in different pathologies and other Laboratory investigations of diagnostic importance to differentiate normal from disease.
• To conceive the role of inherited genes in inborn errors of metabolism and methodologies pertaining to in utero diagnosis and post-natal screening.
• To get updated about electrolyte and hormonal imbalances and the biochemical tests to diagnose them.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3, K4, K5 & K6)
Biochemical investigations in diagnosis, prognosis, monitoring, screening:
1.1 Specimen collection – Blood, (primary/Secondary specimen), urine and CSF.
1.2 Preservation of biological specimens -blood, urine, CSF and amniotic fluid. Biological reference ranges.
1.3 Disorders of blood cells: Hemolytic, iron deficiency and aplastic anemia and diagnosis.
1.4 Sickle cell anemia, thalassemia HBA1C variants. Porphyrias, Thrombocytopenia, Causes of leucopenia, leukemia, and leukocytosis.
1.5 Disorders of blood clotting mechanism - Von willebrand’s disease, Hemophilia A, B and C.
1.6 Diagnostic test for clotting disorders, D-dimer, and its clinical significance.</td></tr>
<tr><td></td><td colspan="7">UNIT II (18 hours) (K1, K2, K3, K4, K5 & K6)
Diabetes mellitus: pathology and complications:
2.1 Acute changes and chronic complications of Diabetic nephropathy, neuropathy, retinopathy, and Diabetic foot ulcers.
2.2 Random/ Fasting/ PP glucose testing, Impaired glucose tolerance (IGT), Impaired fasting glucose (IFT), Diagnosis-by GTT, Pre-diabetes, Gestational DM.
2.3 Glycosylated Hemoglobin (HBA1c); Glycated albumin., Hypoglycemia and critical alert value for glucose.
2.4 Markers of complications of Diabetes mellitus: Metabolic Syndrome.
2.5 Lipid profile &lipoproteinemia, Atherosclerosis, Diabetic nephropathy, Microalbuminuria, eGFR. Point of care testing for glucose (Glucometers) and continuous glucose monitoring (CGM)-principle and its use.
2.6 Major groups of anti-diabetic drugs. Diet and lifestyle modifications</td></tr>
</table>

	UNIT III (18 hours) (K1, K2, K3, K4, K5 & K6) **Diagnostic Enzymology:** 3.1 Clinically Important of Enzymes and Isoenzymes as diagnostic markers: Clinical significance of AST, ALT, ALP, ACP, CK, γ-GT, amylase, pseudocholinesterase and their pattern in Myocardial infarction, Liver disease, Bone disease, Muscle disease. 3.2 Cancer and tumor markers, GI tract pancreatitis, Enzymes as therapeutic agents. **Pre- and post-natal testing:** 3.3 Amniocentesis, prenatal detection of inborn errors of metabolism in developing fetus. 3.4 Autosomal recessive mode of inheritance- cystic fibrosis, X linked recessive inheritance-Duchenne muscular dystrophy. 3.5 Newborn screening (NBS) for Inborn errors of metabolism. 3.6 Tandem mass spectrometry application in NBS.
	UNIT IV (18 hours) (K1, K2, K3, K4, K5 & K6) **Liver function tests:** 4.1 Liver function test panel, Fatty liver. 4.2 Plasma protein changes in liver diseases. 4.3 Hepatitis A, B and C. Liver Cirrhosis, and fibrosis. Portal hypertension and hepatic coma. 4.4 Acute phase proteins - CRP, Haptoglobins, α-fetoprotein, ferritin and transferrin and their clinical significance. 4.5 Interpreting serum protein electrophoresis. 4.6 Inflammatory markers (cytokines such as TNF-alpha IL6 and others)
	UNIT V (18 hours) (K1, K2, K3, K4, K5 & K6) **Renal function tests:** 5.1 Tests for glomerular and tubular function-Acute and chronic renal failure, Glomerulonephritis, Nephrotic syndrome, uricemia-urinary calculi. 5.2 Nephrocalcinosis and Nephrolithiasis-causes, pathology, and symptoms-chronic kidney disease. Dialysis-Hemodialysis and peritoneal dialysis. **Electrolyte disorder:** 5.3 Calcium: hypercalcemia and hypocalcemia; Calcium homeostasis in Blood, phosphate: hyperphosphatemia, or hypophosphatemia. 5.4 Clinical significance: Potassium, hyperkalemia and hypokalemia, Sodium: hypernatremia and hyponatremia; Chloride: hyperchloremia, hypochloremia **Hormonal disorders and diagnostics:** 5.5 T3, T4 and TSH in the diagnosis of thyroid disorders. 5.6 Diagnostic methods for disorders associated with adrenal, pituitary and sex hormones - Addison's disease, Cushing's syndrome, pituitary tumour, Hypopituitarism, Hypogonadism.

Extended Professional Component (is a part of internal component only, not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text Books	1. Thomas M. Devlin, 2014, Textbook of Biochemistry with clinical correlations, 7th Edition, John Wiley & Sons. 2. Montgomery R, Conway TW, Spector AA, 1996, Biochemistry A Case-Oriented Approach, 6th Edition, Mosby Publishers, USA. 3. Tietz, Fundamentals of Clinical Chemistry and Molecular Diagnostics, 2018, 8th Edition, Saunders 4. Dinesh Puri, 2020, Textbook of Biochemistry, 4th Edition, Elsevier. 5. Chatterjee M N and Rana Shinde, 2012, Textbook of Medical Biochemistry, 8th Edition, Jaypee Brothers Medical Publishers.
Reference Books	1. Gowen AH Lock, 2009, Varley's Practical Clinical Biochemistry, 5th Edition. 2. Carl A Burtis, 2017, Fundamental of Clinical chemistry, 8th Edition, Harcourt Private Limited. 3. Philip D Mayne, 1994, Clinical chemistry in diagnosis and treatment, 6th Edition, ELBSP Publications.
Web resources	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.youtube.com/watch?v=fKtRChdX5wc&t=132s 3. https://www.britannica.com/science/metabolic-disease/Disorders-of-carbohydrate- metabolism 4. https://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests 5. https://onlinecourses.nptel.ac.in/noc20_ge13/preview

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	M	H	M
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	M	H	L	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	M	H	H	H
CO4	H	H	H	H	H	H
CO5	H	M	H	H	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">LABORATORY COURSE ON CLINICAL BIOCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core IX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core Practical</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td>Course Code</td><td>PCBCI24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">6</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To instill skill in students enabling them to apprehend the wider knowledge about principles and techniques to be employed for the investigation of biological samples, clinical approach, normal values of biochemical constituents and clinical interpretations.
• To inculcate the knowledge of collection, preservation of blood sample and learning various hematological parameters and their significance.
• To perform experiments to assess cardiac, kidney and liver functions. And also to study the marker enzymes for the respective organs.
• To learn basic immuno techniques antigen –antibody reactions.
• To introduce visit to hospital so that students may be aware of Phleobotomy, collection and storage of specimen, Good laboratory practices, Automation and current methods adopted in the diagnostic labs and perform data analysis using MS Excel</td></tr>
<tr><td>Course Outline</td><td colspan="7">Hematology (15 hours) (K1, K2, K3, K4, K5 & K6)
1. Enumeration of RBC and WBC
2. Total and differential count of WBC
3. Determination of ESR, PCV, MCV, Bleeding Time and Clotting time
4. Estimation of haemoglobin.
5. Determination of Electrolytes: Sodium and Potassium</td></tr>
<tr><td></td><td colspan="7">Liver Function Test (15 hours) (K1, K2, K3, K4, K5 & K6)
1. Estimation of Bilirubin – Direct and indirect method
2. Estimation of plasma protein and A/G ratio
3. Determination of globulins using Thymol turbidity test
4. Determination of Prothrombin time
5. Assay of SGOT and alkaline phosphatase.</td></tr>
<tr><td></td><td colspan="7">Renal Function Test (15 hours) (K1, K2, K3, K4, K5 & K6)
1. Collection and preservation of urine sample
2. Qualitative tests for normal and pathological components of urine
3. Estimation of blood urea
4. Estimation of blood creatinine
5. Estimation of uric acid</td></tr>
<tr><td></td><td colspan="7">Sugar and Lipid Profile (15 hours) (K1, K2, K3, K4, K5 & K6)
1. Estimation of blood glucose by orthotoluidine and glucose oxidase method
2. Determination of glycosylated Hb- Kit method.
3. Lipid profile: Estimation of cholesterol by Zak’s method
4. Determination of lipoprotein profile</td></tr>
</table>

	Immunology (Group Experiment) (15 hours) (K1, K2, K3, K4, K5 & K6) 1. Antigen – Antibody Reaction – HCG Kit method, RA kit method 2. Phlebotomy – Venipuncture, Different techniques of venipuncture. 3. Collection of blood, serum or plasma separation and storage 4. Automation in clinical biochemistry – Auto analyser and semiauto analyser. 5. Isoenzyme separation of LDH by electrophoresis.

Text Book	1. Alan H Gowenlock, 1988, Practical Clinical Biochemistry, 6th Edition, CBS Publishers and distributors, India. 2. Shivananda Nayak B, 2013, Manipal Manual of Clinical Biochemistry 5th Edition, Jaypee Brothers Medical Publishers.
Reference Books	1. Rajesh Kawaduji Jambhulkar, Abhijit D Ninghot, 2019, Case Oriented Approach in Biochemistry 1st Edition, IP Innovative Publicaiton. 2. Kanai L Mukerjee, 1996, Medical Lab Technology Vol I& II, New Delhi:Tata Mcgraw Hill Publishing Company 3. Plummer, 2000, Practical Biochemistry 1st Edition, New Delhi: Tata Mcgraw Hill Publishing Company. 4. Sawhney SK, Randhir Singh, 2005, Introductory practical Biochemistry 2nd Edition, Alpha Science International. 5. Rafi MD, 2023, Manual of Practical Biochemistry, 4th Edition, Orient Blackswan.
Web resources	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.https://www.researchgate.net/publication/260182512_Practical_Manual_in_Biochemistry_and_Clinical_Biochemistry. 3. https://main.icmr.nic.in/sites/default/files/upload_documents/GCLP_Guidelines_2020_Final.pdfhttps://www.westgard.com/clia.html 4. https://www.researchgate.net/publication/263929434_Biochemistry 5. https://www.euro.who.int/__data/assets/pdf_file/0005/268790/WHOguidelines-on-drawing-blood-best-practices-in-phlebotomy-Eng.pdf.com/watch?v=3P50Ypr5YHY

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	H	L	M
CO2	H	H	L	M	L	H
CO3	H	H	H	H	M	H
CO4	H	M	L	H	L	H
CO5	H	M	L	H	L	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	L	M	L	M
CO2	H	H	H	M	M	M
CO3	H	H	L	M	L	M
CO4	H	M	M	H	L	M
CO5	H	M	M	H	L	M

<table>
<tr><td>Title of the Course</td><td colspan="7">MOLECULAR BIOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core X</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td>4</td><td>Course Code</td><td>PCBCJ24</td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To introduce the students to the process of inheritance, concepts of genes, genome, chromatin and chromosomes.
• To impart a thorough understanding of the key events of molecular biology, including the mechanisms of DNA replication, transcription and translation along with DNA repair mechanisms.
• To provide a detailed understanding of post transcriptional and posttranslational modifications and processing of eukaryotic RNA and proteins.
• To give a detailed explanation of transcriptional regulation with lac operon and tryptophan operon as examples.
• To impart adequate information of the types of regulatory RNAs along with key concepts of gene silencing.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3, K4, K5 & K6)
Law of inheritance and genome organization:
1.1 Mendel’s laws of inheritance-dominance-complete, incomplete and co-dominance, multiple alleles.
1.2 Gene mapping in haploids and diploids, recombination mapping-restriction mapping.
1.3 Modes of gene information transfer in bacterial- conjugation, transformation and transduction.
1.4 The bacterial chromosome, the eukaryotic genome- chromosome structure – Histones, Nucleosome, chromatin- heterochromatin, euchromatin, chromatin remodeling, DNAase hypersensitive sites.
1.5 Genome organization – the C-value paradox, reassociation kinetics, repetitive sequences, gene amplification, telomeres, pseudogenes, split genes.
1.6 Organelle genomes – mitochondrial and chloroplast genome.</td></tr>
<tr><td></td><td colspan="7">Unit II (18 hours) (K1, K2, K3, K4, K5 & K6)
Replication, mutation and recombination:
2.1 DNA replication and repair: Enzymes of replication, prokaryotic replication mechanisms, primosome & replisomes.
2.2 Eukaryotic DNA replication, the role of topoisomerases and telomerase.
2.3 Regulation of replication, difference between prokaryotic and eukaryotic replication.
2.4 Mutations -Types of mutations, mechanisms of mutations, mutagenic agents.
2.5 DNA repair mechanisms – Direct repair, excision repair, mismatch repair, recombination repair, SOS response, eukaryotic repair systems.
2.6 Recombination and mobile genetic elements- the Holliday model, the general recombination in E.coli, site specific recombination, transposons and retroposons.</td></tr>
</table>

	UNIT-III: (18 hours) (K1, K2, K3, K4, K5 & K6) **Transcription and translation:** 3.1 Transcription – Prokaryotic transcription-subunits of RNA polymerase, E. coli promoters, sigma factor and promoter recognition, alternative sigma factors, initiation, elongation, Rho-dependent and independent termination of transcription. 3.2 Eukaryotic transcription- Initiation, promoter elements, RNA polymerases, transcription factors. 3.3 Regulatory sequences in eukaryotic protein – coding genes, CpG islands, enhancers. 3.4 Translation – organization of the ribosome, the genetic code, evidence for a triplet code, deciphering the genetic code, wobble hypothesis, deviation in the genetic code, unusual codons. 3.5 Activation, initiation, elongation and termination of translation in E. coli. 3.6 The role of tRNA and rRNA, suppressor tRNAs and inhibitors of protein synthesis., Comparison of prokaryotic translation with eukaryotic translation.
	UNIT-IV: (18 hours) (K1, K2, K3, K4 K5 & K6) **Regulation of gene expression:** 4.1 Regulation of gene expression in prokaryotes-– Positive and negative control, the lac operon. 4.2 Identification of operator and regulator sequences by mutations, induction and repression. 4.3 Foot-printing and gel-shift assays for identification of protein-DNA interactions. 4.4 Catabolite repression. *Trp* operon – Attenuation, alternative secondary structures of *trp* mRNA. 4.5 Regulation of gene expression in eukaryotes- Response elements, DNA-binding motifs, steroid receptors. 4.6 Association of methylation and histone acetylation with gene expression.
	UNIT-V: (18 hours) (K1, K2, K3, K4, K5 & K6) **Post transcriptional and post translational modifications:** 5.1 Post transcriptional modifications in eukaryotes- RNA processing- mRNA 5' capping and 3'poly-adenylation, introns and exons. 5.2 RNA splicing - spliceosome assembly, alternative splicing, processing of tRNA and rRNA, self-splicing. 5.3 Ribozymes, RNA editing- substitution and insertion/deletion editing. Genome editing-CRISPR- Cas technology. 5.4 Post translational modification of proteins- Proteolytic cleavage, covalent modifications, glycosylation of proteins, disulfide bond formation. 5.5 Protein sorting – signal peptides, transport of secretory proteins, Golgi and post-golgi sorting, coated vesicles, targeting of mitochondrial, lysosomal and nuclear proteins. 5.6 Protein degradation-Ubiquitination of proteins, Protein folding-chaperones.

Extended Professional Component (is a part of internal component only, not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. Krebs JE, Goldstein ES, Kilpatrick ST, 2017, Lewin's Genes XII, 12th Edition, Prentice Hall, Delhi. 2. Watson JD, Baker TA, Bell S, Gann A, Levine M, Losick R, 2013, Molecular Biology of the Gene, 6th edition, Cold Spring Harbor Laboratory Press, New York.
Reference books	1. Alberts B, Bray D, Hopkin K, Johnson A, Lewis J, Raff M, Roberts K, Walter P, 2009, Essential Cell Biology, 3rd Edition, Garland Science, New York. 2. Lodish H, Arnold Berk, 2016, Molecular Cell Biology, 8th Edition, W. H. Freeman & Co, New York. 3. Gerald Karp, Janet Iwasa, Wallace Marshall, 2016, Karp's Cell and Molecular Biology: Concepts and Experiments, 8th Edition; Wiley, India. 4. Griffith AF, Doebley J, Peichel C, David A, Wassarman DA, 2020, An Introduction to Genetic Analysis, 12th Edition, Albion Press. W. H. Freeman & Co, New York. 5. Robert FW, 2011, Molecular Biology, 5th Edition, McGraw-Hill Education.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. Molecular Biology Free Online Course by MIT Part 3: RNA Uploaded by edX 3. https://mooc.es/course/molecular-biology/ 4. https://onlinecourses.swayam2.ac.in/cec20_ma13/preview 5. https://learn.genetics.utah.edu/ 6. https://www.cellbio.com/education.html 7. https://lifescienceinteractive.com/category/molecular-biology/

CO	Course Outcomes
On completion of the course, the students should be able to:	
CO1	Comprehend the organization of genomes, the molecular basis of DNA replication, recombination and transposition, the significance of these processes, the various ways in which the DNA can be damaged leading to mutations and lesions and the different ways in which they are repaired.
CO2	Gain knowledge about how genes are transcribed and translated in prokaryotes and eukaryotes and how these processes are regulated, recognize the nature of the genetic code and the various experimental approaches used to crack the code.
CO3	Acquire knowledge of the molecular basis of RNA processing and RNA splicing and the various human pathologies that can result from defects of RNA modification.
CO4	Comprehend the techniques of gene silencing and its applications.

CO5	Apply the knowledge they have gained in understanding the above vital life processes to enhancing their analytical and problem- solving skills and develop an interest to pursue high quality research

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	H	H	H	H
CO2	H	H	H	M	M	H
CO3	H	M	H	M	L	M
CO4	H	L	H	H	M	L
CO5	H	L	M	M	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	M	M	H	H	L
CO2	H	H	M	M	M	M
CO3	H	L	M	M	L	H
CO4	H	M	M	H	H	H
CO5	H	H	L	H	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE V A: BIOCHEMICAL TOXICOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective V-A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">PEBCI24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>1</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To understand the detailed study of biochemical basis of drugs and its toxicity, particularly their actions on living systems.
• To understand the relevance and methods to identify the chemotherapeutic value of drug.
• To understand the fundamentals of toxicology and dose- response relationships.
• To understand the toxicological drug testing procedures based on in vitro and animal studies.
• To understand biochemical pathways of drug toxicity and its manifestation on vital organs.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (6 hours) (K1, K2, K3, K4, K5 & K6)
Fundamentals of Toxicology and dose-Response and Relationships:
1.1 Introduction - Biomarkers criteria of toxicity.
1.2 New technologies evaluation of toxicity interactions.
1.3 Dose Response, Measurement of Dose-Response.
1.4 Relationships Linear Dose Response hormesis.
1.5 Hazard and Risk assessment duration and Frequency of Exposure and Effect.</td></tr>
<tr><td></td><td colspan="7">UNIT II (6 hours) (K1, K2, K3, K4, K5 & K6)
Factors Affecting Toxic Responses:
2.1 Disposition, Absorption.
2.2 Sites of absorption, distribution, Excretion.
2.3 Metabolism: Types of Metabolic change phase I reactions.
2.4 Metabolism: Types of Metabolic change Phase II reactions.
2.5 Control of Metabolism.
2.6 Detoxification mechanism</td></tr>
<tr><td></td><td colspan="7">UNIT III (6 hours) (K1, K2, K3, K4, K5 & K6)
Toxicity testing:
3.1 Test protocol, Genetic toxicity testing, Mutagenesis assay: In vitro test systems - Bacterial mutation tests-Reversion test.
3.2 Ames test, Fluctuation test, and Eukaryotic mutation test.
3.3 In vivo test system Mammalian mutation test-Host mediated assay and Dominant Lethal test.
3.4 Biochemical basis of toxicity: Mechanism of toxicity.
3.5 Disturbance of excitable membrane function, Altered Calcium homeostasis, Covalent binding to cellular macromolecules.
3.6 Genotoxicity, Tissue specific toxicity.</td></tr>
</table>

	UNIT IV (6 hours) (K1, K2, K3, K4, K5 & K6) **Toxic Responses to Foreign Compounds:** 4.1 Direct Toxic Action: Tissue lesions. 4.2 Mechanism and response in cellular toxicity. 4.3 Pharmacological, Physiological and Biochemical effects of toxicity. 4.4 Developmental Toxicology- Teratogenesis. 4.5 Immunotoxicity, Genetic Toxicity. 4.6 Chemical Carcinogenesis.
	UNIT V (6 hours) (K1, K2, K3, K4, K5 & K6) **Biochemical Mechanisms of Toxicity:** 5.1 Tissue Lesions: Liver Necrosis; kidney Damage; Lung Damage, Liver damage, Cardiac damage. 5.2 Neurotoxicity; Exaggerated and unwanted pharmacological effects, Physiological effects. 5.3 Biochemical Effects: Lethal Synthesis and Incorporation. 5.4 Interaction with specific Protein Receptors. 5.5 Teratogenesis; Immunotoxicity. 5.6 Multi-Organ Toxicity.

Extended Professional Component (is a part of internal component only, not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text Books	1. Ali S. Faqi DVM, 2024, A Comprehensive Guide to Toxicology in Nonclinical Drug development. 2. Curtis Klaassen and John Watkins, 2015, Essentials of Toxicology,3rd Edition, McGraw Hill. 3. Mary Durrant, 2019, Biochemical Pharmacology and Toxicology, Hayle Medical. 4. Robert C. Smart and Ernest Hodgson, 2018, Molecular and Biochemical Toxicology, 5th Edition, Wiley Publications. 5. Sigmund F. Zakrzewski, 2002, Environmental Toxicology, Oxford University Press, USA
Reference Books	1. Barry S. Levine, 2020, Principles of Forensic Toxicology, Springer. 2. Casarett and Doull, 2022, Toxicology, 9th Edition, McGraw Hil. 3. John A. Timbrell, Principles of Biochemical Toxicology, Informa Healthcare 4. Karen E Stine, Thomas M Brown, 2006, Principles of Toxicology. 5. Meloni M D and M Mastenbjork MD, 2022, Pharmacology, A Comprehensive Reference guide.
Web resources	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://pdfroom.com/books/case-studies-in-medical toxicology-from-the-american-college-of-medical-toxicology/9zk2Aqwo2PJ 3. https://onlinelibrary.wiley.com/doi/book/10.1002/0471646776 4. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119122357 5. https://www.freebookcentre.net/medical_text_books_journals/toxicolo

	gyebooks_online_texts_download.html 6. https://www.scijournal.org/articles/pharmacology-toxicology-and-pharmaceutics-books

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	M	H
CO2	H	M	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	L	H
CO2	H	H	H	M	H	H
CO3	H	H	H	M	M	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE V B: NANOTECHNOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective V-B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td>PEBCJ24</td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>1</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To get a fundamental introduction about nanoscience and nanotechnology.
• To understand the basics of quantum mechanics.
• To learn the structure and interactions of nanomaterials.
• To understand the properties of nanomaterials.
• To learn and apply the techniques for characterization of nanomaterials.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (7 hours) (K1, K2, K3, K4, K5 & K6)
Foundation of Nanoscience and nanotechnology:
1.1 Basics of molecular spectroscopy. Idea about spectra- FWHM, Fourier transformation.
1.2 Signal to Noise ratio- Natural broadening- Doppler Broadening- Homogeneous broadening.
1.3 Basics of quantum mechanics. Limitations of classical mechanics, introduction to quantum mechanics, contributions of Heisenberg, Dirac, and Schrodinger.
1.4 Concept of de Broglie wave, interpretation of wave equation, postulates of quantum mechanics, operators, eigen function, particle in a box, harmonic oscillator.
1.5 Born – Oppenheimer approximation, hydrogen atom, uncertainty principle, photoelectric effect.
1.6 Basics of optics, basic principle of microscopy, plasmonics, nanospectroscopy, nanooptics, photonic crystal.</td></tr>
<tr><td></td><td colspan="7">Unit II (7 hours) (K1, K2, K3, K4, K5 & K6)
Properties of Nanomaterials- I
2.1 Crystal structure: crystal lattices, space lattices, basis and crystal structure, unit cell, lattice parameter of a unit cell - Seven crystal systems - Bravais lattices.
2.2 Crystal directions and crystal planes (Miller indices) - Coordination number, radius ratio, packing factor.
2.3 Atomic bonding in solids, Types of bond: Metallic, Ionic, Covalent, Co-ordination/dative bonds.
2.4 Vander Waals interactions/Electrostatic interactions: Ion pair interactions, solvent effects, Ion-dipole and dipole – dipole interactions, π-interactions - Hybridization, Hydrogen bonding - hydrophobic interactions.
2.5 Bonding in Nanostructures: Graphene – Fullerenes – Carbon nanotubes - Bonding in armchair, zigzag and chiral structures - n-m=3q rule – Inorganic nanotubes: Silica nanotubes, boron nitride nanotubes, nanotubes of dichalcogenides, and nanotubes of several metal oxides.
2.6 Reactivity on nanosurfaces: Functionalization of carbon nanotubes and Graphene.</td></tr>
</table>

	UNIT-III: (7 hours) (K1, K2, K3, K4, K5 & K6) **Properties of Nanomaterials- II** 3.1 Electrical properties: Classification of materials, Band structures, Brillouin zones – Electrical and electronic conductivity, Hall effect and its determination. 3.2 Dielectric Properties: Different kinds of dielectric materials, dielectric constant and its determination – Piezoelectric, pyroelectric and ferroelectric materials. 3.3 Optical Properties: Photoconductivity, Optical absorption and transmission - Photoluminescence, Jablonski diagram, fluorescence and phosphorescence – Electroluminescence. 3.4 Mechanical behavior Stress-strain behavior, tensile strength, toughness, micro-hardness, wear resistance, corrosion resistance behavior of nanostructures. 3.5 Thermal properties: Concept of phonon, thermal conductivity, thermal expansion and thermal expansion coefficient. 3.6 Magnetic properties: Fundamentals of magnetism - Different kinds of magnetic materials: dia, para, ferro, ferri and anti-ferromagnetic materials - Magnetic hysteresis – Superparamagnetism – Important properties in relation to nano-magnetism.
	UNIT-IV: (7 hours) (K1, K2, K3, K4, K5 & K6) **Synthesis of Nano materials** 4.1 Chemical methods I: Synthesis of semiconductor nanoparticles, nanowires, quantum dots, nanoclusters, metal oxide nanoparticles- ZnO, TiO2. 4.2 Chemical methods II: Metal nanoparticle by reduction, Nanoparticle synthesis of different types of metals (Cu, Ag, Au, Pd, Pt), synthesis of nanoparticles having different size, shapes and facet selective synthesis. 4.3 Top-down methods: Lithography, Electron beam lithography, Ion beam lithography, X-ray lithography, UV lithography, Synthesis of nanomaterials by Laser ablation- chemical vapour deposition- Molecular beam epitaxy. 4.4 Nano-polymer, carbon-based nanostructures - carbon nanotube, graphene, fullerenes. 4.5 Biological methods of nanoparticle synthesis by bacteria, fungi, algae, plants, mechanism of formation, use of viruses as components of nanostructured materials, electrospinning of nanofibers. 4.6 Green synthesis of nanoparticles, biomaterial-based metallic nanowires
	UNIT-V: (7 hours) (K1, K2, K3, K4 & K5) **Characterization of Nanomaterials** 5.1 Spectral characterization: Absorption, Emission, Circular Dichroism Spectroscopy (CD). 5.2 Optical Rotatory Dispersion (ORD)- InfraRed (IR)- Raman spectroscopy and Surface Enhanced Raman Spectroscopy (SERS). 5.3 Electron energy loss spectroscopy (EELS)-Photoelectron spectroscopy (PES), X-Ray Photoelectron Spectroscopy (XPS). 5.4 Structural characterization: X-ray diffraction- Transmission electron microscopy (TEM). 5.5 Scanning electron microscopy (SEM)-Selected Area Diffraction (SAED) -Energy dispersive X-ray spectroscopy (EDAX).

	5.6 Surface characterization: Scanning tunneling microscope (STM)- Atomic force microscopy (AFM) - Scanning transmission electron microscopy (STEM)- High-angle annular dark-field microscopy (HAADF).

Extended Professional Component (is a part of internal component only, not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. Fiorani D, 1994, Fundamental Properties of Nanostructured Materials, World Scientific, Singapore. 2. Sanjay Mathur and Mrityunjay Singh, 2008, Nanostructured Materials and Nanotechnology, 2nd Edition, Willey. 3. Tilley, and Richard JD, 2004, Understanding Solids: The Science of Materials, John Wiley & Sons.
Reference books	1. Guozhong Cao, 2004, Nanostructures & Nanomaterials Synthesis, Properties G; Z, Applications, World Scientific Publishing Pvt. Ltd., Singapore. 2. Nalw HS, Encylopedia of Nanoscience and Nanotechnology, 4th Edition, American scientific publishers. 3. Massimiliano Diventra, 2007, Introduction to Nanoscale Science and Technology. 4. Sergey Edward Lyshhevski, 2005, Nanoscience and Nanotechnology, 4th Edition. 5. Carl C. Koch, 2004, Nanostructured Materials, Noyes Publications, New York.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.youtube.com/watch?v=irGJ6dmcZfI 3. https://www.youtube.com/watch?v=uUDWK4MGcr0 4. https://www.youtube.com/watch?v=aFU5Qx-cLu8 5. https://www.youtube.com/watch?v=3wFh0z7so8w 6. https://www.youtube.com/watch?v=EvqAmrIkV1s

CO	Course Outcomes
On completion of the course, the students should be able to:	
CO1	Discuss on the fundamentals of nanoscience and nanotechnology
CO2	Outline the structure and bonding of nanomaterials.
CO3	Discuss the properties of nanomaterials.
CO4	Create knowledge to develop Nanomaterials.
CO5	Apply the knowledge in characterization of nanoparticles.

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	L	M	L	M	H
CO2	H	M	H	H	M	H
CO3	H	M	H	M	H	M
CO4	H	H	H	H	L	L
CO5	H	H	M	H	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	L	M	M	M	H
CO3	H	H	M	L	H	H
CO4	H	M	H	H	H	M
CO5	H	L	H	H	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">SEC: MOLECULAR BASIS OF DISEASES AND THERAPEUTIC STRATEGIES</td></tr>
<tr><td>Paper No.</td><td colspan="7">Skill Enhancement Course -II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td>Course Code</td><td>PSBC224</td></tr>
<tr><td>Semester</td><td>III</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>1</td><td>1</td><td colspan="3">-</td><td colspan="2">2</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">● To understand the concepts of the mechanisms involved in regulation of blood sugar and management of diabetes mellitus.
● To gain in-depth knowledge of the mechanisms of cancer and of tumor metastasis.
● The student will review the basic organization of the central and peripheral nervous system that coordinates the sensory and motor functions of the body. In addition, the student will explore impaired features underlying the major neuropathological complications.
● To gain knowledge in renal diseases.
● To understand the mechanisms involved in cardiac disorders</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (6 hours) (K1, K2, K3, K4, K5 & K6)
Diabetes:
Mechanism of blood sugar regulation in the human body. Pathophysiology of Type I and II diabetes. Diabetes – Investigation methods for the diagnosis of diabetes, Nutritional care, Complications related to diabetes, Diabetic cardiovascular disease, Retinopathy, Neuropathy and Nephropathy, Cellular and molecular mechanism of development of diabetes, Management of Type I and Type II diabetes, Drugs for the treatment of diabetes.</td></tr>
<tr><td></td><td colspan="7">UNIT II (6 hours) (K1, K2, K3, K4, K5 & K6)
Cancer:
Biology of cancer: Overview of hallmarks of cancer, Tumorigenesis and Tumor progression, Mechanism of Metastasis. Proto-oncogene to oncogene. Oncogene-myc and src family, Tumor suppressor gene-Rb and p53 pathway in cancer, Molecular techniques in cancer diagnosis - Non-invasive imaging techniques, Interventional radiology, new imaging technique. Treatment of cancer- surgery, radiotherapy, chemotherapy, hormonal treatment, and biological therapy, Introduction to personalized medicine.</td></tr>
<tr><td></td><td colspan="7">UNIT III (6 hours) (K1, K2, K3, K4, K5 & K6)
Neuronal disorders:
Brain – Parts and functions, Neuronal network – Memory. Neurogenerative diseases - Parkinson Disease. Neurogenerative diseases - Alzheimer Disease. Molecular understanding of the neurodegenerative diseases. Neurodegenerative diseases -Treatment modalities</td></tr>
<tr><td></td><td colspan="7">UNIT IV (18 hours) (K1, K2, K3, K4, K5 & K6)
Renal failure:
Acute renal failure: Cause, Symptoms, and treatment. Chronic renal failure: Cause, Symptoms, and treatment. Glomerular diseases – Glomerulonephritis. Nephritic syndrome – Cause, Symptoms and treatment. Diabetes insipidus: Cause, Symptoms, and treatment. Diagnosis of kidney disease.</td></tr>
</table>

	UNIT V (18 hours) (K1, K2, K3, K4, K5 & K6) **Cardiovascular diseases:** Introduction to cardiovascular diseases. Lipids and lipoproteins in coronary heart disease. Cardiac enzymes. Molecular changes during cardiac remodeling. Hypertrophy of hearts. Heart failure - Treatment modalities.

Extended Professional Component (is a part of internal component only, not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text Books	1. Ambika Shanmugam's, Biochemistry for medical students, 8th Edition, published by Wolters Kluwer India Pvt. Ltd. 2. Feuer G and La lglesia F, 2021, Molecular Biochemistry of Human Diseases, CRC Press. 3. Kalpana L A, Perce A J, 2009, Clinical Chemistry, 5th Edition. 4. Nandha Maheswari, 2017, Clinical Biochemistry, 2nd Edition, Jaypee Medical Publish. 5. Thomas H, Gillham B, Biochemical Basis of Medicine, 2nd Edition, Elsevier
Reference Books	1. Gowen A H lock, 2009, Varley's Practical Clinical Biochemistry, 5th Edition. 2. Carl A Burtis, 2017, Fundamental of Clinical chemistry, 8th Edition, Harcourt Private Limited. 3. Philip D Mayne, 1994, Clinical chemistry in diagnosis and treatment, 6th Edition, ELBSP Publications. 4. Thomas M. Devlin, 2014, Textbook of Biochemistry with clinical correlations 7th Edition, John Wiley, and sons. 5. Saunder, 2014, Tietz Fundamentals of Clinical chemistry and molecular Diagnostics, 7th Edition.
Web resources	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.britannica.com/science/metabolic-disease/Disorders-of-carbohydrate- metabolism 3. https://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests 4. https://onlinecourses.nptel.ac.in/noc20_ge13/preview 5. https://pdfroom.com/books/clinical-biochemistry-an-illustrated-text-5e/v0K2lGPZgap

CO	Course Outcomes
On completion of this course, students will be able to	
CO1	To understand overall view about the complications of diabetes mellitus and its management.
CO2	Comprehensive understanding of the concepts of cancer biology and implicating the theoretical concepts for further research
CO3	To understand and appreciate the pathophysiology of conditions affecting the nervous system.
CO4	To gain a thorough knowledge of renal and cardiac diseases with emphasis related to mechanistic aspects and therapeutic interventions.

CO5	To gain a thorough knowledge on the experimental models of non- communicable diseases that will be applied for future research or project dissertation. An in-depth knowledge on development of drugs against non-communicable diseases.

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	M	M
CO2	H	H	H	H	H	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	H	M
CO5	H	H	H	H	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	H	L
CO2	H	H	H	H	H	M
CO3	H	H	H	H	H	H
CO4	H	H	M	H	H	H
CO5	H	H	H	M	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">GENE EDITING, CELL AND GENE THERAPY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core XI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td>PCBCK24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To train the student in techniques related to the molecular basis of genetic diseases and to incorporate skills essential for various types of sequencing.
• To inculcate practical knowledge on comparing the animal models used to model genetic diseases
• To introduce and also elaborate knowledge about wide varieties of vectors and their features in addition to their applications.
• To identify the viral and non-viral gene transfer techniques
• To educate about the characteristics of cell culture, therapeutic strategies in gene therapy with relevant safety/ethics involved and patents as well.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3, K4, K5 & K6)
Gene Editing Basics and Principles
1.1 Gene Editing: Basis of gene editing Gene, DNA repair mechanisms.
1.2 Double strand DNA breaks, Nonhomologous End-Joining (NHEJ), Homology directed repair.
1.3 Programmable nucleases for gene editing, Mega nucleases, Zinc-Finger nucleases.
1.4 Transcription Activator-Like Effector Nucleases (TALEN)
1.5 CRISPR-Cas systems, gene editing using CRISPR-Cas, drawbacks and major challenges to present gene editing techniques.
1.6 Gene editing for human disease therapy.</td></tr>
<tr><td></td><td colspan="7">UNIT II (18 hours) (K1, K2, K3, K4, K5 & K6)
Gene Therapy Types
2.1 Gene and cell therapy: Basics of Gene and cell therapy
2.2 Types of gene therapy, gene therapy strategies.
2.3 Therapeutic targets for gene therapy, choice of the therapeutic target.
2.4 Administration routes, delivery systems, expression of transgene, and persistence of the gene therapy.
2.5 Cell targeting, immunological response to the therapy.
2.6 Ethical and legal issues, concerns about gene and cell therapy.</td></tr>
</table>

	UNIT III (18 hours) (K1, K2, K3, K4, K5 & K6) **Vectors for Gene therapy and Gene transfer Methods** 3.1 Vectors for Gene therapy: Non-viral and viral vectors for gene therapy. 3.2 Physical methods of gene delivery, Polymer, Lipid and inorganic material based chemical systems for gene delivery. 3.3 Viral vectors, Lentiviral, Adenoviral, Adeno-associated virus, Herpes Simplex virus, vaccinia, baculoviral vectors for gene delivery. 3.4 Choice of viral vector and oncolytic virus. 3.5 Gene therapy applications. 3.6 Gene therapy for cancer, suicide and oncolytic gene therapy.
	UNIT IV (18 hours) (K1, K2, K3, K4, K5 & K6) **Stem Cells** 4.1 Stem cells and tissue regeneration: Adult and fetal stem cells. 4.2 Embryonic stem cells- cell reprogramming, induced pluripotent stem cells (iPSC). 4.3 Chemically induced pluripotent stem cells (CiPSC). 4.4 Reprogramming factors. 4.5 iPSC derived progenitors 'cells, organoids. 4.6 Three dimensional (3D) bioprinting.
	UNIT V (18 hours) (K1, K2, K3, K4, K5 & K6) **Ethics in stem cell and gene therapy** 5.1 Regulatory and ethical considerations of stem cell. 5.2 Regulatory and ethical considerations of gene therapy. 5.3 Pluripotent stem cell-based cell replacement therapies. 5.4 Assessing human stem cell safety. 5.5 Use of genetically modified stem cells in experimental gene therapies. 5.6 Technological challenges towards development of pluripotent stem cell-based cell replacement therapies.

Extended Professional Component (is apart of internal component only, not to be included in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text Books	1. Daniel Marshak, Richard L. Gardener and David Gottlieb, 2001, Stem Cell Biology, 1st Edition, Cold Spring Harbour Laboratory Press. **2.** Peter J. Quesenberry, Gary S. Stein, Bernard F, Sherman W, 1998, Stem cell biology and gene therapy, 1st Edition, Wiley -Liss.
Reference Books	1. Pasternak JJ, 2005, An Introduction to Human Molecular Genetics: Mechanisms of inherited diseases, 2nd Edition, Wiley-Liss. 2. Thomas F. Kresina Upadhyay, SK, 2001, An Introduction to Molecular Medicine and Gene Therapy 1st Edition, Wiley-Liss. 3. Tom Strachan and Andrew Read, 2010, Human Molecular Genetics, 4th Edition, Garland Science.

	4. Stewart Sell MD, 2004, Stem Cells Handbook: 1st edition, Humana Press; Totowa NJ, USA. 5. Alexander Battler, Jonathan Leor, 2006, Stem Cell and Gene-Based Therapy: Frontiers in Regenerative, Springer.
Web resources	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.youtube.com/watch?v=_6ZBVf6H_IA 3. https://www.youtube.com/watch?v=eGD75uOPrxA 4. https://www.youtube.com/watch?v=bZfd0vUEFGs 5. https://www.youtube.com/watch?v=HeEqX_UGa0s 6. https://www.youtube.com/watch?v=62FdhX-zS2Y

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

CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	H	L	M
CO2	H	H	L	M	L	H
CO3	H	H	H	H	M	H
CO4	H	M	L	H	L	H
CO5	H	M	L	H	L	H

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	L	M	L	M
CO2	H	H	H	M	M	M
CO3	H	H	L	M	L	M
CO4	H	M	M	H	L	M
CO5	H	M	M	H	L	M

<table>
<tr><td>Title of the Course</td><td colspan="7">PHARMACEUTICAL BIOCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core XII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td>PCBCL24</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To understand the different types of bioinformatics tools for drug discovery.
• To get an overview of how different bioinformatics tools aid in the process of target identification, drug screening and quantitative structure activity relationship.
• To assimilate the involvement of different metabolic pathways involved in drug metabolism and correlate their involvement in elimination process.
• To understand the biochemical basis of drug action at the target tissue.
• To understand different phases in drug clinical trials and its assessment.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3, K4, K5 & K6)
Introduction:
1.1 Drug discovery and development, drug target identification and validation, Hit identification.
1.2 General principles of screening, correlations between various animal models and human situations.
1.3 Correlation between in-vitro and in-vivo screens.
1.4 Special emphasis on cell-based assay.
1.5 Biochemical assay, radiological binding assay.
1.6 Pharmacological assay, In vitro, In vivo & Ex-vivo experiments, lead optimization, preclinical studies.</td></tr>
<tr><td></td><td colspan="7">UNIT II (18 hours) (K1, K2, K3, K4, K5 & K6)
Bioinformatics approaches for drug development:
2.1 Identification of potential molecules, chemical compound library preparation.
2.2 Identification of target in pathogen, Ligand & protein preparation, Molecular docking.
2.3 Binding free energy estimation, High throughput virtual screening, Docking protocol validation and enrichment analysis.
2.4 Single point energy calculation, Pharmacokinetics and Pharmacodynamics, ADME & toxicity prediction.
2.5 Molecular dynamic simulation, Rule of three and five, Lipinski rule, Pharmacophore development, Quantitative structure activity relationship, 3D-QSAR.
2.6 Techniques of developing a pharmacophore map covering both ligands based and receptor-based approaches.</td></tr>
<tr><td></td><td colspan="7">UNIT III (18 hours) (K1, K2, K3, K4, K5 & K6)
Drug metabolism & interactions:
3.1 Drug-receptor interactions, receptor theories and drug action, Xenobiotics, xenobiotics phases (Phase-I, Phase-II and Phase-III).
3.2 Role of cytochrome P450 oxidases and glutathione S-transferases in</td></tr>
</table>

	drug metabolism, factors affecting drug metabolism. 3.3 Enzymes as a drug target, Kinase inhibitors, ATPase inhibitors, drug protein interaction, Drug DNA interaction. 3.4 Basic ligand concepts-agonist, antagonist, partial agonist, inverse agonist, efficiency and potency. 3.5 Forces involved in drug-receptor complexes. 3.6 Receptor classification – the four super families. Receptor binding assays- measurement of Kd, Bmax and IC_{50}.
	UNIT IV (18 hours) (K1, K2, K3, K4, K5 & K6) **Biochemical mode of action of antibiotics**: 4.1 Penicillin and chloramphenicol. 4.2 Actions of alkaloids, antiviral and antimalarial substances. 4.3 Biochemical mechanism of drug resistance- sulphonamides. 4.4 Drug potency and drug efficacy. 4.5 General principles of chemotherapy: chemotherapy of parasitic infections, fungal infections, viral diseases. 4.6 Introduction to immunomodulators and chemotherapy of cancer.
	UNIT V (18 hours) (K1, K2, K3, K4, K5 & K6) **Clinical trials:** 5.1 Clinical trials (Phase-I, Phase-II) 5.2 Clinical trials (Phase-III and Phase-IV). 5.3 Main features of clinical trials including methodological and organizational considerations. 5.4 The principles of trial conduct and reporting. 5.5 Key designs surrounding design, sample size, delivery. 5.6 Assessment of clinical trials.

Extended Professional Component (is apart of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. Kerns, EH, Lipinski CA, Thakker DR and Wang B, 2004, Pharmaceutical Profiling in Drug Discovery for Lead Selection, Borchardt RT, AAPS Press. 2. Rang HP, 2006, Drug Discovery and Development; Technology in Transition. Elsevier Ltd 1st Edition.
Reference books	1. Krogsgaard-Larsen, 2002, Textbook of Drug Design., Liljefors and Madsen (Editors), Taylor and Francis, London UK. 2. Wiley, 2005, Drug Discovery Handbook S.C. Gad (Editor), Hoboken USA. 3. Kenakin T. P, 2012, Pharmacology in Drug Discovery. Elsevier, 1st Edition. 4. Stromgaard K, 2022, Textbook of Drug Design and Discovery 5th Edition.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://www.youtube.com/watch?v=nirpkjciTNM&ab_channel=LevelUpR

	N 3. https://www.youtube.com/watch?v=gqoqexfqoBM&ab_channel=DrMatt%26DrMike 4. https://www.youtube.com/watch?v=v23FfMWbJfM&ab_channel=MedicalKnowledgeOnline 5. https://www.youtube.com/watch?v=z2XvrbRw7y8&ab_channel=Biotecnika

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	L	H	L	M
CO2	H	H	L	M	L	H
CO3	H	H	H	H	M	H
CO4	H	M	L	H	L	H
CO5	H	L	M	H	L	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	M	H	H	H	M
CO2	H	L	M	M	M	H
CO3	H	M	H	H	H	M
CO4	H	H	L	H	M	H
CO5	H	H	M	M	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE VI A: INDUSTRIAL MICROBIOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective VI-A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td>PEBCK24</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To gain knowledge of the structure, classification and use of microorganisms in various industries.
• To know various fermenter designs, culture systems and the application of fermentation process in industry.
• To understand the production and purification of fermented products and their industrial applications.
• Understand the basic concepts of food and agricultural microbiology</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (12 hours) (K1, K2, K3, K4, K5 & K5)
Microbes and their classifications
1.1 Structure of bacteria and its classification.
1.2 Structure of fungi and its classification.
1.3 Structure of viruses and their classification.
1.4 Types and characteristics of microorganisms used in food industry
1.5 Types and characteristics of microorganisms used in chemical industry.
1.6 Types and characteristics of microorganisms used in pharmaceutical industry.</td></tr>
<tr><td></td><td colspan="7">UNIT II (12 hours) (K1, K2, K3, K4, K5 & K6)
Fermentation and its types
2.1 Fundamentals and principles of microbial fermentation techniques.
2.2 Application in industry and pharmaceutical Biochemistry.
2.3 Fermentation – types, techniques, design and operation of fermenters including addition of medium.
2.4 Types and characteristics of microorganisms, environmental conditions required for the growth and metabolism of industrially and pharmaceutically important microbes.
2.5 Sterilization methods in fermentation techniques, air, gas, culture medium sterilization.
2.6 Steam-filtration and chemicals.</td></tr>
<tr><td></td><td colspan="7">UNIT III (12 hours) (K1, K2, K3, K4, K5 & K6)
Products from fermentation
3.1 Recovery and estimation of products of fermentation.
3.2 Production of ethanol, acetic acid, glycerol, acetone, butanol and citric acid by fermentation.
3.3 Production of Enzymes- amylase, protease, lipase.
3.4 Production of pharmaceuticals by fermentation– penicillin, streptomycin, tetracycline.
3.5 Production of riboflavin, vitamin B12.
3.6 Beverages-wine, beer and malt beverages.</td></tr>
</table>

	UNIT IV (12 hours) (K1, K2, K3, K4, K5 & K6) **Food Microbiology** 4.1 Food Microbiology: Production of dairy products-bread, cheese and yoghurt (preparation and their types). 4.2 Food borne diseases- Bacterial and Non- Bacterial. 4.3 Food preservation - Principles–Physical methods: temperature (low, high, canning, drying). 4.4 Irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging. 4.5 Chemical methods - salt, sugar, organic acids, SO2, nitrite and nitrates. 4.6 Ethylene oxide, antibiotics and bacteriocins.
	UNIT V (12 hours) (K1, K2, K3, K4 & K5) **Agricultural Microbiology** 5.1 General Properties of soil, microorganisms in soil. 5.2 Decomposition of organic matter in soil. 5.3 Biogeochemical cycles- nitrogen fixation. 5.4 Production of bio fertilizers and its field applications – Rhizobium, azotobacter, blue green algae, mycorrhizae, azospirilium. 5.5 Production of biofuels (biogas- methane). 5.6 Soil inoculants.

Extended Professional Component (is apart of internal component only, not to be included in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text Books	1. Kanunga R, 2017, Ananthanarayanan and Panicker's Text book of Microbiology, 10th Edition, Universities Press (India) Pvt. Ltd. 2. Chan E.C.S., Pelczar M. J. Jr. and Krieg N. R, 2010, Microbiology. 5th Edition. Mc.Graw Hill. Inc, New York. 3. Prescott L. M., Harley J. P. and Klein D. A, 2004, Microbiology, 6th Edition, McGraw - Hill Company, New York. 4. White D. Drummond J. and Fuqua C, 2011, The Physiology and Biochemistry of Prokaryotes, Oxford University Press, Oxford, New York. 5. Dubey R.C. and Maheshwari D. K, 2009, Textbook of Microbiology. S. Chand, Limited.
Reference Books	1. Pasternak J.J, 2005, An Introduction to Human Molecular Genetics: Mechanisms of inherited diseases, 2nd Edition, Wiley-Liss. 2. Thomas F. Kresina Upadhyay, S. K, 2001, An Introduction to Molecular Medicine and Gene Therapy 1st Edition, Wiley-Liss. 3. Tom Strachan & Andrew Read, 2010, Human Molecular Genetics, 4th Edition, Garland Science. 4. Stewart Sell M.D, 2004, Stem Cells Handbook: 1st Edition, Humana Press; Totowa NJ, USA. 5. Madigan M. T., Bender K.S., Buckley D. H. Sattley W. M. and Stahl, 2018, Brock Biology of Microorganisms, 15th Edition, Pearson.ed.

Web resources	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://nptel.ac.in/courses/102/105/102105058/ 3. https://nptel.ac.in/courses/102/106/102106053/ 4. https://nptel.ac.in/courses/126/103/126103017/ 5. https://www.youtube.com/watch?v=f7UXyVImZ_c 6. https://www.youtube.com/watch?v=3P50Ypr5YHY

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	H	L	M
CO2	H	H	L	M	L	H
CO3	H	H	H	H	M	H
CO4	H	M	L	H	L	H
CO5	H	M	L	H	L	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	L	M	L	M
CO2	H	H	H	M	M	M
CO3	H	H	L	M	L	M
CO4	H	M	M	H	L	M
CO5	H	M	M	H	L	M

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE VI B: RESEARCH METHODOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective VI-B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td>PEBCL24</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To introduce the basic concepts in research methodology.
• To addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project.
• To enable the students to prepare report writing and framing Research proposals.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (7 hours) (K1, K2, K3, K4, K5 & K6)
1.1 Scientific research & writing - Importance and need for research.
1.2 Ethics and scientific research. Formulation of hypothesis.
1.3 Types and characteristic designing a research work.
1.4 Scientific writing - Characteristics - Logical format for writing thesis and papers.
1.5 Essential features of abstract, introduction, review of literature, materials and methods, and discussion.
1.6 Effective illustration - tables and figures. Reference styles - Harvard and Vancouver systems.</td></tr>
<tr><td></td><td colspan="7">Unit II (7 hours) (K1, K2, K3, K4 K5 & K6)
2.1 Biostatistics - Collection and classification of data.
2.2 Diagrammatic and graphic representation of data measurement of central tendency.
2.3 Standard deviation - normal distribution.
2.4 Test of significance based on large samples - small samples - Student t test.
2.5 Correlation and regression.
2.6 Chi square test for independence of attributes - ANOVA.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (7 hours) (K1, K2, K3, K4, K5 & K6)
3.1 Bioinformatics - Introduction to bioinformatics.
3.2 Scope of bioinformatics.
3.3 Role of computers in biology.
3.4 Internet - The World Wide Web.
3.5 Useful search engines - Boolean searching, search engine algorithms.
3.6 Finding scientific articles – PubMed, Science direct.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: (7 hours) (K1, K2, K3, K4, K5 & K6)
4.1 Databases - Data base concepts - database, database system, database management systems - hierarchical, rational and network, database security.
4.2 Biological databases - types, sequence and structure.
4.3 Data submission.
4.4 Data retrieval.
4.5 Searching sequence databases - sequence similarity searches, amino acid substitution matrices.</td></tr>
</table>

	4.6 Database search - FASTA and BLAST, CLUSTAL.
	UNIT-V: (7 hours) (K1, K2, K3, K4, K5 & K6) 5.1 Bioethics. 5.2 Ethics in animal experimentation. CPCSEA guidelines - Animal care and technical personnel environment, animal husbandry, feed, bedding, water, sanitation and cleanliness, waste disposal, anesthesia and euthanasia. 5.3 Composition of (Human) institutional Ethical Committee (IEC) - General ethical issues. 5.4 Specific principles for chemical evaluation of drugs, herbal remedies and human genetics research 5.5 Ethics in food and drug safety. 5.6 Environmental release of microorganisms and genetically engineered organisms. Ethical issues in human gene therapy and human cloning. .

Extended Professional Component (is apart of internal component only, not to be included in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. C R Kothari, 2019, Research Methodology- Methods and Techniques, 4th Edition. 2. Ranjit Kumar, 2005, Research methodology- Pearson education.
Reference books	1. Bryan Bergeron MD, 2012, Bioinformatics Computing, Prentice-Hall of India Pvt. Ltd, 2012. 2. Bergeron BP, 2002, Bioinformatics Computing, Printice Hall, 1st Edition. 3. John M Lachin, 2000, Biostatistical Methods, Wiley interscience, 1st Edition. 4. Sundar Rao, 2012, Jesudian Richard, An Introduction to Biostatistics, 5th Edition.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. https://youtu.be/3FE5ldiIp6A 3. https://youtu.be/Coe0N2xb8kk 4. https://youtu.be/Nx_E4Z4y8uQ 5. https://youtu.be/Ap3rUxB4k9Q 6. https://youtu.be/kAxTbc6nsFs

CO	Course Outcomes
On completion of the course, the students should be able to:	
CO1	Design the research work.
CO2	Gain an idea on the role of biostatistics in research.
CO3	Understand the significance of internet in research.
CO4	Develop the understanding on database management system.
CO5	Practice the concepts of animal studies and CPCSEA guidelines in research.

CO/PSO	PSO 1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	M	M	H
CO2	H	H	M	H	M	H
CO3	H	L	H	M	H	M
CO4	H	M	L	M	H	M
CO5	H	M	M	H	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	M	H	M	M	M
CO3	H	H	M	H	H	M
CO4	H	H	L	H	M	M
CO5	H	M	H	H	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">DEVELOPMENTAL BIOLOGY AND ENDOCRINOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Professional Competency Skill</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td>Credits</td><td>2</td><td>Course Code</td><td>PPBC24</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>1</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">The candidates undertaking this course will understand the concepts of developmental biology and endocrinology
• To understand the background of developmental biology.
• To gain insights into morphogenesis and organogenesis.
• To gain insight into aspects of hormones.
• To acquire in-depth understanding of various endocrine glands.
• To understand the gonadal hormones.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (9 hours) (K1, K2, K3, K4, K5 & K6)
Principles of developmental biology – Potency, commitment, specification, induction, competence, determination and differentiation. Morphogenetic gradients; cell fate and cell lineages. Stem cells, genomic equivalence and the cytoplasmic determinants. Imprinting, mutants and transgenics in analysis of development. Gametogenesis – production of gametes, Formation of zygote. Fertilization and early development: molecules in sperm-egg recognition in animals.</td></tr>
<tr><td></td><td colspan="7">Unit II (9 hours) (K1, K2, K3, K4 K5 & K6)
Morphogenesis & Organogenesis: Cell aggregation and differentiation in Dictyostelium. Axes and pattern formation in Drosophila, amphibia and chick. Organogenesis – vulva formation in Caenorhabditis elegans, eye lens formation, limb development and regeneration in vertebrates, differentiation of neurons. Post embryonic development- larval formation, metamorphosis. Environmental regulation of normal development. Sex determination.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (9 hours) (K1, K2, K3, K4 & K5)
Hormones−Definition, chemical nature and classification. Mechanism of action of Group I and Group II hormones, Signal transduction and introduction to Hormonal receptors (Tyrosine receptors). Positive and negative feedback regulation of endocrine system. Hypothalamus and hypothalamic releasing factor. Pituitary hormones- Chemistry, secretion, functions and regulation - Anterior Pituitary hormones–GH, Pituitary tropic hormones (LH, FSH, TSH, ACTH and Prolactin). Chemistry, secretion, functions and regulation – Posterior Pituitary hormones (Vasopressin and Oxytocin).</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: (9 hours) (K1, K2, K3, K4 K5 & K6)
Thyroid – chemistry, synthesis, secretion, functions and regulations. Parathyroid hormones - chemistry, synthesis, secretion, functions and regulations. Pancreatic hormones - chemistry, secretion, functions and regulations (Insulin and Glucagon). Adrenal gland hormones: Adrenal cortex hormones - chemistry, secretion, functions and regulations (glucocorticoids and mineralocorticoids). Adrenal medullary hormones - chemistry, secretion, functions and regulations (Epinephrine and Nor-Epinephrine). Renin-angiotensin system.</td></tr>
</table>

	UNIT-V: (9 hours) (K1, K2, K3, K4 & K5) Chemistry, secretion, functions and regulations of Gonadal hormones – Testosterone, estrogen and Progesterone. Ovarian cycle and its regulation.

Extended Professional Component (is apart of internal component only, not to be included in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations NET/SET /GATE and others to be solved (To be discussed during the Tutorial hours)

Text books	1. Scott F. Gilbert, Susan R. Singer, 2006, Developmental biology, 8th Edition, Sinauer Associates, Inc. 2. Kleine B, Rossmanith WG, 2016, Hormones and the endocrine system: Textbook of endocrinology, 2nd Edition, Springer International Publishing.
Reference books	1. Peter J. Kennelly, Kathleen M. Botham, Owen P. McGuinness, Victor W. Rodwell, and P. Anthony Weil, 2023, Harper's Illustrated Biochemistry, 32nd Edition, McGraw Hill. 2. Ananthalakshmi R, Niyas Ahamed I, 2018, Introduction to Endocrinology: A Textbook of Hormones, LAP Lambert Academic Publishing. 3. Subramanian MA, 2019, Developmental Biology, MJP Publisher. 4. Jonathan MW Slack, Leslie Dale, 2021, Essential Developmental Biology, 4th Edition, John Wiley & Sons. 5. Twyman RM, 2000, BIOS Instant Notes in Developmental Biology, 1st Edition, CRC Press. 6. Williams RH, Larsen PR, 2003, Williams Textbook of endocrinology, Volume 355, Saunders. 7. Mala Dharmalingam, 2010, Text book of endocrinology, 1st Edition, Jaypee Brothers Medical Publishers Pvt. Limited.
Web resource	1. https://www.youtube.com/@biochemistryauxiliumcollege 2. http://bgc.org.in/pdf/study-material/developmental-biology-7th-ed-sf- gilbert.pdf 3. https://www.sdbonline.org/sites/archive/Other/VL_DB_EducaRes.html 4. https://www.biologyonline.com/tutorials/developmental-biology 5. https://www.ncbi.nlm.nih.gov/books/NBK22/ 6. https://www.rose-hulman.edu/~brandt/Chem330/EndocrineNotes/

CO	Course Outcomes
On completion of the course, the students should be able to:	
CO1	Grasp knowledge about the background of developmental biology.
CO2	Gain abundant knowledge about model organisms and gametogenesis.
CO3	Gain knowledge about basic of hormones and their applications.
CO4	Good knowledge about organogenesis.
CO5	Learn the basics of endocrine hormones and its functions.

CO/PSO	PSO 1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	H	H	H	H
CO2	H	H	H	H	M	M
CO3	H	H	H	M	H	L
CO4	H	M	L	H	M	M
CO5	H	M	M	M	H	H

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	L	M	M	H	H
CO2	H	H	M	H	H	M
CO3	H	H	H	M	M	L
CO4	H	M	M	M	H	H
CO5	H	H	L	H	L	H