M Sc BIOCHEMISTRY

LOCF SYLLABUS 2025

Department of Biochemistry

School of Biological Sciences

St. Joseph's College (Autonomous)

Tiruchirappalli - 620002, Tamil Nadu, India

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS) POSTGRADUATE COURSES

St. Joseph's College (Autonomous), an esteemed institution in the realm of higher education in India, has embarked on a journey to uphold and perpetuate academic excellence. One of the pivotal initiatives in this pursuit is the establishment of five Schools of Excellence commencing from the academic year 2014-15. These schools are strategically designed to confront and surpass the challenges of the 21st century.

Each School amalgamates correlated disciplines under a unified umbrella, fostering synergy and coherence. This integrated approach fosters the optimal utilization of both human expertise and infrastructure. Moreover, it facilitates academic fluidity and augments employability by nurturing a dynamic environment conducive to learning and innovation. Importantly, while promoting collaboration and interdisciplinary study, the Schools of Excellence also uphold the individual identity, autonomy, and distinctiveness of every department within.

The overarching objectives of these five schools are as follows:

1. Optimal Resource Utilization: Ensuring the efficient use of both human and material resources to foster academic flexibility and attain excellence across disciplines.

2. Horizontal Mobility for Students: Providing students with the freedom to choose courses aligning with their interests and facilitating credit transfers, thereby enhancing their academic mobility and enriching their learning experience.

3. Credit-Transfer Across Disciplines (CTAD): The existing curricular structure, compliant with regulations from entities such as TANSCHE and other higher educational institutions, facilitates seamless credit transfers across diverse disciplines. This underscores the adaptability and uniqueness of the choice-based credit system.

4. Promotion of Human Excellence: Nurturing excellence in specialized areas through focused attention and resources, thus empowering individuals to excel in their respective fields.

5. Emphasis on Internships and Projects: Encouraging students to engage in internships and projects, serving as stepping stones toward research endeavors, thereby fostering a culture of inquiry and innovation.

6. Addressing Stakeholder Needs: The multi-disciplinary nature of the School System is tailored to meet the requirements of various stakeholders, particularly employers, by equipping students with versatile skills and competencies essential for success in the contemporary professional landscape.

In essence, the Schools of Excellence at St. Joseph's College (Autonomous) epitomize a holistic approach towards education, aiming not only to impart knowledge but also to cultivate critical thinking, creativity, and adaptability – qualities indispensable for thriving in the dynamic global arena of the 21st century.

Credit system

The credit system at St. Joseph's College (Autonomous) assigns weightage to courses based on the hours allocated to each course. Typically, one credit is equivalent to one hour of instruction per week. However, credits are awarded regardless of actual teaching hours to ensure consistency and adherence to guidelines.

The credits and hours allotted to each course within a programme are detailed in the Programme Pattern table. While the table provides a framework, there may be some flexibility due to practical sessions, field visits, tutorials, and the nature of project work.

For postgraduate (PG) courses, students are required to accumulate a minimum of 92 credits, as stipulated in the programme pattern table. The total minimum number of courses offered by the department is outlined in the Programme Structure.

OUTCOME-BASED EDUCATION (OBE)

OBE is an educational approach that revolves around clearly defined goals or outcomes for every aspect of the educational system. The primary aim is for each student to successfully achieve these predetermined

outcomes by the culmination of their educational journey. Unlike traditional methods, OBE does not prescribe a singular teaching style or assessment format. Instead, classes, activities, and evaluations are structured to support students in attaining the specified outcomes effectively.

In OBE, the emphasis lies on measurable outcomes, allowing educational institutions to establish their own set of objectives tailored to their unique context and priorities. The overarching objective of OBE is to establish a direct link between education and employability, ensuring that students acquire the necessary skills and competencies sought after by employers.

OBE fosters a student-centric approach to teaching and learning, where the delivery of courses and assessments are meticulously planned to align with the predetermined objectives and outcomes. It places significant emphasis on evaluating student performance at various levels to gauge their progress and proficiency in meeting the desired outcomes.

Here are some key aspects of Outcome-Based Education:

Course: A course refers to a theory, practical, or a combination of both that is done within a semester.

Course Outcomes (COs): These are statements that delineate the significant and essential learning outcomes that learners should have achieved and can reliably demonstrate by the conclusion of a course. Typically, three or more course outcomes are specified for each course, depending on its importance.

Programme: This term pertains to the specialization or discipline of a degree programme.

Programme Outcomes (POs): POs are statements that articulate what students are expected to be capable of by the time they graduate. These outcomes are closely aligned with Graduate Attributes.

Programme Specific Outcomes (PSOs): PSOs outline the specific skills and abilities that students should possess upon graduation within a particular discipline or specialization.

Programme Educational Objectives (PEOs): PEOs encapsulate the expected accomplishments of graduates in their careers, particularly highlighting what they are expected to achieve and perform during the initial years postgraduation.

LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

The Learning Outcomes-Centric Framework (LOCF) places the learning outcomes at the forefront of curriculum design and execution. It underscores the importance of ensuring that these outcomes are clear, measurable, and relevant. LOCF orchestrates teaching methodologies, evaluations, and activities in direct correlation with these outcomes. Furthermore, LOCF adopts a backward design approach, focusing on defining precise and attainable learning objectives. The goal is to create a cohesive framework where every educational element is in harmony with these outcomes.

Assessment practices within LOCF are intricately linked to the established learning objectives. Evaluations are crafted to gauge students' achievement of these outcomes accurately. Emphasis is often placed on employing authentic assessment methods, allowing students to showcase their learning in real-life scenarios. Additionally, LOCF frameworks emphasize flexibility and adaptability, enabling educators to tailor curriculum and instructional approaches to suit the diverse needs of students while ensuring alignment with the defined learning outcomes.

Some important terminologies

Core Courses (CC): *These are compulsory courses that students must undertake as essential components of their curriculum, providing fundamental knowledge within their primary discipline. Including core courses is essential to maintain a standardized academic programme, ensuring recognition and consistency across institutions.*

Discipline Specific Elective Courses (ES): *Elective courses are offered within the main discipline or subject of study. They allow students to select specialized or advanced options from a range of courses, offering in-depth exposure to their chosen area of study. Typically, ES are more applied in nature and provide a deeper understanding of specific topics.*

Research Methodology/IPR(RM)*: It is a two-credit course offered in the third semester as a common program across disciplines within the school. It is designed to acquaint postgraduate learners with the research foundations and legal frameworks vital for innovation and entrepreneurship in technology and business.*

Open Elective Courses (OE): *These elective courses are chosen from disciplines unrelated to the student's main area of study, aiming to broaden their exposure and knowledge base. As per the Choice Based Credit System (CBCS) policy, students may opt for open elective courses offered by other disciplines within the college, enhancing the diversity of their learning experience.*

Ability Enhancement Course (AEC): *AE is designed to enhance skills and proficiencies related to the student's main discipline. It aims to provide practical training and hands-on experience, contributing to the overall development of students pursuing academic programmes.*

Skill Enhancement Course (SEC): *SE focus on developing specific skills or proficiencies relevant to students' academic pursuits. While it is open to students from any discipline, SE is particularly beneficial for those within the related academic programme.*

Self-Learning (SL): *A two-credit course designed to foster students' ability for independent and self-directed learning. There are* Three Self-Learning Courses:

- 'Global Citizenship Education' *a common online course offered to all PG students in Semester I on JosTEL.*
- *Compulsory MOOC on NPTEL-SWAYAM in Semester I or II*
- *A Department-Specific Self-Learning Course in Semester III on JosTEL*

Comprehensive Examination (CE): *These examinations cover detailed syllabi comprising select units from courses offered throughout the programme. They are designed to assess crucial knowledge and content that may not have been covered extensively in regular coursework.*

Extra Credit Courses: *To support students in acquiring knowledge and skills through online platforms such as Massive Open Online Courses (MOOCs), additional credits are granted upon verification of course completion. These extra credits can be availed across three semesters (2 - 4). In line with UGC guidelines, students are encouraged to enhance their learning by enrolling in MOOCs offered by portals like SWAYAM, NPTEL, and others. Additionally, certificate courses provided by the college are also considered for these extra credits.*

Outreach Programme (OR): *It is a compulsory course to create a sense of social concern among all the students and to inspire them to dedicated service to the needy.*

Course Coding

The following code system (10 alphanumeric characters) is adopted for Postgraduate courses:

25	**UXX**	**0**	**XX**	**00/X**
Year of Revision	PG Department Code	Semester Number	Course Specific Initials	Running Number/with Choice

Course Specific Initials

CC - Core Course
CP - Core Practical
ES - Discipline Specific Elective
AE - Ability Enhancement Course
SL - Self-Learning
OE – Open Elective
PW - Project and Viva Voce
CE - Comprehensive Examination
OR - Outreach Programme
IS – Internship
RM – Research Methodology

EVALUATION PATTERN (PG)

Continuous Internal Assessment

Sl No	Component	Marks Allotted
1	Mid Semester Test	30
2	End Semester Test	30
3	*Two Components (15 + 20)	35
4	Library Referencing	5
	Total	**100**

Passing minimum: 50 marks

* *The first component is a compulsory online test (JosTEL platform) for 15 marks comprising 7 questions (1 mark) at K1 level and 4 questions (2 marks) at K2 level;* The second component is decided by the course in-charge in accordance with the prescribed K levels.

Question Paper Blueprint for Mid and End Semester Tests

Duration: 2 Hours								**Maximum Marks: 60**
Section		**K levels**						**Marks**
		K1	**K2**	**K3**	**K4**	**K5**	**K6**	
A *(compulsory)*		7						7 × 1 = 7
B *(compulsory)*			5					5 × 3 = 15
C *(either…or type)*				3				3 × 6 = 18
D *(2 out of 3)*	Mid Sem				1 (2)	1*		2 × 10 = 20
	End Sem					1 (2)	1*	
							Total	**60**

***** *Compulsory*

Question Paper Blueprint for Semester Examination

Duration: 3 Hours						**Maximum Marks: 100**	
Section	**K levels**						**Marks**
	K1	**K2**	**K3**	**K4**	**K5**	**K6**	
A *(compulsory)*	10						10 × 1 = 10
B *(compulsory)*		10					10 × 3 = 30
C *(either…or type)*			5				5 × 6 = 30
D *(2 out of 3)*				1(2)	1(2)	1*	3 × 10 = 30
						Total	**100**

***** *Compulsory*

Evaluation Pattern for One/Two-credit Courses

Title of the Course	CIA	Semester Examination	Final
• Ability Enhancement Course	20 + 10 + 20 = 50	50 *(Department)*	100
• Self - Learning Course (Dept. Specific) • Comprehensive Examination	25 + 25 = 50	50 *(CoE)*	100
• Internship • Self - Learning Course (Common) • Self - Learning Online Course (NPTEL / SWAYAM)	100	-	100
• Skill Enhancement Course: Soft Skills	100	-	100
• Project Work and Viva Voce	100	100	100

Grading System

The marks obtained in the CIA and semester for each course will be graded as per the scheme provided in Table - 1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA), respectively. These two are calculated by the following formulae:

$$SGPA \ and \ CGPA = \frac{\sum_{i=1}^{n} C_i Gp_i}{\sum_{i=1}^{n} C_i}$$

$$WAM = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$$

Where,

Ci - credit earned for the Course i

Gpi - Grade Point obtained for the Course i

Mi - Marks obtained for the Course i

*n - Number of Courses **passed** in that semester*

WAM - Weighted Average Marks

Table - 1: Grading of the Courses for PG

Mark Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above and below 90	9	A+
70 and above and below 80	8	A
60 and above and below 70	7	B+
50 and above and below 60	6	B
Below 50	0	RA

Table - 2: Grading of the Final Performance for PG

CGPA	Grade	Performance
9.00 and above	O	Outstanding*
8.00 to 8.99	A+	Excellent*
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
Below 5.00	RA	Re-appear

**The Candidates who have passed in the first appearance and within the prescribed duration of the PG programme are eligible. If the Candidates Grade is O/A+ with more than one attempt, the performance is considered "Very Good".*

Vision

Forming globally competent, committed, compassionate and holistic persons, to be men and women for others, promoting a just society.

Mission

- Fostering learning environment to students of diverse background, developing their inherent skills and competencies through reflection, creation of knowledge and service.
- Nurturing comprehensive learning and best practices through innovative and value- driven pedagogy.
- Contributing significantly to Higher Education through Teaching, Learning, Research and Extension.

Programme Educational Objectives (PEOs)

1. Graduates will be able to accomplish professional standards in the global environment.
2. Graduates will be able to uphold integrity and human values.
3. Graduates will be able to appreciate and promote pluralism and multiculturalism in working environment.

Programme Outcomes (POs)

1. Graduates will be able to apply the concepts learnt, in real life situations with analytical skills.
2. Graduates with acquired skills and enhanced knowledge will be employable/ become entrepreneurs or will pursue higher Education.
3. Graduates with acquired knowledge of modern tools and communicative skills will be able to contribute effectively as team members.
4. Graduates will be able to read the signs of the times analyze and provide practical solutions.
5. Graduates imbibed with ethical values and social concern will be able to appreciate cultural diversity, promote social harmony and ensure sustainable environment.

Programme Specific Outcomes (PSOs)

1. Graduates are prepared to be creators of new knowledge in the field of life sciences, causing innovation and entrepreneurship, employable in various sectors such as private, government, and clinical /biomedical research organizations.
2. Graduates are trained to study and evolve the biomolecular mechanisms for the life processes in health and diseases.
3. Graduates are groomed to carry on research in biology on chemical basis, by exploring their knowledge independently.
4. Graduates are encouraged to design and conduct experiments, to analyze and interpret biological problems behind the research.
5. Graduates ought to have the ability of effectively communicating the findings of Biological sciences with existing knowledge ethically.

M. Sc. Biochemistry				
Programme Structure				
Semester	**Specification**	**No. of Courses**	**Hours**	**Credits**
1 – 4	Core Course	11	58	49
1 - 4	Core Practical	4	26	12
1, 3 & 4	Discipline Specific Elective	3	12	9
1 – 2	Open Elective	2	8	4
1	Ability Enhancement Course	1	2	1
1 – 3	Self-Learning	3	-	4
2	Skill Enhancement Course	1	4	2
3	Research Methodology	1	4	2
4	Project	1	6	3
4	Comprehensive Examination	1	-	2
2 – 4	Outreach Programme (SHEPHERD)	-	-	4
1 – 4	Extra Credit Course	4	-	12
	Total	**32**	**120**	**92 (12)**

M Sc BIOCHEMISTRY PROGRAMME PATTERN								
Course Details						Scheme of Exams		
Sem.	**Course Code**	**Course Type**	**Title of the Course**	**Hours**	**Credits**	**CIA**	**SE**	**Final**
1	25PBI1CC01	**CC Major**	**Core Course - 1:** Biomolecular Chemistry	5	5	100	100	100
	25PBI1CC02		**Core Course - 2:** Bioenergetics and Enzymology	5	4	100	100	100
	25PBI1CC03		**Core Course - 3:** Molecular Biology	5	4	100	100	100
	25PBI1CP01		**Core Practical - 1:** Biochemistry and Microbiology	5	2	100	100	100
	25PBI1ES01A	**DSE**	**Discipline Specific Elective - 1:** Microbiology	4	3	100	100	100
	25PBI1ES01B		**Discipline Specific Elective - 1:** Energy and Drug Metabolism					
	25PBI1AE01	**AEC**	**Ability Enhancement Course:** Herbal Technology	2	1	100	-	100
	25PBI1OE01	**OE**	**Open Elective - 1 (WS):** Biochemistry of Natural Products	4	2	100	100	100
	25PGC1SL01	**SL**	Global Citizenship Education (Online)	-	1	100	-	100
	-	-	Extra Credit Course	-	(3)			
			Total	**30**	**22 (3)**			
2	25PBI2CC04	**CC Major**	**Core Course - 4:** Genetic Engineering	5	4	100	100	100
	25PBI2CC05		**Core Course - 5:** Human Physiology	6	5	100	100	100
	25PBI2CC06		**Core Course - 6:** Clinical Biochemistry (Internship Embedded Course)	6	5	100	100	100
	25PBI2CP02		**Core Practical - 2:** Enzymology, Genetic Engineering and Molecular Biology	5	2	100	100	100
	25PBI2OE02	**OE**	**Open Elective - 2 (BS):** First Aid Management	4	2	100	100	100
	25PSS2SE01	**SEC**	**Skill Enhancement Course:** Soft Skills	4	2	100	-	100
	25PBI2SL02	**SL**	Online Courses: NPTEL / SWAYAM	-	2	-	100	100
	-	-	Extra Credit Course	-	(3)			
			Total	**30**	**22 (3)**			
3	25PBI3CC07	**CC Major**	**Core Course - 7:** Immunology	5	5	100	100	100
	25PBI3CC08		**Core Course - 8:** Developmental Biology	5	4	100	100	100
	25PBI3CC09		**Core Course - 9:** Analytical Biochemistry and Research Methodology	4	3	100	100	100
	25PBI3CP03		**Core Practical - 3:** Immunology, Andrology and Hormone Assay	8	4	100	100	100
	25PBI3ES02A	**DSE**	**Discipline Specific Elective - 2:** Advances in Clinical Research	4	3	100	100	100
	25PBI3ES02B		**Discipline Specific Elective - 2:** Life Sciences for Competitive Examinations					
	25SBS3RM01	**RM**	Intellectual Property Rights	4	2	100	100	100
	25PBI3SL03	**SL**	**Self Learning:** Advanced Nutrition*	-	1	50	50	50
	-	-	Extra Credit Course	-	(3)			
			Total	**30**	**22 (3)**			
4	25PBI4CC10	**CC Major**	**Core Course - 10:** Advanced Endocrinology	6	5	100	100	100
	25PBI4CC11		**Core Course - 11:** Pharmaceutics and Nanotechnology	6	5	100	100	100
	25PBI4CP04		**Core Practical - 4:** Hematology, Biochemical Analysis and Urology	8	4	100	100	100
	25PBI4ES03A	**DSE**	**Discipline Specific Elective - 3:** Fundamentals of Forensic Science	4	3	100	100	100
	25PBI4ES03B		**Discipline Specific Elective - 3:** Neuro biochemistry					
	25PBI4PW01	**PW**	Project Work and Viva Voce	6	3	100	100	100
	25PBI4CE01	**CE**	Comprehensive Examination*	-	2	50	50	50
			Extra Credit Course	-	(3)			
			Total	**30**	**22 (3)**			
2-4	25PCW4OR01	**OR**	Outreach Programme	-	4			
1-4			**Total**	**120**	**92 (12)**			

***For Grade Calculation:** Marks obtained out of 50 will be converted into 100 in the mark statements.

Open Elective - 1 (WS): 1st Semester

School	Course Code	Title of the Course
SBS		
Botany	25PBO1OE01	Medicinal Botany
Biochemistry	25PBI1OE01	Biochemistry of Natural Products
Biotechnology	25PBT1OE01	Medical Biotechnology

Open Elective – 2 (BS): 2nd Semester
Offered to students from other Schools

School	Course Code	Title of the Course
SBS		
Botany	25PBO2OE02	Sustainable Horticulture and Urban Landscaping
Biochemistry	25PBI2OE02	First Aid Management
Biotechnology	25PBT2OE02	Food Technology
SCS		
Artificial Intelligence and Machine Learning	25PAI2OE02	Cyber Security
Computer Science	25PCA2OE02A	Web Design
	25PCA2OE02B	Cyber Security
Information Technology	25PCS2OE02	Recent Trends in Computing
Data Science	25PDS2OE02	Discrete Mathematics
Mathematics	25PMA2OE02	Operations Research
Visual Communication	25PVC2OE02	Women and Media
SLAC		
English	25PEN2OE02	English for Digital Media
History	25PHS2OE02	Public Administration
Tamil	25PTA2OE02	விளம்பரக்கலை (Art of advertising)
SMS		
Commerce	25PCO2OE02	Basics of Tally Prime
Commerce Computer Application	25PCC2OE02	Behavioural Dynamics and Psychology
Counselling Psychology	25PCP2OE02	Artificial Intelligence in Psychology
Economics	25PEC2OE02	Managerial Economics
Human Resource Management	25PHR2OE02	Counselling and Guidance
SPS		
Chemistry	25PCH2OE02	Chemistry of Health and Nutrition
Electronics	25PEL2OE02	Computer Hardware and Networks
Physics	25PPH2OE02A	Physics for Competitive Exams
	25PPH2OE02B	Nanoscience

Semester	Course Code	Title of the Course	Hours	Credits
1	25PBI1CC01	**Core Course - 1:** Biomolecular Chemistry	5	5

Course Objectives
Students will be introduced to the structure of biomolecules.
The significance of carbohydrates in biological processes will be understood.
The structure, properties and biological significance of lipids in the biological system will be studied.
Students will learn about the concepts of protein structure and their significance in biological processes and creatively comprehend the role of membrane components with their biological significance.
Students will gain knowledge about the structures and functional roles of nucleic acids in the biological system.
The students will study the integration of metabolism of various metabolites like carbohydrates, proteins and nucleic acids.

Unit - I: Biomolecules (15 Hours)

Composition of living mater: Water - Physiochemical properties, biomolecular reactions. Macromolecules and their monomeric subunits: Carbohydrates - classification, structure and isomerism. Monosaccharides, oligosaccharides & polysaccharides - structure and properties. Amino acids - structures, classification and properties. Proteins - classification, types, structures and functions. Lipids - classification, sources and biological functions. Nucleic acids - composition, nucleosides & nucleotides.

Unit – II: Metabolism of carbohydrates (15 Hours)

Introduction to metabolism - Anabolism and catabolism in living cells (Overview). Glycolysis, Citric acid cycle, HMP shunt, Glucuronic acid pathway, Gluconeogenesis, Glycogenesis, Glycogenolysis, Glyoxylate cycle. Regulations of Glycolysis and Gluconeogenesis. Metabolism of Amino sugars - Sialic acids, Mucopolysaccharides and glycoproteins.

Unit - III: Metabolism of Proteins and Amino acids **(15 Hours)**

Biosynthesis of aspartate, alanine and aromatic amino acid families, Amphibolic activity of amino acids. Methods for determining protein conformations - symmetry and functional properties- denaturation & renaturation, protein folding, Ramachandran plot. Solid state synthesis of peptides and sequence determination. Degradation of proteins and amino acids. Urea cycle and its significance.

Unit - IV: Metabolism of lipids (15 Hours)

Biosynthesis of fatty acids, hydroxy fatty acids, acylglycerols and their regulation. Fatty acid degradation. Membrane lipids - phospholipids, sphingolipids & eicosanoids- Biosynthesis and functions. Cholesterol biosynthesis and its regulation. Lipoproteins - types, methods of inter organ transport of fatty acids and functions. Formation of ketone bodies.

Unit - V: Metabolism of nucleic acids (15 Hours)

Structure of RNAs and DNA, forces stabilizing nucleic acid structures. Unusual Nucleic acids. Fractionation, sequencing and chemical synthesis of oligonucleotides. Denaturation and hybridization. Synthesis of purines and pyrimidines, synthesis of deoxy ribonucleotides. Biosynthesis of nucleotide coenzymes, nucleotide degradation – purines and pyrimidines.

Teaching Methodology	Chalk and talk, PPT, video lecture
Assessment Methods	Seminar, Snap Test, Online test (JosTel), Group Discussion, Alayna

Books for Study:

1. Robert K. Murray *et al.*, 2000. Harper's Biochemistry, Appleton and Lange StanfordPublishers, Connecticut (e-book).
   - **Unit-I** (Chapter 2-Pages-5 to 9, Chapter13-Pages 102 to 110, Chapter 14-page 111,Chapter 3-Pages14 to 20 Chapter 35-Pages 303-314)
   - **Unit-II** (Chapter17-Pages 136 to 145, Chapter 18 Pages 145 to 152, Chapter 16 Pages 130 to 135, Chapter 19 Pages 153 to 162, Chapter 20 Pages 163 to 172, Chapter-48 Pages 542 to 545, Chapter 47 Pages 514-534)

Unit-III (Chapter 28 –Pages 237 to 241, Chapter 29-Pages 242 to 248, Chapter 30 -Pages 249 to 263)

Unit-IV (Chapter 21 - Pages 173 to 180, Chapter 22- Pages 181 to 190, Chapter 23 Pages 191 to 197, Chapter 24 Pages 198-205, Chapter 25 Pages 205 to 219 Chapter 26 Pages 219 to 231)

Unit-V (Chapter 34 Pages 293 to 303)

2. Lehninger, A. L. *et al.*, 1993. Principles of Biochemistry, Worth Publishers. Inc. USA (e-book).
   Unit-I (Chapter-2-2.1-Pages 43-51, Chapter-7 7.1-Pages 235-241, 244-246 Chapter-3-3.1 Pages-72-74 Chapter 8-8.1-Pages 271-276 Chapter 10-10.1- Pages-343-346)
   Unit-II (Chapter 14 14.1 to 14.5 Pages-528-563, Chapter 16, 16.1to16.4 Pages-616-639, Chapter 22-22.2 Pages-860-872)
   Unit-III (Chapter 3 -3.4-Pages 92-102, Chapter 4- 4.2 Pages 117 to 122, 4.4-Pages140-146, Chapter 18 18.2-18.3 Pages 682-684,687-701)
   Unit-IV (Chapter 21- 21.1 to 21.4 Pages-805-836, Chapter 17-17.1 to 17.3-Pages 648-667)
   Unit-V (Chapter-8.3-Pages 287-297, Chapter 22-22.4 Pages-882-893)
3. Robert Horton et al; 2011. Principles of Biochemistry, Pearson Education, Inc. U.S.A,5th Edition (e-book).
   Unit –I (Chapter-I, 1.1 to 1.3 Pages 2 to 9, Chapter 2 Pages 28 to 50, Chapter 8 Pages 227-238, 8.6 Pages 240-244. Chapter 3, 3.1 to 3.5-Pages 56-67, Chapter 9, 9.1 to 252-259)
   Unit- II (Chapter 11-Pages 325 to 347, Chapter 12-Pages 356 to 373, Chapter 13- Pages 387 to 409)
   Unit - III (Chapter-17, 17.3 Pages 520 to 529, 17.6 and 17.7-Pages 534 to 547 Chapter-4, 4.1 Pages 88- 91, 4.11 Pages 114 to 116)
   Unit-IV (Chapter 16- 476 to 499, 505 to 507, Chapter 16.11 Pages-508 to 511)
   Unit-V (Chapter-18-652-668)
4. Rawn, J.D. (1989): Biochemistry (Neil Patterson Publ. North Carolina)

Books for References:

1. Stryer, I., 1988. Biochemistry (2nd Edition), W.H. Freeman & Co., New York.
2. White, A. *et al*., 1959. Principles of Biochemistry, McGraw Hill Book Co., New York.
3. Donald Voet and Judith, G. Voet. 2011. Biochemistry. (4th Edition). John Wiley andSons, New York.

Websites and eLearning Sources:

1. https://study.com/learn/lesson/macromolecules-overview-types-examples.html
2. https://mgcub.ac.in/pdf/material/2020042810553621e311a9a5.pdf
3. https://davuniversity.org/images/files/study-material/BCH103-7.pdf
4. https://steenbock.biochem.wisc.edu/wp-content/uploads/sites/1978/2023/02/34th_Steenbock.pdf
5. https://mlsu.ac.in/econtents/1003_Nucleic%20acid%20Metabolism.pdf

Course outcome		
CO. No.	**CO-Statements**	**Cognitive Level (K-Level)**
On successful completion of the course, the students will be able to		
CO-1	Recall the molecular makeup of the living cells	**K1**
CO-2	Understand the types, structure and functions of carbohydrates	**K2**
CO-3	Relate structures of amino acids and proteins with their functions	**K3**
CO-4	Analyse the metabolism of dietary and endogenous carbohydrates	**K4**
CO-5	Evaluate the relationship between the bimolecular constitution and metabolic processes	**K5**
CO-6	Replicate biosynthesis and chemical reactions of lipids	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours/Weeks**		**Credits**
1	**25PBI1CC01**		**Core Course - 1:** Biomolecular Chemistry						**5**		**5**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	3	3	3	3	3	3	2	2.8
CO2	2	3	3	3	3	1	3	3	3	3	2.7
CO3	3	2	3	0	3	3	2	3	2	2	2.3
CO4	3	3	3	2	3	3	2	0	3	3	2.5
CO5	3	3	3	2	3	2	3	3	3	3	2.8
CO6	3	3	3	2	2	2	3	3	2	2	2.5
	Mean Overall Score										2.6
											High

Semester	Course Code	Title of the Course	Hours/ Weeks	Credits
1	25PBI1CC02	**Core Course - 2:** Bioenergetics and Enzymology	5	4

Course Objectives
To learn the different types of biotransformation reactions involvingenzyme
To analyse the bioenergetics of enzyme mediated catalysis
To learn the use of enzymes in various fields
To discern analyse the mechanism of action of selected enzymes
To evaluate the rate of enzyme action (kinetics)
To design the methodology of purification of enzymes

Unit - I: Thermodynamics (15 Hours)

Thermodynamic terms and basic concepts – types of thermodynamic systems, intensive and extensive properties, state of system, reversible and irreversible thermodynamic processes. Biological redox reactions. Electron transport chain and oxidative phosphorylation. High- energy phosphate compounds, role of ATP in biological system; acyl-phosphate group transfer.

Unit – II: Basics of Enzymology (15 Hours)

Historical aspects of enzymology, nomenclature and classification of enzymes according to IUB-EC-1964. Intracellular localization of enzymes, homogenization techniques, isolation and fractionation of enzymes – classical methods of purification and crystallization, separation based on molecular size (Gel filtration), electric charge (SDS PAGE and IonExchange), solubility difference and selective adsorption (Adsorption chromatography, Affinity Chromatography). Criteria of purity, units of enzyme activity. Turn over number, specific activity. Active site - definition, organization and determination of active site residues.

Unit – III: Criteria of chemical reactions (15 Hours)

Collision & transition state theories, specificity of enzymes. Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Mechanism of enzyme action - lysozyme, chymotrypsin, carboxypeptidase and DNA polymerase. Isoenzymes- Creatine phosphokinase and LDH. Multienzyme systems- mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthase complex.

Unit - IV: Kinetics of catalyzed reaction (15 Hours)

Single and bisubstrate reactions, concept and derivation of Michaelis–Menten equation. Briggs Haldane relationship. Determination and significance of kinetic constants, limitations of Michaelis – Menten kinetics. Enzyme regulation - Control of synthesis, Allosteric inhibition and activation, cooperative, cumulative, feedback inhibition. Inhibition kinetics- competitive, non-competitive and uncompetitive.

Unit – V: Applications of Enzymes (15 Hours)

Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment. Immobilized multienzyme systems. Biosensors - glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors. Abzymes and ribozymes. Enzymes of clinical and diagnostic significance-LDH, SGOT and SGPT. Industrial significance- Renin, Papain, Elastase. Enzyme engineering.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Basic concepts in biochemistry, Hiram F. Gilbert, second edition, McGraw-Hill Health Professions Division.
   Unit-I *Chapter 14, Chapter 24*
   Unit-IV *Chapter 7, Chapter 8*
2. Harper's Illustrated Biochemistry, twenty-sixth edition, Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Lange Medical Books/McGraw- Hill, Medical Publishing Division.
   Unit-III *Section 1*

3. Price and Stevens, 1999, Fundamentals of Enzymology, Oxford University Press, UK.
Unit-II *Chapter 3, Chapter 9*
Unit-V *Chapter 10*
4. Dixon, M. and Webb, J.F., 1979, Enzymes, Longman Publishing, London. Price and Stevens, 1999, Fundamentals of Enzymology, Oxford University Press, UK.

Books for References:

1. Trevor Palmer, 1991, Understanding Enzymes, 3rd Edition, Ellis Harwood, UK.
2. Lehninger, A. H. *et al.*, 1993, Principles of Biochemistry, Worth Publ. Inc., USA.
3. Jeremy M. Berg., John L Tymoczko and Lubert Stryer. 2007. Biochemistry. (6thEdition). W H Freeman and Co, New York.

Websites and eLearning Sources:

1. https://www.physics.ox.ac.uk/system/files/file_attachments/basic_thermo.pdf
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBC2102.pdf
3. https://mgcub.ac.in/pdf/material/20200413025103dafdce701b.pdf
4. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBC2102.pdf

Course Outcomes		
CO. No.	**CO- Statements** On successful completion of the course, the students will be able to	**Cognitive Level (K-level)**
CO-1	Explain the bioenergetics of the enzyme catalysed reactions.	**K1**
CO-2	Discern the isolation and purification methods of enzymes	**K2**
CO-3	Analyse the catalytic mechanism of enzymes	**K3**
CO-4	Determine the rate of the enzyme action and mechanism of regulation	**K4**
CO-5	Follow the methods of immobilization of enzymes	**K5**
CO-6	Apply the enzymes for the clinical diagnosis and industrial purposes.	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**					**Hours**			**Credits**
1	**25PBI1CC02**		**Core Course - 2:** Bioenergetics and Enzymology					**5**			**4**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	3	2	2	3	3	3	3	2.7
CO2	3	2	3	3	2	2	3	3	2	3	2.6
CO3	3	2	3	3	2	3	3	2	3	2	2.6
CO4	3	2	3	2	2	3	3	2	3	3	2.7
CO5	3	2	3	2	2	3	3	3	3	3	2.7
CO6	3	2	3	2	2	3	3	3	3	3	2.7
										Mean overall score	**2.66**
											High

Semester	Course Code	Title of the Course	Hours / Weeks	Credits
1	25PBI1CC03	**Core Course - 3:** Molecular Biology	5	4

Course Objectives
To Know the pioneering experiments involved in molecular biology
To know the mechanisms concerned with the mobile genetic elements
To know the isolation procedures of nucleic acids
To know the steps involved in the induction of transcription
To know the errors and correction mechanisms of informational molecules
To know the mechanisms of protein synthesis

Unit – I: Introduction and Organization of Chromosomes (15 Hours)

Terms and definitions – DNA is the Genetic Material: Griffith's Experiment, Avery, Hershey & chase Experiment. RNA as the Genetic Material: Conrat & Singer Experiment with TMV-Central Dogma. Organization of prokaryotic genome: Bacterial genome, Viral genome – types of RNA and their role. Structural organization of eukaryotic chromosomes. Types and basic structure of chromosomes.Chromosomal Proteins – Histones and Protamines – nucleosomes – levels in the organization of Metaphase Chromosome. Special types of Chromosomes: Polytene and Lamp brush chromosomes. Duplication & segregation of Chromosomes.

Unit – II: Transposons and Extra chromosomal DNA (15 Hours)

Discovery of IS elements, Transposons in Bacteria (Tn elements), Maize (Ac/Ds and Sp/Dsp elements), Drosophila (P elements) and Yeast (Ty elements). Transposition, Genetic and evolutionary significance of transposons. Maternal Inheritance, Structure, gene contents and functions of Chloroplast and Mitochondrial DNA, theory of prokaryotic endosymbionts. Plasmids: Definition, Types, Structure, Properties,gene content. Use in rDNA technology.

Unit – III: DNA replication (15 Hours)

Models-Messelson & Stahl Experimental proof for Semi-conservative replication- Rules,requirements, problems and molecular mechanism of the replication of linear and circular (Rolling circle Model) DNA in prokaryotes and eukaryotes. DNA polymerases -structureand function. Replication of RNA – RNA and DNA mediated.

Unit – IV: Transcription and Translation (15 Hours)

RNA types (tRNA, mRNA, rRNA, Ribozyme, snRNA, hnRNA, RNAi, RNA-P and microRNA), structure and functions. Transcription mechanism in prokaryotes and eukaryotes – initiation, elongation and termination, Post transcriptional modifications. Antibiotic inhibitors of transcription. Genetic code and its features. Wobbling hypothesis. Machinery, initiation, elongation and termination of translation in bacteria and eukaryotes. Translational proof reading, translational inhibitors, post-translational modifications, chaperones and protein targeting- translocation, heat shock proteins, glycosylation; SNAPs and SNAREs. Bacterial signal sequences. Mitochondrial, chloroplast and nuclear protein transport. Endocytosis – viral entry. Ubiquitin TAG protein destruction.

Unit – V: Chromosomal changes and mutation (15 Hours)

Changes in the chromosome number: euploidy and aneuploidy and related genetic disorders. Changes in the chromosome structure: addition, deletion, inversion and translocation and related genetic disorders. Mutation: Definition, chemical basis and types**.** Mutagens: Physical, chemical and Biological. Mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. DNA repair mechanism: thymine dimer, lightactivation, excision, recombinational, SOS and mismatch repair.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Molecular cell Biology. Fifth edition By Harvey Lodish, Arnold Berk, Chris A Kaser
   UNIT-I *Chapter 10*

UNIT-II *Chapter 10*
UNIT-IV *Chapter 11*

2. David Freifelder, 2008. Molecular Biology. (Ed: 2). Narosa Publications. New Delhi.
UNIT-I *Chapter VIII*
UNIT-II *Chapter XX*
UNIT-III *Chapter IX*
UNIT-IV *Chapter XII*
UNIT-V *Chapter X, XX IV*
3. Jeoffrey M. Cooper & Rober E. Hausman. 2000. The Cell: A Molecular Approach ASMPress, Washington D.C.
UNIT-I *Chapter IV*
UNIT-II Chapter *VI*
UNIT-III *Chapter VI*
UNIT-IV *Chapter VII*
UNIT-V *Chapter VI, XVIII*

Books for References:

1. Ajoy Paul. 2007. Textbook of Cell and Molecular Biology. Books and Allied, Kolkata
2. De Robertis and De Robertis. 1990. Cell and Molecular Biology. Saunders, Philadelphia.
3. Gerald Karp. 2008. Cell and Molecular Biology. (Ed: 5). John Wiley and Sons, New York.
4. Lewin's. 2017. GENES XII. 12th edition. Jones and Bartlett Publishers, Inc; Burlington, Massachusetts, USA.

Websites and eLearning Sources:

1. http://www.csun.edu/~cmalone/pdf360/Ch10-1%20Gen%20material.pdf
2. https://microbenotes.com/transposable-elements/
3. https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/replication/a/molecular-mechanism-of-dna-replication
4. https://atdbio.com/nucleic-acids-book/Transcription-Translation-and-Replication
5. https://www.biologyonline.com/dictionary/chromosomal-mutation

Course Outcomes		
CO. No.	**CO- Statements** On successful completion of the course, the students will be able to	**Cognitive Level (K-level)**
CO-1	Recall the pioneering experiments of the genetic materials	**K1**
CO-2	Explain the mechanisms of recombination	**K2**
CO-3	Evaluate the mechanisms of replication.	**K3**
CO-4	Elucidate the reactions of transcription	**K4**
CO-5	Reveal the mechanisms of translation and modifications of proteins.	**K5**
CO-6	Synthesize the mechanisms of repair machinery	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
1	**25PBI1CC03**			**Core Course - 3:** Molecular Biology					**5**		**4**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	3	2	2	3	2	3	2	3	2.4
CO2	3	2	2	3	2	3	2	2	3	3	2.5
CO3	3	2	3	2	2	3	3	3	2	2	2.5
CO4	3	2	3	3	2	3	3	2	2	2	2.5
CO5	3	2	3	2	2	3	3	2	2	3	2.5
CO6	3	3	2	2	3	3	3	3	3	3	2.8
										Mean overall score	**2.6**
											High

Semester	Course Code	Title of the Course	Hours	Credits
1	25PBI1CP01	**Core Practical - 1:** Biochemistry and Microbiology	5	2

Course Objectives
To instill skill in students enabling them to apprehend the wider knowledge about principles and techniques to be employed for the biomolecules under investigation.
To inculcate the knowledge of various isolation and purification techniques of macromolecules like DNA, RNA, Glycogen and Starch.
To perform colorimetric estimations to quantify important metabolites.
To undergo the identification of microbes by staining method.
Using various biochemical test to characterizes the species of microorganism.
To understand the different staining procedures implied in culture of microorganism.
To get knowledge about the antibiotic sensitivity by various microorganism and to lead for effective treatment.

1. Biochemistry

- Estimation of liver glycogen.
- Estimation of amino acids by Sorenson's formal titration.
- Estimation of Iodine value of oil.
- Estimation of Acid value of oil.
- Estimation of Reducing sugars by Benedict's titration.
- Estimation of Vitamin C. (Titration and Colorimetric)
- Extraction and Estimation of DNA and RNA.
- Estimation of protein by Lowry's method.
- Colorimetric estimation of Vitamin E.

2. Microbiology

- Media preparation and Culture techniques.
- Staining techniques (simple, differential and capsular)
- Biochemical Characterization of Microbes.
  - Amylase activity
  - Methyl Red test – VP test
  - TSI Agar test

Citrate Utilization test

- Qualitative test for Milk.
  - Methylene Blue Reductase test.
  - Phosphatase test.
- Antibiotic sensitivity test.

Books for References:

1. Praful. B. Godkar, 2014, Text book of Medical laboratory technology; III edition,Volume I and II, Bhalani Publishing house.
2. Alan H. Gowenhock, Varley's Practical Clinical Biochemistry, 6th Edition; CBSPublishers.
3. Sadasivam, S. and Manickam, A. 2010. Biochemical Methods. (3rd Edition), New Age International (P) Ltd., New Delhi.
4. David T. Plummer. 1988. Practical Biochemistry (3rd Edition). Tata McGraw HillPublishers, New Delhi.

CO. No.	CO- Statements	Cognitive Level (K-level)
	On successful completion of the course, the students will be able to	
CO-1	Recall the knowledge in use of pipettes, making solutions for enzyme and biochemical studies	**K1**
CO-2	Examine the culture the of microbial colonies	**K2**
CO-3	Apply the culture techniques and characterize microbial species	**K3**
CO-4	Analyze the nutritive value of oils	**K4**
CO-5	Estimate the bio compounds and design the methodology for their characterization	**K5**
CO-6	To understand the nature of Antibiotic and its sensitivity against microorganisms.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
1	**25PBI1CP01**			**Core Practical - 1:** Biochemistry and Microbiology					**5**		**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO 3**	**PSO4**	**PSO5**	
CO1	2	3	3	3	2	3	2	3	2	2	2.5
CO2	2	3	3	2	3	3	2	3	1	2	2.4
CO3	3	2	2	2	3	2	3	3	2	3	2.5
CO4	3	2	2	3	2	2	3	2	3	2	2.4
CO5	3	2	2	3	3	2	3	2	3	2	2.5
CO6	2	2	2	3	2	3	2	2	3	3	2.4
	Mean overall score										**2.4**
											High

Semester	Course Code	Title of the Course	Hours	Credits
1	25PBI1ES01A	**Discipline Specific Elective – 1:** Microbiology	4	3

Course Objectives
To appreciate the classification of microorganisms based on their structure, size, and shape with an insight into the ancient scriptures about microbes.
To understand the role of microorganisms in environment and to learn the culture conditions.
To recognize the possible contamination of foods by microorganisms, to learn about counter acting 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 to explore natural remedial measures against microbes.
To be able to exploit the various features of microorganisms for the beneficial industrial production.

Unit - I: General microbiology (12 Hours)

Introduction - history and scope of microbiology. Brief study of structure and organization of major groups of microorganisms – Archaebacteria, cyanobacteria, eubacteria, fungi, algae, protozoa and viruses. Culture of microorganisms – batch, continuous and pure cultures. Growth curve – factors affecting it. Control of microorganisms – physical, chemical and chemotherapeutic agents. Preservation of microorganisms. Microscopy – Principles and types – Simple, Compound and Phase contrast.

Unit – II: Environmental microbiology (12 Hours)

Microbiology of soil - soil microflora, role of soil microbes in biogeochemical cycles (C, N, S).Marine and fresh water microbiology. Contamination of domestic and marine waters. Water purification and sewage treatment. Microbes in waste water treatments. Microbiology of air (Indoor and Outdoor).

Unit – III: Industrial microbiology (12 Hours)

Selection of industrially useful microbes. Fermentors and fermentation technology. Industrial production of alcohol, vinegar, lactic acid, antibiotics (Penicillin, and Streptomycin), enzymes (Alpha amylase, Cellulase, Renin), Vitamins (Ascorbic acid, Thiamine, B12) and amino acids. Microbiology of food: sources of contamination, food spoilage and food preservation methods.

Unit – IV: Clinical microbiology (12 Hours)

Epidemic, endemic, pandemic and sporadic diseases. Epidemiology, pathogenicity, virulence and infection of diseases. Bacterial diseases of human (typhoid, cholera, syphilis, gonorrhoea and pertussis). Fungal diseases of human (superficial, cutaneous, subcutaneous and systemic mycoses) Mycotoxins – Aflatoxin A and B (Mode of action). Viral diseases of human (AIDS, hepatitis, polio, rabies and measles). Mycoplasmal, Chlamydial, Rickettsial and protozoan diseases of human (Malaria and Kala-azar).

Unit – V: Applied Microbiology (12 Hours)

Role of microbes in the manufacture of vaccines. Microorganisms as biofertilizers. Microbes as foods - SCP production. Role of microbes in biogas production, petroleum industry and mining. Microbial degradation of lignin, cellulose and pesticides. Microbial immobilization. Microbes in biowar.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Ananthanarayan, R. and Jayaram Paniker, C.K. 2007. Text Book of Microbiology.(7thEdition). Orient Longman Ltd., Chennai.
   UNIT-I *Chapter* I *Pages*-1 to 7, *Chapter* 3 and 4 – *Pages*-34 to 43, *Chapter* 2 *Pages*-8 to 23. *Chapter* 48 - *Pages* 430-439. *Chapter* 64-*Pages* 603-610.
   UNIT-IV *Chapter 9 Pages 64 to 71, Chapter 25 Pages*-222 to 231, *Chapter* 32-*Pages* 290 to 304 *Chapter* 37- *Pages* 339 to 344, *Chapter* 43 *Pages* 395 to 400, *Chapter* 46 and 47-*Pages* 412 to 429. *Chapter*-56 *Pages* 513 to 520, *Chapter* 59-427 to 432. *Chapter*- 62-*Pages* 582 to 598, *Chapter*-65-*Pages* 610 to 627.

2. Lansing M Prescott, John P Harley and Donald A Klein. 2007. Microbiology.(7thEdition). McGraw Hill, New York.
   UNIT-I *Chapter*-I *Pages* 1 to 16, *Chapter* 20 -26 *Pages*-503 to 629, *Chapter* 7 *Pages*149 to 165, *Chapter* 6.3 and 6.4 *Pages* 128 to 130, *Chapter* 16 and 17 *Pages* 407 to 446.
   UNIT-II *Chapter* 26 *Pages*-629-635 *Chapter* 27 to 28 *Pages* 643 to 714, *Chapter*-41 *Pages* 1049 to 1054.
   UNIT-III *Chapter* 40 *Pages* 1023 to 1030.
   UNIT-IV *Chapter*33 *Pages* 815 to 832, *Chapter* 36 *Pages* 885 to 911.
3. Sivakumar. P. K, JOE. M. M and Sukesh. K An introduction to Industrial microbiologyFirst edition 2010 (S. Chand and Company Ltd, New Delhi).
   UNIT-III *Chapter* 2 *Pages* 21 to 46, *Chapter* 3 *Pages* 47 to 62, *Chapter* 5 *Pages* 86 to 99, *Chapter* 6 *Pages* 113 to 123, *Chapter* 9 *Pages* 164 to 183, *Chapter* 12 *Pages* 262 to 264.
   UNIT-V *Chapter* 10 *Pages* 184 to 193, *Chapter* 11 *Pages* 208 to 211, 213 to 215, *Chapter* 12 *Pages* 250 to 261.

Books for References:

1. Martin Alexander (1969): Introduction to soil microbiology. Wiley International, NY.
2. Gladwin and Trattler, 2013, Clinical Microbiology Made Ridiculously Simple(6thEdition), Medmaster, UK.
3. Mackie and McCarthy, 1994. Medical Microbiology, (4th Edition). Churchill Livingstone, New York.
4. Michael Pelczar, Microbiology 5th Edition, 2001. Mcgraw Higher Ed Publisher.
5. M. R. Adams, M. O. Moss. Food microbiology (3rd Edition), 2008. Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, UK.

Websites and eLearning Sources:

1. https://s3.studentvip.com.au/notes/16878-sample.pdf
2. https://uou.ac.in/sites/default/files/slm/EVS-507.pdf
3. https://kamarajcollege.ac.in/wp-content/uploads/Core-Industrial-Microbiology-and-Bioprocess-Technology.pdf
4. https://www.researchgate.net/publication/377466470_Clinical_Microbiology
5. https://www.rlsycollegebettiah.ac.in/wp-content/uploads/2023/02/file_63e39dc730ae1.pdf

Course Outcomes		
CO. No.	**CO- Statements** On successful completion of the course, the students will be able to	**Cognitive Level (K-level)**
CO-1	Recall the classification and characteristic features of microbes	**K1**
CO-2	Understand the implications of microbes in the environment	**K2**
CO-3	Apply and analyse the microbial metabolism for the benefits of mankind	**K3**
CO-4	Evaluate the infectious diseases, their diagnosis and treatment options	**K4**
CO-5	Study the impact of microbes in warfare	**K5**
CO-6	Produce nutrients for the use of mankind	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**25PBI1ES01A**			**Discipline Specific Elective – 1:** Microbiology						**4**	**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	2	2	3	2	3	2	2.3
CO2	2	2	2	2	3	3	2	3	2	2	2.3
CO3	3	2	2	2	2	2	2	3	3	2	2.3
CO4	3	2	2	2	2	2	2	3	3	2	2.3
CO5	2	3	3	3	2	2	2	2	2	3	2.4
CO6	2	2	3	3	2	2	2	2	2	3	2.3
										Mean overall score	**2.6**
											High

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	25PBI1ES01B	**Discipline Specific Elective - 1:** Energy and Drug Metabolism	4	3

Course Objectives
Familiarize on concepts of enthalpy, entropy, free energy, redox system, biological oxidation, and high energy compounds.
Provide an insight into the relationship between electron flow and phosphorylation.
Inculcate knowledge on processes involved in converting light energy to chemical energy and associated food production by autotrophs.
Provide a platform to understand the versatile role of Krebs cycle, transport of NADH across mitochondrial membrane and energetics.
Educate on the various phase I and II reactions.
Mode of transformation of xenobiotics and endobiotics.

UNIT I: Thermodynamics (12 Hours)

Thermodynamic- principles in biology- Concept of entropy, enthalpy and free energy change. Redox systems. Redox potential and calculation of free energy. Biological oxidation - Oxidases, dehydrogenases, hydroperoxidases, oxygenases. Energy rich compounds - phosphorylated and non- phosphorylated. High energy linkages.

UNIT II: Electron Transport Chain (12 Hours)

Electron transport chain-various complexes of ETC, Q-cycle. Inhibitors of ETC. Oxidative phosphorylation-P/O ratio, chemiosmotic theory. Mechanism of ATP synthesis - role of F0F1 ATPase, ATP-ADP cycle. Inhibitors of oxidative phosphorylation ionophores, protonophores. Regulation of oxidative phosphorylation.

UNIT III: Photosynthesis and Dark Reactions (12 Hours)

Light reaction-Hills reaction, absorption of light, photochemical event. Photo ETC-cyclic and non-cyclic electron flow. Photophosphorylation-role of CF0-CF1 ATPase. Dark reaction- Calvin cycle, control of C3 pathway, and Hatch-Slack pathway (C4 pathway),
Photorespiration. Synthesis and degradation of starch.

UNIT IV: Metabolic Pathways (12 Hours)

Interconversion of major food stuffs. Energy sources of brain, muscle, liver, kidney and adipose tissue. Amphibolic nature of Citric acid cycle. Anaplerotic reaction. Krebs cycle-inhibitors and regulation of TCA cycle. Transport of extra mitochondrial NADH - Glycerophosphate shuttle, malate aspartate shuttle. Energetics of metabolic pathways - glycolysis, (aerobic and anaerobic), citric acid cycle, beta oxidation.

UNIT V: Detoxification (12 Hours)

Activation of sulphate ions - PAPS, APS, SAM and their biological role. Metabolism of xenobiotics - Phase I reactions - hydroxylation, oxidation and reduction. Phase II reactions - glucuronidation, sulphation, glutathione conjugation, acetylation and methylation. Mode of action and factors affecting the activities of xenobiotic enzymes.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Tripathi, K. D. (2010). *Essentials of medical pharmacology,* (7th Ed.). Jaypee Publishers.
2. Ghosh, J. (2010). *A textbook of pharmaceutical chemistry,* (3rd Ed.). S. Chand & Company Ltd.

Books for Reference:

1. Nelson, D. L., & Cox, M. M. (2012). *Lehninger principles of biochemistry,* (6th Ed.). W. H. Freeman.
2. Murray, R. K., Granner, D. K., & Rodwell, V. W. (2012). *Harper's illustrated biochemistry,* (29th Ed.). McGraw-Hill Medical.
3. Metzler, D. E. (2003). *The chemical reactions of living cells,* (2nd Ed.). Academic Press.
4. Zubay, G. L. (1999). *Biochemistry,* (4th Ed.). Mc Graw-Hill.

5. Devlin, R. M. (1983). *Plant physiology*, (4th Ed.). PWS publishers.
6. Taiz, L., & Zeiger, E. (2010). *Plant physiology*, (5th Ed.). Sinauer Associates Inc.

Websites and eLearning Sources:

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

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will 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	**K1**
CO2	Gain knowledge on role of mitochondria in the production of energy currency of the cell	**K2**
CO3	Acquaint with the process of photosynthesis	**K3**
CO4	Comprehend on the diverse role of TCA cycle and the energy obtained on complete oxidation of glucose and fatty acid	**K4**
CO5	Correlate the phase I and phase II reactions to metabolize the xenobiotics	**K5**
CO6	Apply the knowledge in the transformation of xenobiotics and endobiotics	**K6**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**								**Hours**	**Credits**
1	**25PBI1ES01B**	**Discipline Specific Elective - 1:** Energy and Drug Metabolism								**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	3	2	1	2	3	2	2	1	**2.0**
CO2	2	3	2	2	1	2	3	2	3	1	**2.2**
CO3	2	2	3	2	1	2	3	3	2	1	**2.1**
CO4	2	3	3	2	1	2	3	2	3	1	**2.2**
CO5	2	3	3	2	1	2	3	1	3	1	**2.1**
CO6	2	3	3	2	1	2	3	3	3	1	**2.3**
Mean Overall Score											**2.15 (High)**

Semester	Course Code	Title of the Course	Hours	Credits
1	25PBI1AE01	**Ability Enhancement Course:** Herbal Technology	2	1

Course Objectives
Familiarize the indigenous systems of medicines like Ayurveda, Siddha, Unani, Homeopathy and Yoga.
Study the types and formulations of drugs.
Identify the active principles of Phytomedicine and their screening methods.

Unit I **(6 Hours)**

Introduction: Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Indian systems of medicine; Ayurveda, Yoga, Siddha, Unani and Homeo. Cultivation - harvesting - processing -storage - marketing and utilization of medicinal plants.

Unit II **(6 Hours)**

Pharmacognosy: Systematic position, medicinal uses of the herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka. Drug Formulations- Types, Advantages and Disadvantages. Packing Materials

Unit III **(6 Hours)**

Phytochemistry: active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster).

Unit IV **(6 Hours)**

Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation – Biological testing of herbal drugs - screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids and phenolic compounds).

Unit V **(6 Hours)**

Conservation of herbs: Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi) - Herbal foods in weight management, diabetes mellitus and hypertension. Future of Pharmacognosy.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Text book of Pharmacognosy and Phytochemistry, Biren N. Shah, A.K. Seth, FirstEdition 2010.
   UNIT-II *Chapter 1 (Pages 1-26)*
   UNIT-IV *Chapter 4 (pages 105-138)*
2. Chemistry, biochemistry and Ayurveda of Indian medicinal plants, I.P. Tripathi, 2013International E-Publication.
   UNIT-I *Chapter 3 (130-153)*
   UNIT-III *Chapter 1(Pages 1-12)*
   UNIT-V *Chapter 1(Pages 13-40)*
3. Glossary of Indian medicinal plants, R.N. Chopra, S.L. Nayar and I.C. Chopra, 1956.C.S.I.R, New Delhi.
4. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors.

Books for Reference:

1. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
2. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994.Oxford IBH publishing Co.
3. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
4. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.

Course Outcomes		
CO No.	**CO- Statements**	**Cognitive Level (K-level)**
	On successful completion of the course, the students will be able to	
CO-1	Describe the medicinal value of plants	**K1**
CO-2	Outline the medicinally used traditional herbs	**K2**
CO-3	Apply the various methods involved in preservation of medicinal plants and conservation of rare plants	**K3**
CO-4	Investigate the phytochemical reactions of secondary metabolites	**K4**
CO-5	Evaluate secondary metabolites	**K5**
CO-6	Prepare therapeutic formulations	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**25PBI1AE01**			**Ability Enhancement Course:** Herbal Technology						**2**	**1**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	1	2	2	3	2	1	3	2	2	3	2.1
CO2	2	1	3	2	1	1	3	2	3	3	2.1
CO3	2	2	2	3	3	2	2	3	2	2	2.3
CO4	3	2	3	2	1	2	1	1	3	2	2
CO5	3	2	3	2	2	3	3	1	3	3	2.5
CO6	2	2	3	3	2	3	2	2	2	2	2.3
										Mean overall score	**2.8**
											High

Semester	Course Code	Title of the Course	Hours	Credits
1	25PBI1OE01	**Open Elective - 1 (WS):** Biochemistry of Natural Products	4	2

Course Objectives
The occurrence, properties and economic importance of natural products from plants, animals and microbes.
The Classification of the natural compounds based on chemistry and applications.
The isolation strategies of natural products.
The therapeutic importance of those natural products.
The identification of the commercially important natural products.
The medicinal importance of saponins.
The therapeutic importance of Terpenoids.
The therapeutic applications of secondary metabolites.

Unit – I: General aspect of sources of medicinal plant products (12 Hours)

Introduction to primary and secondary metabolites, types of secondary metabolites, production under stress, isolation of active constituent from plant material.

Unit – II: Alkaloids (12 Hours)

Definition, general properties, classification based on nitrogen heterocyclic ring, types -phenylalkylamines, pyridine alkaloids, tropane alkaloids, quinolizidine and pyrrolizidine alkaloids, isoquinoline alkaloids, quinoline, monoterpene, indole alkaloids, purine alkaloids, ruta alkaloids, medicinal importance of each type. Role of alkaloids in plants.

Unit – III: Saponins and Steroids (12 Hours)

Definition, general properties, medicinal importance of saponins. Important saponins of plant origin - diosgenin, hecogenin, glycyrrhizin, aescin and ginseng. Steroids: General properties, classification. Introduction and medicinal importance of - cardiac glycosides from *Digitalis, Strophanthus, Urginea,* steroids from *Withania somnifera, Holarrhena* and *Solanum.*

Unit – IV: Terpenoids (12 Hours)

Definition, general properties, classification, introduction and medicinal importance of terpenoids. General account and medicinal importance of myrcene, ocimene, citronellol,menthol and camphor. Tannins, lignins and pectins: General properties and classification.

Unit – V: Plant pigments (12 Hours)

Occurrence, classification, introduction and applications of carotenoids, xanthophylls, anthocyanins, flavones, flavonols. Acetate pathway and Shikimic acid pathway. Definition, general properties and importance of Pyrethroids and rotenones of plant origin. Naturalproducts of therapeutic importance from animals - Zootherapy - Venom, Body fluids as medicines- Urine, Saliva and Faeces. Isolation, qualitative and quantitative analysis ofsecondary metabolites (Skill component).

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. K. G. Ramawat and J. M. Merillon (Eds.), 2010, Biotechnology - secondary metabolites,Oxford & IBH publishing Co. Pvt. Ltd.
   UNIT-I *Chapter 2-Pages 21 to 59, Chapter 7 pages 179 to 201*
   UNIT-II *Chapter 8 pages 209 to 231*
2. G. E. Trease and W. C. Evans, 2002, Pharmacognosy and Phytochemistry, 15th Edition, W.B. Saunders Edinburgh, New York.
   UNIT-V *Chapter 13-pages-144 to 147*
3. Michael Wink 2010 Biochemistry of Plant Secondary Metabolism (Annual PlantReviews, Volume 40, Second Edition) A John Wiley & Sons, Ltd., Publication.
   UNIT-II *Chapter 2-pages 20 to 66*

UNIT-III *Chapter 4 pages 182 to 230, Chapter 6-pages 304 to347*
UNIT-IV *Chapter 5 pages 258 to 285*

4. J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthrope, J. B. Harborne, 1994, NaturalProducts: Their Chemistry and Biological Significance, Longman Pub Group.

Books for References:

1. Chemistry and biology of herbal medicine: V. P. Agrawal and V. P. Khamboj, (Eds.) (Society of Biosciences).
2. G. E. Trease and W. C. Evans, 2002, Pharmacognosy and Phytochemistry, 15th Edition, W.B. Saunders Edinburgh, New York.
3. Gurdeep Chatwal, 1995, Organic chemistry of natural products, Himalaya publishingHouse, India.

Websites and eLearning Sources:

1. https://www.rroij.com/open-access/a-note-on-metabolites.pdf
2. https://nowgonggirlscollege.co.in/attendence/classnotes/files/1625931800.pdf
3. https://pmc.ncbi.nlm.nih.gov/articles/PMC6149773/
4. https://pvpkm.ac.in/upload/StudyMaterial/Photosynthetic%20Pigments.pdf

Course Outcomes		
CO. No.	**CO- Statements** On successful completion of the course, the students will be able to	**Cognitive Level (K-level)**
CO-1	Describe the occurrence, properties and economic importance ofnatural products from plants, animals and microbes	**K1**
CO-2	Compare the medicinal properties of secondary metabolites	**K2**
CO-3	Classify the natural compounds based on chemistry and applications	**K3**
CO-4	Apply the various methods of isolation of natural products	**K4**
CO-5	To gain the knowledge of Zoo therapy	**K5**
CO-6	Evaluate quantitatively and qualitatively and design the methodology of isolation of secondary metabolites	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
1	**25PBI1OE01**			**Open Elective - 1(WS):** Biochemistry of Natural Products					**4**		**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	2	3	2	3	2	3	2	2	3	2	2.4
CO2	3	2	3	2	3	2	3	2	1	3	2.4
CO3	3	2	3	2	3	3	3	2	2	3	2.6
CO4	2	3	2	2	2	2	3	2	3	2	2.3
CO5	2	3	2	3	2	2	3	3	2	3	2.5
CO6	2	2	3	3	3	3	2	2	3	2	2.5
	Mean overall score										**2.7**
											High

Semester	Course Code	Title of the Course	Hours/ Weeks	Credits
1	25PGC1SL01	Global Citizenship Education	Online	1

Course Objectives
To develop an understanding of global governance structures, rights and responsibilities.
To recognize and respect differences, multiple identities and diversity.
To examine beliefs and perceptions about social justice, equality and civic engagement.
To develop attitudes of care and empathy for others and the environment.
To develop global competence and ethical considerations by enhancing communication and collaboration skills across cultures

UNIT I: Introduction to Global Citizenship

01. Historical and Philosophical Foundations of Global Citizenship
02 Rights and Responsibilities of Global Citizenship
03. Key Organizations and Movements Promoting Global Citizenship

UNIT II: Globalization and Its Impact on Society

04. Globalization and Its Key Drivers
05. Positive and Negative Impacts of Globalization
06. Role of Education in Fostering a Global Perspective

UNIT III: Human Rights, Social Justice, Equality and Diversity

07. Key Human Rights Treaties, Frameworks and Declarations
08. Advocacy, Activism, and Movements for Social Justice and Equality
09. Global Challenges to Human Rights, Equality and Diversity

UNIT IV: Sustainable Development and Environmental Responsibility

10. The Sustainable Development Goals and Their Relevance to Global Citizenship
11. Climate Change, Environmental Degradation and Sustainable Development
12. Strategies for Promoting Environmental Responsibility

UNIT V: Building Global Competence and Engagement

13. Effective Communication and Collaboration Across Cultures
14. Volunteering and Community Engagement in Global Initiatives
15. Ethical Considerations in Global Citizenship

Teaching Methodology	Recorded Lectures/Videos, Reading Materials, PPTs, Case Studies, Collaborative Projects, Quizzes and Polls
Assessment Methods	Seminars, Assignments, MCQs, Reflection Essays Group Project Presentations, Problem-Solving Scenarios

Books for Study:

1. Clapham, A. (2007). *Human rights: A very short introduction.* Oxford University Press.
2. Desai, A. (2018). *Global citizenship and cultural diplomacy: India's role in a changing world*. Routledge India.
3. Gould, J. A. (2012). *The ethics of global citizenship*. Routledge.
4. Held, D., et al. (2022). *Globalization and its impact on the developing world*. Cambridge University Press.
5. Sen, A. (2009). *The idea of justice*. Penguin Books India.

Books for Reference:

1. Ghosh, A. (2007). *The global impact of Indian civilization*. HarperCollins India.
2. Krecker, E. (2008). *The global citizen: A guide to creating an international life and career*. Career Press.
3. Kumar, R. (2017). *Sustainable development and environmental justice in India*. Oxford University Press.
4. Nair, K. G. (2014). *Human rights: A socio-political perspective*. Orient Blackswan.

5. Patel, V. (2015). *Social justice and equality in India: Theories and practices*. Oxford University Press.
6. Pillai, V. (2016). *Globalization and its impact on Indian society*. SAGE Publications India.

Websites and eLearning Sources:

1. https://www.unesco.org/en/global-citizenship-peace-education/need-know
2. TEDxCincinnati: Global Citizenship in the Classroom: Jenny Buccos at TEDxCincinnati https://www.youtube.com/watch?v=6jjLHmyBs7o
3. Social justice -- is it still relevant in the 21st century? | Charles L. Robbins | TEDxSBU https://www.youtube.com/watch?v=Wtroop739uU
4. Are We the Last Generation — or the First Sustainable One? | Hannah Ritchie | TED https://www.youtube.com/watch?v=Kl3VVrggKz4
5. Diversity, Equity & Inclusion. Learning how to get it right | Asif Sadiq | TEDxCroydon https://www.youtube.com/watch?v=HR4wz1b54hw

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, students will be able to	
CO1	Recall the historical, philosophical and practical foundations of global citizenship.	**K1**
CO2	Explain the key drivers of globalization and the role of education in fostering a global perspective.	**K2**
CO3	Apply human rights frameworks, social justice principles, and advocacy strategies to real-world challenges.	**K3**
CO4	Analyze the relevance of the Sustainable Development Goals in addressing climate change and environmental degradation.	**K4**
CO5	Develop strategies for fostering global competence by enhancing communication and collaboration skills across cultures.	**K5**
CO6	Critically evaluate the effectiveness of current global strategies and policies in addressing social justice and environmental sustainability.	**K6**

Semester	Course Code	Title of the Course	Hours	Credits
2	25PBI2CC04	**Core Course - 4:** Genetic Engineering	5	4

Course Objectives
Remember the various underlying principles of genetic engineering and enzymes concerned with it.
To understand the methodologies of gene transfer.
To apply the analytical procedures involving DNA.
To analyze the uptake of genes following screening procedures.
To evaluate the methods of recombinant selection and construct gene cassettes and vectors.
To apply the methods of protection of intellectual properties.

Unit – I: Introduction to Genetic engineering (15 Hours)

Enzymes in molecular biology-restriction endonuclease, ligases, reverse transcriptase, nucleases, polymerase, alkaline phosphatase, terminal transferase, T4 polynucleotide kinase; linker, adaptors & homopolymers. Isolation (Mechanical, cDNA, Shot gun) & purification of nucleic acid, PCR.

Unit – II: Expression cassette (15 Hours)

Promoters (constitutive, inducible, tissue specific), terminators, reporters, markers (antibiotic resistant, herbicide resistant, antimetabolite), Vectors in gene cloning – Plasmids (pBR322, pUC), Bacteriophages (Phage λ, M13), cosmids, phagemids, yeast plasmid vector, viralvectors (adenovirus, adeno associated virus, baculo virus, herpes virus, retrovirus, cauliflower mosaic virus, tobacco mosaic virus, potato virus X), artificial chromosome (BAC, YAC, HAC), shuttle vector, Expression vector.

Unit – III: Gene transfer methods (15 Hours)

Transformation – physical method (electroporation, micro-injection, particle bombardment, liposome mediated transfer), chemical method (PEG mediated, DEAE Dextran mediated, $CaPO_4$ mediated gene transfer), Biological method (*Agrobacterium* mediated gene transfer). Expression systems – prokaryotes (Bacteria) and eukaryotes (yeast, mammalian and, insect cell lines).

Unit – IV: Screening and selection methods (15 Hours)

Insertional inactivation, blue-white selection, colony-*in situ* hybridization, *in vitro* selection, *in vitro* translation, radioactive antibody test, immunological techniques, DNA labelling, dot blot hybridization, Molecular beacons. Gene Silencing, RNA interference, antisense therapy, gene knockout. Blotting techniques–southern, northern, western and south-western.

Unit – V: Molecular Techniques (15 Hours)

RFLP, RAPD, AFLP, DNA Finger printing, DNA Foot printing, Microarray (DNA & Non-DNA). Libraries - Genomic library; C-DNA library & its types; BAC library; YAC library; Methyl filtration libraries; COT fractionation based libraries. Bioethics & Biosafety in genetic engineering; IPR & Patenting.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Glick R. and J. J. Pasternak. 2002. Molecular Biotechnology (3rd Edition). ASM Press,Washington, USA.
   UNIT-II *Chapter IV, VII*
   UNIT-III *Chapter*
   UNIT-V *Chapter XX*
2. Old R.W and S.B. Primrose. 1989. Principles of gene manipulation (Ed: 4). BlackwellScientific Publications, London.
   UNIT-I *Chapter II, III*
   UNIT-II *Chapter IV, V*
   UNIT-III *Chapter VIII, IX, X*
   UNIT-IV *Chapter VI*
   UNIT-V *Chapter XIV*

Books for References:

1. David M Glove. 1984. Gene cloning - The mechanisms of DNA manipulations.Chapman and Hall, New York.
2. Ernst L Winnacker. 2002. From genes to clones - Introduction to gene technology. VCR Pub., Weinheim.
3. James D Watson. *et al.* 1992. Recombinant DNA. WH freeman and Co., NY.

Websites and eLearning Sources:

1. https://microbiologyclass.net/enzymes-used-in-molecular-biology-techniques/
2. https://www.sciencedirect.com/science/article/pii/S0002961005808414
3. https://www.mybiosource.com/learn/gene-transfer-technique/
4. https://pubmed.ncbi.nlm.nih.gov/15032617/
5. https://molecularbrain.biomedcentral.com/articles/10.1186/1756-6606-7-17
6. https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/66/2019/et/MCB%20Mooc%205%20Module%2035%20Academic%20script20033112120303 3636.pdf
7. https://geneticeducation.co.in/genetic-markers-rflp-rapd-aflp-issr-str-scar-est-ssr-and-snp/
8. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4349364/

Course Outcomes		
CO. No.	**CO- Statements**	**Cognitive Level (K-level)**
	On successful completion of the course, the students will be able to	
CO-1	Remember the various underlying principles of genetic engineering and enzymes concerned with it	**K1**
CO-2	Understand the methodologies of gene transfer	**K2**
CO-3	Apply the analytical procedures involving DNA	**K3**
CO-4	Analyze the uptake of genes following screening procedures	**K4**
CO-5	Evaluate the methods of recombinant selection	**K5**
CO-6	Construct genecassettes and vectors	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**25PBI2CC04**			**Core Course - 4:** Genetic Engineering						**5**	**4**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score ofCOs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	1	1	2	3	2	2	3	3	2	2.1
CO2	3	2	2	2	3	3	2	3	2	3	2.5
CO3	2	3	2	3	2	3	2	2	3	3	2.5
CO4	2	2	2	3	2	3	3	2	3	3	2.5
CO5	2	3	3	3	2	3	3	3	3	3	2.8
CO6	2	3	3	2	2	3	2	3	3	3	2.6
	Mean overall score										**2.6**
											High

Semester	Course Code	Title of the Course	Hours/Weeks	Credits
2	25PBI2CC05	**Core Course - 5:** Human Physiology	6	5

Course Objectives
To gain knowledge on the general and cellular physiology of human system
To understand the general principle and functions of gastrointestinal system
To comprehend the structure and functions of the cardiovascular system in humans
To study the structural and functional unit of respiratory system and gaseous exchange
To be able to know the classification and properties of the nervous system
To be able to study the renal physiology and environmental physiology

Unit – I: **(18 Hours)**

General and Cellular Physiology - Cell as the living unit of the body. The internal environment-homeostasis. Control systems, organization of a cell, transport across cellmembranes, functional systems in the cells, blood – composition of body fluids and compartments. Homeostasis –Mechanisms, Homeostatic regulation of water and electrolytes. Plasma proteins and its function. Formed elements – development and function. Hemoglobin –structure and function. Blood Clotting mechanisms.

Unit – II: **(18 Hours)**

Gastro-intestinal System - General principles of GI function - mastication & swallowing, esophageal motility, salivary secretion, gastric mucosal barrier, pancreatic & biliary secretion,gastrointestinal motility, digestion & absorption, functions of colon, pathophysiology ofpeptic ulcer, gastrointestinal hormones and their actions, absorption of carbohydrates, fats and proteins, vitamins, water and electrolytes.

Unit – III: **(18 Hours)**

Cardio-vascular and Respiratory Physiology - Properties of cardiac muscle, cardiac cycle, heart as a pump, cardiac output, specialized tissues of the heart, coronary circulation, generation & conduction of cardiac impulse, control of excitation & conduction, electrocardiogram-arrhythmias. Cardiac failure, circulatory shock. Respiration – functional anatomy of respiratory system, pulmonary ventilation, alveolar ventilation, mechanics of respiration, pulmonary circulation, principles of gaseous exchange - oxygen & carbon dioxidetransport, regulation of respiration.

Unit – IV: **(18 Hours)**

Nerve and Muscle Physiology - General design of nervous system: Classification andProperties of nerve fibers, nerve conduction, Classification of somatic senses, sensory receptors, sensory transduction. Special senses - vision, hearing, smell, taste and their perceptions. Autonomic nervous system, limbic system and hypothalamus. EEG, sleep, emotions & behavior. Learning & memory. Functional anatomy of skeletal muscle, mechanisms of muscle contraction, smooth muscles.

Unit – V: **(18 Hours)**

Renal Physiology - Structure and functions of kidney – Structure of nephron, glomerular filtration, tubular reabsorption of glucose, water and electrolytes. Tubular secretion. Urine formation, renal mechanisms for the control of blood volume, blood pressure (Renin- angiotensin system) micturition, diuretics and renal failure.

Environmental physiology - physiology of hot and cold environment, high altitude, aviationphysiology, space physiology, deep sea diving & hyperbaric conditions.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Arthur C. Guyton and John E. Hall., "Textbook of Medical Physiology" 11th Edition, Elsevier Saunders, Elsevier Inc. 1600 John F. Kennedy Blvd., Suite 1800 Philadelphia, Pennsylvania 19103-2899
   Unit-I *Chapter 1* (Page No. 3-6)
   Unit-I *Chapter 32* (Page No. 420)
   Unit-II *Chapter 62, 63, 64, 65 and 66*
   Unit-III *Chapter 37 (Page No. 471, 472, 477, Chapter 38, 39 and 40*

Unit-IV *Chapter 45, 49, 50, 51, 52, 53, 57, 58, 59*

2. M N Chatterjea and Rana Shinde., "Textbook of Medical Biochemistry" 8th Edition, Jaypee Brothers Medical Publishers (P) Ltd., 4838/24, Ansari Road, Daryaganj, New Delhi 110 002, India.
   Unit-I *Chapter* 7 (Page No. 97-108)
3. Chandi Charan Chatterjee., "Human Physiology" Vol. I and Vol. II, Reprint (2007), Kalyani Publishers, 13/1B, Old Ballygune 2nd Lane, Kolkata 700 019.
   Unit-III *Vol. I - Chapter VII (Page No. 226, 227, 248, 249-254)*
   Vol. I - Chapter VIII (Page No. 365)
   Unit-IV *Vol. II – Chapter 5-2, 5-10, 5-16*
   Unit-V *Vol. II – Chapter 1-1, 1-15, 1-18, 1-40, 1-60 Vol. II – Chapter 8-1, 8-2*
4. Paul A. Iaizzo Editor, University of Minnesota Department of Surgery Minneapolis, MN, USA. Handbook of Cardiac Anatomy, Physiology, and Devices, Third edition, Springer International Publishing Switzerland 2015.
   Unit-III *Part I – Chapter 1.2.4*

Books for References:

1. Kathleen, J.W. Wilson and Anne Waugh. 1998. Ross and Wilson Anatomy and Physiologyin health and illness. (8th Edition). Churchchill Livingstone, New York.
2. Gerald J. Tortora and Sandra Reynolds. 2003. Principles of Anatomy and Physiology.(10th Edition). John Wiley and Sons. Inc. Pub. New York
3. Abraham White, Philip Handler and Emil L. Smith. 1983. Principles of Biochemistry.(6th Edition). Tata Mc Graw – Hill Publishing Company, New Delhi.

Websites and eLearning Sources:

1. https://www.studysmarter.co.uk/explanations/biology/cells/transport-across-cell-membrane/
2. https://www.lecturio.com/concepts/body-fluid-compartments/
3. https://med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Anatomy_and_Physiology_(Boundless)/25%3A_Body_Fluids_and_Acid Base_Balance/25.2%3A_Body_Fluids/25.2C%3A_Body_Fluid_Composition
4. https://www.news-medical.net/health/Blood-Clotting-Process.aspx
5. https://www.toppr.com/ask/question/explain-the-process-of-digestion-in-human-beings/
6. https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/digestive-system
7. https://academic.oup.com/edrv/article/24/5/571/2424269
8. https://www.niddk.nih.gov/health-information/digestive-diseases/peptic-ulcers-stomach ulcers/symptoms-causes
9. https://www.webmd.com/digestive-disorders/peptic-ulcer-overview
10. https://cvil.ucsd.edu/wp-content/uploads/2017/02/cardiac-cycle.pdf
11. https://med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Anatomy_and_Physiology_(Boundless)/21%3A_Respiratory_System/21.1%3A_Overview_of_the_Respiratory_System/21.1B%3A_Functional_Anatomy_of_the_Respiratory_System
12. https://www.onlinebiologynotes.com/mechanism-of-respiration-in-human/
13. https://www.biologydiscussion.com/human-physiology/nerve-fiber-classification-and properties-biology/62074
14. https://nurseslabs.com/special-senses-anatomy-physiology/
15. https://courses.lumenlearning.com/suny-dutchess-ap1/chapter/muscle-contraction-and locomotion/
16. https://www.osmosis.org/notes/Anatomy_and_Physiology_of_the_Renal_System
17. https://www.verywellhealth.com/what-is-the-renin-angiotensin-system-1763941
18. https://academic.oup.com/bioscience/article/69/2/152/5162974
19. https://biology.mcmaster.ca/research-areas/environmental-physiology/

Course Outcomes		
CO No.	**CO- Statements** On successful completion of the course, the students will be able to	**Cognitive Level (K-level)**
CO-1	Describe the anatomy of the human body	**K1**
CO-2	Understand the mechanism of gastrointestinal tract	**K2**
CO-3	Apply the knowledge in relating the structure with the functions of nervous system	**K3**
CO-4	Analyse the interrelationships within and between anatomical and physiological systems of the human body	**K4**
CO-5	Evaluate the influence of environment and feelings in the physiological processes and	**K5**
CO-6	Suggest the possible ways for the well-being	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**25PBI2CC05**			**Core Course - 5:** Human Physiology						**6**	**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	2	2	3	2	3	3	**2.4**
CO2	2	3	2	2	2	2	3	2	3	3	**2.4**
CO3	2	2	3	2	3	3	2	2	3	3	**2.5**
CO4	2	3	2	3	2	3	2	3	3	2	**2.5**
CO5	2	3	2	2	1	2	3	2	3	3	**2.3**
CO6	3	2	3	3	2	2	3	3	3	3	**2.7**
Mean Overall Score											**2.46 (High)**

Semester	Course Code	Title of the Course	Hours	Credits
2	25PBI2CC06	**Core Course - 6:** Clinical Biochemistry (Internship Embedded Course)	6	5

Course Objectives
To learn the biochemical background of diseases
To study the symptoms of various diseases
To apply a wide range of protocols in clinical biochemistry labs
To comprehend the various diagnostics procedures for diseases and disorders
To know mechanism of evaluation of results of diagnostic procedures
To apply the collective knowledge in establishing clinical biochemistry lab

UNIT – I: (18 Hours)

Blood and body fluids: Collection, preservation and anticoagulants. Disturbances in Blood clotting – haemophilia A and haemophilia B. Haemoglobin in anaemias-sickle cell, thallasemia, abnormal haemoglobins. Porphyrias and porphyrinurias. Hemolytic diseases of the new born. Adverse reactions of blood transfusions. Blood banking.

Cellular injury: causes, pathogenesis and morphology of cell injury. Intercellular alterations in lipids, proteins and carbohydrates, cellular adaptation, atrophy and hypertrophy. Basic mechanism involved in the process of inflammation and repair: alteration in vascular permeability and blood flow. Brief outline of the process of repair.

Unit – II: (18 Hours)

Disturbances of carbohydrate and Lipid metabolism: Blood sugars – Its maintenance, hyper and hypoglycemia. Regulation of blood glucose concentration. Diabetes mellitus – complications, secondary degenerative diseases. Laboratory diagnosis of early and latent diabetes. Glucose tolerance test. Dietary regimes in diabetes mellitus. Hypoglycemic agents. Galactosemia, fructosuria and lactose intolerance. Hypo and hyper cholesteremia, Hypo and hyper lipoprotenemia, hypocholestremic agents, hypertension –causes and its management. Lipid storage diseases- fatty liver & obesity.

Unit – III: (18 Hours)

Protein deficiency diseases: Plasma proteins - their significance and variation in health anddiseases. Agammaglobulinemia, Multiple myeloma, Proteinuria, Wilson's disease, Cystinuria, Hartnup disease, Maple syrup urine disease, Alkaptonuria, Albinism, Tyrosinosis, Phenylketonuria. Disorders of sulphur containing amino acid and urea cycle.

Nucleic acid disorders: Orotic aciduria, and Xanthinuria, Gout, Lesch-nyhan syndrome.

Unit – IV: (18 Hours)

Diseases of the liver: Macro and micro anatomy of liver, Hepatitis and its types, jaundice and its types. Cirrhosis, alcoholic liver diseases. Cholestatic liver diseases. Hepatic tumors and biliary tract diseases - clinical manifestation of liver diseases. Liver functions tests. Disorders of bilirubin metabolism. Enzyme released from diseased liver tissue. Pancreatic function test; Gastric function test. Biochemical parameters of CSF in health and disease.

Unit – V: (18 Hours)

Renal Diseases: Renal stress and its analysis. Renal function tests - biochemical changes in acute and chronic renal failure. Normal and abnormal urinary constituents. Enzyme parameters in pathological conditions.

Cardiac pathology - Major manifestations of heart disease - Ischaemic heart diseases, anginapectoris, myocardial infarction. Cardiac markers in infarction - LDH, creatine kinase. Serological tests in infectious diseases and viral infections. Amniotic fluid and maternal serum in ailment and in pregnancies.

Internship: Students are entitled to spend a minimum of ten days in a clinical diagnostic laboratory and submit the relevant documents

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. M N Chatterjea and Rana Shinde., "Textbook of Medical Biochemistry" 8th Edition, Jaypee Brothers Medical Publishers (P) Ltd., 4838/24, Ansari Road, Daryaganj, New Delhi 110 002, India.

Unit II *Pages 384-388* **Unit III** *Chapter – 7 (Pages 97-107)*
Unit IV *Chapter – 31 (Pages 659-72)* **Unit V** *Chapter – 36 (Pages 651-56)*

2. Gundu HR Rao, Ted Eastlund and Latha Jagannathan (Editors), "Handbook of Blood Banking and Transfusion Medicine". Jaypee Brothers Medical Publishers (P) Ltd, EMCA House, 23/23B Ansari Road, Daryaganj, New Delhi 110 002, India
   Unit I *Chapter 1-10*
3. Dinesh Puri. "Textbook of Medical Biochemistry" 3rd Edition, Elsevier A division of Reed Elsevier India Private Limited, Registered Office: 622, Indraprakash Building, 21 Barakhamba Road, New Delhi 110 001.
   Unit V *Chapter – 34 (Pages 695-697)*
4. Thomas M. Devlin (Editor), Textbook of Biochemistry with Clinical Relationship matrixs, 7th Edition, John Wiley & Sons, Inc. (Ebook)
   Unit I *Chapter – 23 – 23.4 (Pages – 982- 997)*
   Unit II *Chapter – 16 – 16.1 to 16.5*
   Unit III *Chapter – 19 – 19.1, 19.2, 19.7 to 19.11and 19.21*
5. John W. Baynes and Marek H. Dominiczak. "Medical Biochemistry" 4th Edition,Saunders, Elsevier (Ebook).
   Unit I *Chapter 4* **Unit II** *Chapter 21*
6. Devlin, 1997, Textbook of Biochemistry (with Clinical Relationship matrix), John Wiley, UK.

Books for References:

1. Henry, R. J., Cannon, D. C, and Winkelman, J. W., 1974. "Clinical Chemistry: Principles and Techniques" 2nd ed. Harper and Row, Hagerstown, Maryland.
2. Cantrow and Trumper, 1962, Clinical Biochemistry, 6th edition, VY.B. Saunders Company, Philadelphia.
3. Luxton. R, 2008, Clinical Biochemistry, 2nd edition, Scion Publishing Ltd., Bloxham, United Kingdom.
4. John W. Baynes and Marek H. Dominiczak. "Medical Biochemistry" 4th Edition, Saunders, Elsevier (E book).

Websites and eLearning Sources:

1. https://www.jstor.org/stable/4576855
2. https://extranet.who.int/lqsi/sites/default/files/attachedfiles/LQMS%205-3%205
3. 6%20Sample%20collection%20transport.pdf
4. https://my.clevelandclinic.org/health/diseases/14083-hemophilia
5. https://www.mayoclinic.org/diseases-conditions/hemophilia/symptoms-causes/syc-20373327
6. https://www.nhlbi.nih.gov/health/sickle-cell-disease
7. https://www.mayoclinic.org/diseases-conditions/sickle-cell-anemia/symptoms-causes/syc20355876
8. https://my.clevelandclinic.org/health/diseases/14508-thalassemias
9. https://www.webmd.com/a-to-z-guides/porphyria-symptoms-causes-treatment
10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7171462/
11. https://step1.medbullets.com/pathology/106028/cell-injury
12. https://my.clevelandclinic.org/health/diseases/7104-diabetes
13. https://www.healthline.com/health/diabetes
14. https://my.clevelandclinic.org/health/diseases/23921-hypercholesterolemia
15. https://www.healthline.com/health/cholesterol/hypocholesterolemia
16. https://rarediseases.org/rare-diseases/maple-syrup-urine-disease/
17. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6331359/
18. https://my.clevelandclinic.org/health/diseases/4755-gout
19. https://medlineplus.gov/hepatitis.html
20. https://my.clevelandclinic.org/health/diseases/15367-adult-jaundice
21. https://www.slideshare.net/YESANNA/gastric-function-tests-44375354
22. https://onlinelibrary.wiley.com/doi/full/10.1046/j.1365-2036.2003.01495.x
23. https://www.physio-pedia.com/Renal_Function_Test_(RFT)
24. https://www.advocatehealth.com/health-services/advocate-heart-institute/conditions/ischemicheart-disease

CO. No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	Discuss thoroughly about the biochemical basis of various diseases and disorders	**K1**
CO-2	Understand the mechanisms of blood clotting and the related disorders	**K2**
CO-3	Apply a wide range of protocols in clinical biochemistry analysis	**K3**
CO-4	Analyze the symptoms of various diseases	**K4**
CO-5	Evaluate various diagnostic procedures for diseases and disordersand initiate blood banking	**K5**
CO-6	To make understand the pregnancies complication and ailment.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**25PBI2CC06**			**Core Course – 6:** Clinical Biochemistry (Internship Embedded Course)					**6**		**5**
Course Outcomes (Cos)	**Programme Outcomes (Pos)**					**Programme Specific Outcomes (PSOs)**					**Mean score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	3	3	3	3	2	3	2	2.7
CO2	3	3	3	1	3	3	2	1	3	2	2.6
CO3	2	3	1	3	3	3	2	1	3	2	2.3
CO4	3	2	2	3	3	2	3	1	1	3	2.3
CO5	3	2	2	2	3	3	1	2	3	1	2.2
CO6	3	2	2	3	3	2	2	1	2	2	2.2
										Mean overall score	**2.48**
											High

Semester	Course Code	Title of the Course	Hours	Credits
2	25PBI2CP02	**Core Practical - 2:** Enzymology, Genetic Engineering and Molecular Biology	5	2

Course Objectives
To know the isolation procedure of enzymes from plant and animal tissues.
To assay the activity of enzymes like acid and alkaline phosphatase.
To comprehend the methods involved in the measurement of blood pressure.
To measure and interpret ECG and BMI.
To isolate and quantify the nucleic acids (DNA and RNA).
To synthesize synthetic seed preparation.

Enzymology

1. Assay of acid phosphatase.
2. Factors influencing reaction rates of acid Phosphatase.
    - Effect of Temperature.
    - Effect of Time.
    - Effect of pH.
    - Effect of Enzyme concentration.
    - Effect of substrate concentration (Measurements of Vmax & Km)

Physiology

1. Blood Pressure - Measurement – Effect of exercise and postural variation on BP.
2. ECG recording
3. Body Mass index calculation

Molecular Techniques

1. Agarose gel electrophoresis of Nucleic acids (DNA & RNA)
2. Polyacrylamide gel electrophoresis (protein)
3. Isolation of chromosomal DNA from blood samples by Phenol-Chloroform method.
4. Preparation of genomic DNA from bacteria
5. Synthetic seed preparation

Books for References:

1. Lansing M Prescott, John P Harley and Donald A Klein. 2007. Microbiology.(7thEdition). Mc Graw Hill, New York.
2. James G. Cappucino and Sherman Natalie 2005. Microbiology – A Laboratory Manual. (7th edition). Pearson education India, New Delhi.
3. Glick R. and J. J. Pasternak. 2002. Molecular Biotechnology (3rd Edition). ASM Press,Washington, USA.
4. Old R.W and S.B Primrose. 1989. Principles of gene manipulation (Ed: 4). Blackwell Scientific Publications, London.
5. Praful. B. Godkar, 2014, Text book of Medical laboratory technology; III Edition,Volume I and II, Bhalani Publishing house.
6. Alan H Gowenhock, Varley's Practical Clinical Biochemistry, 6th Edition; CBS publishers.

Course outcomes		
CO No.	**CO-Statements**	**Cognitive Level (K-level)**
On successful completion of the course, the students will be able to		
CO-1	Describe the isolation procedures of the enzymes	**K1**
CO-2	Explain the factors affecting the enzyme action and the importance ofthe blood circulation and changes in the physiology of the circulation during exercise	**K2**
CO-3	Apply the knowledge to study the effect of various factors over the activity of different enzymes	**K3**
CO-4	Analyze the patterns of cardiac cycle during normal and in exercise condition	**K4**
CO-5	Evaluate the banding pattern in protein	**K5**
CO-6	To prepare seeds germplasm artificially	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**25PBI2CP02**			**Core Practical – 2:** Enzymology, Genetic Engineering and Molecular Biology					**5**		**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	3	2	2	3	2	3	**2.5**
CO2	2	2	3	2	2	2	3	2	3	3	2.4
CO3	2	2	3	3	2	2	3	2	3	3	2.5
CO4	2	3	3	3	2	2	2	3	2	3	2.5
CO5	3	2	2	3	3	2	3	2	2	3	2.5
CO6	3	2	3	2	2	2	3	3	2	2	2.4
	Mean overall score										**2.45**
											High

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25PBI2OE02	**Open Elective - 2 (BS):** First Aid Management	4	2

Course Objectives
To explain the concept of first aid and to understand the difference between emergency treatment and first aid.
To know and explain the basic applications of first aid.
To comprehend the importance of the body systems and to explain the importance of the respiratory system. To explain the importance of the circulatory system.
To explain functions of blood vessels and to explain the types of bleedings. First aid for injuries and explain first aid for other emergencies.
To explain first aid for poisonings and the physiology of drowning.
To explain patient/injured transport techniques. First aid kits and first aid rooms.

Unit – I: (12 Hours)

Principles of First Aid Management: Basic knowledge about human body organs and their functions (Circulatory system, Nervous system, Skeletal system, Digestive system, Muscular system). Principles of First Aid. First aid kits. Causality assessment. Priorities of first aid, unconsciousnessand recovery positions. Resuscitation, control of major bleedings, chocking, and treatment of shocks. Emergency aid in schools and others.

Unit – II: (12 Hours)

Causality assessment: Patient management and care, labeling of causalities. Approach to a causality. Handling and transport of injured persons. Disaster management and multiplecausalities.

Unit – III: (12 Hours)

Bleeding and injuries: Internal and external bleeding, injuries to muscles, joints and bones, stroke. Miscellaneous injuries, splinting skill tests, head, neck, back, chest, abdomen injuries. Poisoning - bites - stings. Drug abuse. Frostbite and cold exposure. Burns and Scalds. Heat stroke, heat cramps and heat exhaustion.

Unit – IV: (12 Hours)

Emergency Care: Accident reporting, first aid to victims of road accidents. Patient assessment and management, breathing emergencies, defibrillation. Sudden illness – heart attack, stroke, fainting, convulsion epilepsy, prevention of heart attack and apoplexy.

Unit – V: (12 Hours)

First aid rooms and equipments: Cleaning of wounds, dressing and bandages. Antiseptics – types and action. Injury assessment in factories and in rural areas. Psychological first aid.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. St. John's Ambulance (India), "First aid to the injured". 1 Red Cross Road, New Delhi –110001.
   UNIT-I *Pages 21-41, 197-198, 176-185,*
   UNIT-II *Pages 186-190, 227-229, 230-270,*
   UNIT-III *Pages 81-103*
   UNIT-V Pages 191-196, 272-274,
2. Manivannan C. and Latha Manivannan T. "Textbook of First aid and emergency nursing",Published by Manjunath S. Hedge, EMMESS Medical Publishers, No.26/3, 1st Cross, 1st 'R' Block, Rajajinagar, Bangalore – 560 010.
   UNIT-IV *Pages 96, 97, 101, 117, 128*

Books for References:

1. John Furst, "The complete First Aid Pocket". Adams Media, New Delhi, India.

2. Standard First Aid and Personal Safety 8th edition – American Red Cross.

Websites and E-Learning Sources:

1. https://my.clevelandclinic.org/health/diseases/hemorrhage
2. https://www.eird.org/isdr-biblio/PDF/Mass%20casualty%20management%20systems.pdf
3. https://egyankosh.ac.in/bitstream/123456789/47237/1/Unit-1.pdf
4. https://tytekmedical.com/blogs/2025/understanding-respiratory-emergencies-common-causes-and-symptoms/
5. https://www.europsy.net/app/uploads/2022/03/Psychological-first-aid-WHO-presentation.pdf

Course Outcomes		
CO. No.	**CO- Statements**	**Cognitive Level (K- level)**
	On successful completion of the course, the students will be able to	
CO-1	Describe the basic assessment of an emergency situation	**K1**
CO-2	Identify and assess the first aid procedures in the management of any injury	**K2**
CO-3	Apply ABC rule in various emergency situations	**K3**
CO-4	Analyze various critical scenario like hemorrhage, fracture, snakebite, poisoning and other situations	**K4**
CO-5	Evaluate psychological intelligence during critical situations	**K5**
CO-6	Applying the learned skills in life situations	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**25PBI2OE02**			**Open Elective - 2 (BS):** First Aid Management						**4**	**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean scoreof COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	2	3	2	3	3	2.6
CO2	2	3	1	2	3	3	1	3	1	3	2.2
CO3	2	3	1	3	2	3	2	3	3	2	2.4
CO4	2	3	3	3	3	1	3	3	2	3	2.6
CO5	2	1	3	3	2	3	3	3	5	1	2.6
CO6	3	2	3	2	2	1	2	3	2	3	2.2
	Mean overall score										**2.43**
											High

Semester	Course Code	Title of the Course	Hours / Weeks	Credits
2	25PSS2SE01	**Skill Enhancement Course:** Soft Skills	4	2

Course Objectives
To provide a focused training on soft skills for students in colleges for better job prospects
To communicate effectively and professionally
To help the students take active part in group dynamics
To familiarize students with numeracy skills for quick problem solving
To make the students appraise themselves and assess others

Unit I: Effective Communication & Professional Communication (12 Hours)

Definition of communication - Barriers of Communication - Non-verbal Communication. Effective Communication - Conversation Techniques - Good manners and Etiquettes - Speech Preparations & Presentations - Professional Communication.

Unit II: Resume Writing & Interview Skills (12 Hours)

Resume Writing: What is a résumé? Types of résumés – Chronological - Functional and Mixed Resume - Purpose and Structure of a Resume - Model Resume.

Interview Skills: Types of Interviews - Preparation for an interview – Attire - Body Language - Common interview questions - Mock interviews & Practicum.

Unit III: Group Discussion & Personal effectiveness (12 Hours)

Basics of Group Discussion- Parameters of GD- Topics for Practice - Mock GD & Practicum & Team Building. *Personal Effectiveness*: Self Discovery - Goal Setting with questionnaires & Exercises.

Unit IV: Numerical Ability (12 Hours)

Introducing concepts - Average – Percentage - Profit and Loss - Simple Interest - Compound Interest - Time and Work - Pipes and Cisterns.

Unit V: Test of Reasoning (12 Hours)

Introducing Verbal Reasoning: Series Completion – Analogy - Data Sufficiency - Assertion and Reasoning and Logical Deduction. *Non-Verbal Reasoning*: Series - and Classification.

Teaching Methodology	Chalk and talk, PPT, Mathematical models, Video presentation

Books for Study:

1. Melchias G., Balaiah, J. & Joy, J. L. (Eds). (2018). Winner in the Making: A Primer on Soft Skills. Trichy, India: St. Joseph's College.

Books for Reference:

1. Aggarwal, R. S. (2010). A Modern Approach to Verbal and Non- Verbal Reasoning. S. Chand.
2. Covey, S. (2004). 7 Habits of Highly effective people. Free Press.
3. Gerard, E. (1994). The Skilled Helper (5th Ed.). Brooks/Cole.
4. Khera, S. (2003). You Can Win. Macmillan Books.
5. Murphy, R. (1998). Essential English Grammar, (2nd Ed.). Cambridge University Press.
6. Sankaran, K., & Kumar, M. (2010). Group Discussion and Public Speaking (5th Ed.). M.I. Publications.
7. Trishna, K. S. (2012). How to do well in GDS & Interviews? (3rd Ed.). Pearson Education.
8. Yate, M. (2005). Hiring the Best: A Manager 's Guide to Effective Interviewing and Recruiting

Websites and eLearning Sources:

1. https://www.indeed.com/career-advice/resumes-cover-letters/communication-skills
2. https://www.seek.com.au/career-advice/article/50-communication-skills-for-the-workplace-your-resume
3. https://southeast.iu.edu/career/files/power-phrases.pdf
4. https://dese.ade.arkansas.gov/Files/20201209124449_Professional-Communication.docx

5. https://www.dol.gov/sites/dolgov/files/ETA/publications/00-wes.pdf
6. https://www.tmu.ac.in/other_websites/cdoe.tmu.ac.in.old/study-material/28-08-2024/COMMON/SEMESTER_2/MAIN_SOFT_SKILLS.pdf
7. https://byjus.com/maths/profit-and-loss-questions/
8. https://www.indiabix.com/

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, students will be able to	
CO1	Recall various soft skill sets	**K1**
CO2	Understand personal effectiveness in any managerial positions	**K2**
CO3	Apply verbal and non-verbal reasoning skills to solve problems	**K3**
CO4	Differentiate problems at work and home; and design solutions to maintain work-life balance	**K4**
CO5	Assess growth and sustainability and infuse creativity in employment that increases professional productivity	**K5**
CO6	Construct plans and strategies to work for better human society	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
2	**25PSS2SE01**		**Skill Enhancement Course:** Soft Skills							**4**	**2**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	2	3	2	3	2.7
CO2	3	3	3	2	3	3	3	3	3	3	2.9
CO3	3	2	2	3	3	3	3	3	3	3	2.8
CO4	3	3	2	2	3	3	3	3	3	3	2.8
CO5	3	3	3	2	2	3	3	3	3	3	2.8
CO6	3	3	3	2	2	3	3	3	3	3	2.8
										Mean Overall Score	**2.8 (High)**

Semester	Course Code	Title of the Course	Hours / Weeks	Credits
3	25PBI3CC07	**Core Course – 7:** Immunology	5	5

Course Objectives
To gain knowledge on the anatomy of the immune reactions
To study the adverse effects of various hypersensitivity reactions
To gain the knowledge of tissue matching procedures
To learn the structural and functional details of various types ofantibodies
To understand the biochemical basis of immune disorders
To learn the methods used to produce monoclonal antibodies

Unit – I: **(15 Hours)**

Introduction to Immunology: Infection- types, factors influencing infection pathogenicity. Sources and carriers of infectious agents. Immune system- definition and properties. Cells of the immune system. Lymphoid organs- primary and secondary; structure and functions.Natural defenses of the body (Innate immunity) - skin, mucous membrane, lysozyme and phagocytes. Reticuloendothelial system and its components.

Unit - II: **(15 Hours)**

Antigens and Antibodies: definition, properties- antigenicity and immunogenicity, antigenicdeterminants and haptens. Types of antigens - flagellar, somatic, capsular, soluble, heterophile,tumour and autoantigens. Antigen - antibody interactions - molecular mechanism of binding. Affinity, avidity, valency, cross reactivity and multivalent binding. Complement system; components - alternate and classical pathways, initiators and MAC. Inflammation - acute and chronic; mechanism and significance.

Unit – III: **(15 Hours)**

Immunoglobulins: Basic structure, classes and distribution of antibodies. Antibody diversity -genetic and other factors. Theories of antibody formation. Acquired immunity - Humoral: Biosynthesis of antibodies; B and T lymphocyte cooperation. Primary and secondary immuneresponse. Cell Immunity-components of T lymphocytes, T cell receptor diversity and CD molecules. Role of antigen presenting cells. Regulation of immune response. Cytokines, types and role in immunity. Mitogens and immunosuppressants. Immunological tolerance- at birth and in adults; induction and termination.

Unit – IV: **(15 Hours)**

Immune system in health & disease: Transplantation immunology- graft rejection and HLAantigens. Role of MHC and T cells. Prevention of graft rejection. Hypersensitivity- Immediate and delayed types; mechanism of reaction. Vaccines and toxoids: types - Messenger RNA (mRNA) vaccines, Subunit, recombinant, polysaccharide, and conjugate vaccines, and toxoids - production and uses. Active and passive immunization, immunization schedule. Tumor immunology: tumor antigens, immunosurveilance and NK cells. Auto immunity-mechanism of breakdown, pathogenesis and specific diseases.

Unit – V: **(15 Hours)**

Immunological techniques: Polyclonal antibodies - principle and production of antisera. Monoclonal antibodies - hybridoma technique, applications, merits and demerits. Recombinantantibodies. Principle and applications of RIA, ELISA. Precipitation reaction - Immunodiffusion,immunoelectrophoresis, precipitin ring test. Agglutination tests – heam agglutination, febrile and latex agglutination. Widal, VDRL, pregnancy and rheumatoid factor tests.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for study:

1. Kuby Richard, A. Goldsby., Thomas J. Kint and Barbara. A. Osborne. 2000. Immunology. (4th Edition), W.H. Freeman and Company, New York.
   UNIT-I *Chapter II*
   UNIT-II *Chapter III*
   UNIT-III *Chapter IV, XI, XII*

UNIT-IV *Chapter VII, XVI, XX*
UNIT-V *Chapter XXIII*

2. Cellular and Molecular Immunology, 7th Edition, Abul K Abbas, Andrew H Litchman Elsevier Publications 2012 (E book)
   UNIT-I *Chapter I* and II
   UNIT-II *Chapter V*
   UNIT-III Chapter *V, IX, X*
   UNIT-IV *Chapter XVI, XVII* and *XVIII*
   UNIT-V *Appendix IV*
3. Charles A. Janeway and Paul, J. R. 1994. Immunobiology. (4th Edition), Travels Blackwell Scientific Publishers, New York.
   UNIT-I *Chapter* I
   UNIT-II *Chapter* II
   UNIT-III *Chapter* IV, V, VI, VII, VIII
   UNIT-IV *Chapter* XII XIII
   UNIT-V *Chapter* Appendix I

Books for Reference:

1. Fahim Halim Khan, 2009, The Elements of Immunology, Pearson education, New Delhi.
2. Frank C. Hay and Olwyn M. R. Westwood, 2006, Practical Immunology, BlackwellPublishing, India.
3. Ivan M. Roitt and Peter J. Delves. 2005. Roitt's Essential Immunology. (10th Edition).Blackwell Scientific Publishers, New York.

Websites and eLearning Sources:

1. https://pmc.ncbi.nlm.nih.gov/articles/PMC11656891/
2. https://microbenotes.com/antigen/
3. https://www.deshbandhucollege.ac.in/pdf/resources/1589563184_LS-VI-Immuno-Unit_4.4.pdf
4. https://my.clevelandclinic.org/health/body/24630-t-cells
5. https://www.biologydiscussion.com/immunology/short-notes-on-polyclonal-antibodies-with-diagram/56038
6. https://microbiologynotes.com/elisa-principle-types-and-applications/

CO. No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	Describe the anatomy of the immune reactions	**K1**
CO-2	Compare the adverse effects of various hypersensitivity reactions	**K2**
CO-3	Apply the knowledge of tissue matching procedures	**K3**
CO-4	Analyze the structural and functional details of various types ofantibodies	**K4**
CO-5	Evaluate the biochemical basis of immune disorders	**K5**
CO-6	Produce monoclonal antibodies	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
3	**25PBI3CC07**			**Core Course – 7:** Immunology					**5**		**5**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	1	3	3	1	2	3	3	1	2	2.2
CO2	3	1	2	2	3	3	2	1	2	2	2.1
CO3	2	1	3	1	3	3	1	2	3	3	2.2
CO4	1	2	3	1	3	3	2	1	3	3	2.2
CO5	3	2	1	3	2	3	2	3	2	2	2.3
CO6	2	3	2	3	3	2	2	3	3	2	2.5
									Mean overall score		**2.25**
											High

Semester	Course Code	Title of the Course	Hours/Weeks	Credits
3	25PBI3CC08	**Core Course - 8:** Developmental Biology	5	4

Course Objectives
To know the basic concepts involved in the cells during early development and communication.
To understand the structure and physiology of gametes and sex determination.
To comprehend the stages involved in the development of organs in mammals.
To study the steps involved during and after fertilization.
To be able to explain the various factors involved in the determination of sex.
To gain knowledge on the genetic disease.

Unit - I: Basic concepts (15 Hours)

General principles of cell-cell communication in development: cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, paracrine factors. General concept of organisms development: Potency, commitment, specification, induction, competence, determination & differentiation; morphogenetic gradients; cell fate & cell lineages; genomic equivalence and cytoplasmic determinants; imprinting.

Unit – II: Fertilization, development and sex determination in humans (15 Hours)

Gametogenesis - Sperm & Egg formation; ultra-structure of sperm and ovum, egg types, egg membrane. Fertilization, cleavage, Morula, Implantation, blastulation, gastrulation, formation of germ layers, axis formation - anterior and posterior. Sex determination - chromosomes and environment.

Unit – III: Organogenesis - I (15 Hours)

Central nervous system and the epidermis - Formation of neural tube, Differentiation of the neural tube, tissue architecture of the central nervous system, origin of cutaneous structures. Neural crest cells and axonal specificity - specification, Trunk neural crest, pattern generation in the nervous system.

Unit – IV: Organogenesis - II (15 Hours)

Paraxial and intermediate mesoderm - Somites formation, Osteogenesis, Urogenital system. Lateral plate mesoderm and endoderm - Heart formation, digestive tube and its derivatives.

Unit – V: Implications of developmental biology (15 Hours)

Medical implications of developmental biology - genetic disorders in human development, environmental assaults on human development, Future therapies and developmental biology, Environmental regulation of animal development - Environment as a part of normaldevelopment, Polyphenisms and plasticity, Learning system.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. S. Chattopadhyay. 2016. An Introduction to Developmental Biology. Books and Allied (P) Ltd. Kolkata.
   Unit I *Chapter 4 (Pages 73-101) Chapter 5 (Pages 101-117) Chapter 7 (Pages 131-154)*
   Unit II *Chapter 9 (Pages 189-212) Chapter 10 (Pages 214-226)*
   Unit III *Chapter 16 (Pages 351 – 384)*
2. Scott F. Gilbert. 2010. Developmental Biology, (Ed: 9) Sinauer Associates Inc.Massachusetts.
   Unit I *Part 1 - Chapter 3, 6* **Unit II** *Part 2 - Chapter 7, 8, 9, 11, 17*
   Unit III *Part 3 – Chapter 12, 13* **Unit IV** *Part 3 – Chapter 14, 15*
   Unit V *Part 4 – Chapter 21*
3. Paul A. Iaizzo Editor, University of Minnesota Department of Surgery Minneapolis, MN, USA. Handbook of Cardiac Anatomy, Physiology, and Devices, Third edition, Springer International Publishing Switzerland 2015 (eBook).
   Unit IV *– Part – II Chapter – 3 – 3.1 to 3.6*
4. Schoenwolf, Bleyl, Brauer and Francis-West. "Larsen's Human Embryology" 5th Edition,Elsevier, Churchill Livingstone, 1600 John F. Kennedy Blvd. Ste 1800 Philadelphia, PA 19103-2899 (Ebook).

Unit II *Chapter – 1(Pages 14-38)* **Unit III** *Chapter – 4 (Pages 82-107)*

Books for References:

1. Alberts B. *et al.* 2002. Molecular Biology of the Cell, (Ed: 3) Garland Science, NY.
2. Harvey Lodish., Arnold Berk and Paul Matsudaira. 2008. Molecular Cell biology.(5th Edition). W. H. Freeman and Company, New York.

Websites and eLearning Sources:

1. https://asutoshcollege.in/new-web/Study_Material/Msc_2nd_sem_06042020.pdf
2. https://kvmwai.edu.in/upload/StudyMaterial/Chromosomal_Environmental_Sex_Determination_-_20240408_011156.pdf
3. https://sdmiramar.edu/sites/default/files/2024-01/%239%20Nervous%20System%20Lect%20Notes.pdf
4. https://teachmeanatomy.info/the-basics/embryology/cardiovascular-system/
5. https://bgc.ac.in/pdf/study-material/developmental-biology-7th-ed-sf-gilbert.pdf
6. https://www.ncbi.nlm.nih.gov/books/NBK9997/
7. https://ncert.nic.in/textbook/pdf/kebt108.pd
8. https://www.genome.gov/For-Patients-and-Families/Genetic-Disorders
9. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7405896/
10. https://shs.hal.science/halshs_01498604/file/NicoglouPhenotypic_Plasticity_From_Microevolutio.pdf

Course Outcomes		
CO. No.	**CO- Statements**	**Cognitive Level (K-level)**
	On successful completion of the course, the students will be able to	
CO-1	Describe the cellular basis and embryonic development	**K1**
CO-2	Elucidate the process and mechanisms of sex determination inmammals	**K2**
CO-3	Assign the gene function to the phenotype of an organism	**K3**
CO-4	Analyze mechanisms of the development of various organs	**K4**
CO-5	Evaluate the role of environment in the developmental process	**K5**
CO-6	Apprehend the various genetic diseases	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**	**Credits**	
3	**25PBI3CC08**			**Core Course – 8:** Developmental Biology					**5**	**4**	
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO 5**	
CO1	2	3	2	2	3	2	2	2	2	2	2.2
CO2	2	3	3	2	1	2	3	3	3	3	2.5
CO3	2	2	3	2	3	3	2	2	3	3	2.5
CO4	2	3	2	3	2	3	2	3	3	2	2.5
CO5	2	3	2	2	1	2	3	2	3	3	2.3
CO6	3	2	1	3	2	2	1	2	3	3	2.2
										Mean overall score	**2.36**
											High

Semester	Course Code	Title of the Course	Hours	Credits
3	25PBI3CC09	**Core Course – 9:** Analytical Biochemistry and Research Methodology	4	3

Course Objectives
To gain the knowledge on the working principle, construction of lab instruments.
To learn the principle and application of electrophoresis, chromatography and centrifugation and the nuances of scientific writing and publishing.
To study the lab instruments based on the need and various bioinformatics tools.
To analyze the output of various spectroscopic methods.
To learn the methods to evaluate the project results using statistical procedures and designmethodologies for the isolation for bioactive compounds.
To gain the knowledge on the working principle, construction of lab instruments.

Unit – I: **(12 Hours)**

Electrochemical techniques – Principles, electrochemical cells and reaction – pH and buffers. Measurement of pH – glass electrode and titration curves. Ion selective and gas sensing electrodes, oxygen electrode, and their applications.

Chromatographic techniques – General principle; adsorption and partition chromatography.Techniques and application of paper, column, thin layer**,** normal phase and reverse phase - ion-exchange chromatography, exclusion chromatography, affinity chromatography, GLC and HPLC, HPTLC.

Unit – II: **(12 Hours)**

Centrifugation: Principles, differential and analytical centrifugation, density gradient centrifugation; Analysis of sub cellular fractions, ultracentrifuge and its application.

Electrophoresis: Principles, electrophoretic mobility, factors influencing electrophoretic mobility – paper, disc, slab gel electrophoresis. Isoelectric focusing, 2D PAGE, blotting techniques, capillary electrophoresis.

Unit – III: **(12 Hours)**

Spectroscopy – Properties of EMR, absorption spectrum, absorption *Vs* emission spectrophotometry, AAS& flame photometer, UV / VIS spectroscopy, IR, NMR, GCMS, Mass spectrometry MALDI-TOF, LC-MS.

Tracer technique: Nature of Radioactivity: Patterns of decay, half-life and its application, Geiger Muller Counter- principle and applications. Scintillation counter – Principle, typesand applications. Use of isotopes in biological studies.

Unit – IV: **(12 Hours)**

Research Methodology: Selection of research problems – hypothesis – definition and characteristics. Experimental approaches – biological, physical and chemical methods. Sources of information: Journals, e-journals, books, biological abstracts, Preparation of index cards, Review writing, Article writing – structure of article. Selection of journals for publication- Impact factor – Citation index and H index. Proposal writing for funding.

Biostatistics: Basics and uses of Measures of Central values, Measures of Dispersion (Standard Deviation and coefficient of variation) in data analysis and presentation. Sample Testing: Large samples(Z), small sample test: t, Chi-square, ANOVA - one way & two way, SPSS.

Unit – V: **(12 Hours)**

Bioinformatics: Introduction to Bioinformatics, Bioinformatics and its applications, Information networks - EMB net and NCBI. Databases; Primary Nucleic acid databases - EMBL; Gene Bank and DDBJ. Structure of Gene bank entries. Protein sequences databases; primary databases PIR, MIPS, SWISS - PROT, TrEMBL, NRL-3D. Structure of SWISS - PROT entries. Secondary Databases; PROSITE, PROFILES, PRINTS, Pfam, BLOCKS and IDENTITY. Composite protein Databases.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath, 2014 Biophysical Chemistry(Principles and Techniques) (4th Edition,) Himalaya Publishing House, India.
   UNIT-I *Chapter 1(Pages 1-63***),** *Chapter 2 (Pages 66-73), and Chapter 11 (Pages-416)*
   UNIT-II *Chapter 10 (Pages 301-343), Chapter 12 (Pages 422-474)*
   UNIT-III *Chapter 8(Pages 175-186,192-221,243-262), Chapter 13(489-555)*
2. Fundamentals of research methodology and data collection. Chinelo Igwenagu, Enugu State University of Science and Technology (April 2016), Faculty of Physical Sciences University of Nigeria, Nsukka.
   UNIT-IV *Chapter 1 (Sec 1.1, 1.3, 1.5,1.6), Chapter 2 (Sec 2.3), Chapter 3 (3.1), Chapter 6*.
3. Andreas D. Baxevanis, B. F. Francis Ouellette, Bioinformatics, A Practical Guide to the Analysis of Genes and Proteins, (2nd Edition, 2001), A John Wiley & Sons., Inc.,publication.
   UNIT-V *Chapter 2 (Page 19), Chapter 3 (Page 45), Chapter 4, Chapter 5 and Chapter 8*.

Books for References:

1. Wayne W. Daniel, 2006, Biostatistics: A Foundation for Analysis in the Health Sciences (9th Edition), John Willey and Sons Inc., USA.
2. Attwood, T. K., and Parry-Smith, D.J. 1999. Introduction to bioinformatics. Pearson Education Ltd., Delhi, India.
3. Rodney F. Boyer. 1993. Modern Experimental Biochemistry. (2nd Edition), Benjamin- Cummings Publishing, Redwood City, CA.

Websites and eLearning Sources:

1. https://www.egyankosh.ac.in/bitstream/123456789/105041/1/Unit-3.pdf
2. https://www.vbspu.ac.in/e-content/Prabhakar-Singh/ELECTROPHORESIS.pdf
3. https://uou.ac.in/sites/default/files/slm/MSCCH-509.pdf
4. https://www.shimadzu.com/an/sites/shimadzu.com.an/files/pim/pim_document_file/technical/primers/13484/jpo118059.pdf
5. https://www.utoledo.edu/library/mulford/pdf/ba.pdf

CO. No.	CO- Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	Describe the knowledge on the working principle, construction of lab instruments	**K1**
CO-2	Explain the principle and application of electrophoresis, chromatographyand centrifugation and the nuances of scientific writing and publishing	**K2**
CO-3	Apply lab instruments based on the need and various bioinformatics tools	**K3**
CO-4	Analyze the output of various spectroscopic methods	**K4**
CO-5	Evaluate the project results using statistical procedures	**K5**
CO-6	Design methodologies for the isolation for bioactive compounds	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**25PBI3CC09**			**Core Course - 9:** Analytical Biochemistry and ResearchMethodology						**4**	**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	1	3	1	2	3	1	2	1	2	1.8
CO2	3	1	1	1	2	3	1	3	2	2	1.9
CO3	2	3	3	2	3	2	1	3	3	1	2.3
CO4	2	3	2	3	1	3	2	1	3	1	2.1
CO5	3	2	1	3	1	3	3	1	1	2	2.1
CO6	3	2	1	3	1	3	3	1	1	2	2.1
	Mean overall score										**2.04**
											Medium

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25PBI3CP03	**Core Practical - 3:** Immunology, Andrology and Hormone Assay	8	4

Course Objectives
To learn the basic tests of immunology like WIDAL, VDRL and immune electrophoresis.
To understand the test procedures of andrology.
To be able to discern the technical procedures of ELISA for the estimation of hormones.
To learn the miscellaneous experiments like phytochemical extraction using Soxhlet extraction.
To identify the active principles using spectroscopic techniques.
To learn the principle and procedure of histopathology for applying during project work.

1. Immunology techniques

- Widal test – rapid slide test for typhoid
- VDRL test – test for syphilis
- Latex agglutination test for rheumatoid factor and Pregnancy
- Immunoelectrophoresis
- Skin Prick Test.

2. Andrology

- Total sperm count.
- Motility Test.
- Fructose estimation.

3. Hormone Assay

- ELISA (TSH, T3, T4, ESTROGEN AND PROGESTERONE – Any Two)

4. Miscellaneous

- Extraction of phytochemicals using Soxhlet apparatus.
- Identification of active principles by spectral studies (FTIR, UV-Vis)
- Histopathology

5. Visit to National Research Centers.

Books for Reference:

1. Kuby Richard, A. Goldsby., Thomas J. Kint and Barbara. A. Osborne. 2000. Immunology. (4th Edition), W.H. Freeman and Company, New York.
2. Ivan M. Roitt and Peter J. Delves. 2005. Roitt's Essential Immunology. (10th Edition). Blackwell Scientific Publishers, New York.

Course Outcomes		
CO. No.	**CO-Statement**	**Cognitive Level (K-level)**
	On successful completion of the course, the students will be able to	
CO-1	Discuss the immune techniques used in the clinical diagnosis	**K1**
CO-2	Demonstrate sperm morphology, sperm count and its viability	**K2**
CO-3	Apply the histopathological screening of the various organs inanimal models	**K3**
CO-4	Analyze the results of various diagnostic procedures	**K4**
CO-5	Evaluate disease progression and design the methodologies for the diagnosis of various disease,	**K5**
CO-6	Comprehend protocols for the isolation of secondary metabolites from plant sources	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**25PBI3CP03**			**Core Practical - 3:** Immunology, Andrology and Hormone Assay						**8**	**4**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	1	3	3	3	1	2	2.3
CO2	3	3	2	3	1	3	3	1	2	2	2.3
CO3	3	3	2	3	3	2	3	3	1	3	2.6
CO4	3	2	3	3	3	3	2	3	1	3	2.6
CO5	3	3	2	3	2	3	2	2	3	2	2.5
CO6	2	3	2	2	1	3	2	3	2	2	2.2
	Mean overall score										**2.41**
											High

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25PBI3ES02A	**Discipline Specific Elective - 2:** Advances in Clinical Research	4	3

Course Objectives
To be able know the history and origin of clinical research emphasizing the global and Indian perspective in CR.
To know the concepts in drug administration and approval of the same for therapeutic purpose.
To study the ethical considerations and guidelines involved in the process of CR.
To comprehend the various regulatory mechanism in clinical trial and its management.
To understand the methodologies involved in the clinical data management.
To be able to study the guidelines and regulations in clinical trial data.

Unit I - Introduction to clinical research (12 Hours)

Introduction to clinical research, origin and history of clinical research terminologies and definition in clinical research, difference between clinical research and clinical practice, types ofclinical research, phases of clinical research, clinical trials in India - the national perspective, post marketing surveillance, pharmaceutical industry - global and Indian perspective, clinical trial market, career in clinical research.

Unit II - Pharmacology and drug development (12 Hours)

Introduction to pharmacology, concept of essential drugs, routes of drug administration,introduction to drug discovery and development, hurdles in drug development, sources of drugs, basics of drug, discovery & development, approaches to drug discovery, evolutionary classification of the strategies for drug discovery, emerging technologies in drug discovery, preclinical testing, investigational new drug application, clinical trials, new drug application and approval, pharmacokinetics, pharmacodynamics, recent advances - pharmacogenomics and protein based therapies.

Unit III - Ethical considerations and guidelines in clinical research (12 Hours)

Historical guidelines in clinical research, Nuremberg code, declaration of Helsinki, Belmont report, international conference on harmonization (ICH)-brief history of ICH, structure of ICH, ICH harmonization process, guidelines for good clinical practice, glossary, the principles of ICH GCP, institutional review board / independent ethics committee, investigator, sponsor, clinical trial protocol and protocol amendment(s), investigator's brochure, essential documents for the conduct of a clinical trial.

Unit IV - Regulation in clinical research & management (12 Hours)

Introduction of clinical trial regulation, European Medicine Agency, US FDA, drug and cosmetic act, Schedule Y, ICMR Guideline. Clinical Trial Management project management, protocol in clinical research, informed consent, case report form, investigator's brochure (IB),selection of an investigator and site, clinical trial stakeholders, ethical and regulatory submissions, documentation in clinical trials, pharmacovigilance, training in clinical research,roles and responsibilities of clinical research professionals.

Unit V - Clinical data management (12 Hours)

Introduction to CDM, CRF Design, clinical data entry, electronic data capture, data validation, discrepancy management, clinical data coding, SAE reconciliation, quality assurance & clinical data management, guideline & regulation in clinical trial data.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Fundamentals of Clinical Trials by Lawrence M Friedman: Fifth Edition: SpringerPublications.
   UNIT-I *Chapter 1, 2*
   UNIT-II *Chapter 3, 4*
   UNIT-IV *Chapter 15, 16*
   UNIT-V *Chapter 18*
2. Text Book of Clinical Trials by David Machin and Simon day, 2004; John Wileypublications.
   UNIT-I *Chapter I, 2*

UNIT-II *Chapter 6, 7, 8*
UNIT-III *Chapter 4*
UNIT-V *Chapter 7, 8*

Books for Reference:

1. Clinical Trials by Tom Brody, Second Edition: 2016 Elsevier Publications. Unit IV:Chapter 25.
2. Principle and Practice of Clinical Research By John I Gallin, Second Edition: 2002.
3. Health Research Methodology by WHO 2001: Second Edition.

Websites and E-Learning Sources:

1. https://www.youtube.com/watch?v=BBTqkHQjUzg
2. https://www.cancer.org/cancer/managing-cancer/making-treatment-decisions/clinicaltrials/what-you-need-to-know/phases-of-clinical-trials.html
3. https://www.thieme.in/image/catalog/Sample%20Chapter/Bhandari%20sample%20chapter.pdf
4. https://www.frontiersin.org/articles/10.3389/fddsv.2023.1201419
5. https://www.technologynetworks.com/drug-discovery/lists/6-drug-discovery-strategies-316373
6. https://www.news-medical.net/health/Pharmacokinetics.aspx
7. https://admin.ich.org/sites/default/files/2019-10/CPT%20Article_April_2019.pdf
8. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3371548/
9. https://hub.ucsf.edu/protocol-development
10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5372399/
11. https://ifar-connect.hsl.harvard.edu/isac_book/project-management.html
12. https://www.youtube.com/watch?v=OKAwaC6OQtc
13. https://www.who.int/teams/regulation-prequalification/regulation-andsafety/pharmacovigilance
14. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5372399/

Course Outcomes		
CO No.	**CO- Statements**	**Cognitive Level (K-level)**
	On successful completion of the course, the students will be able to	
CO-1	Discuss the basic introductory knowledge on the clinical research	**K1**
CO-2	Compare the protocols related to the clinical trial procedures in India and abroad.	**K2**
CO-3	Apply the GLP in clinical research lab.	**K3**
CO-4	Test the activity of the newly formulated drugs in experimental animals	**K4**
CO-5	Evaluate the formulations preparation and usage of the newly revealed drug for human consumption.	**K5**
CO-6	Design the protocols for clinical trials.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**25PBI3ES02A**			**Discipline Specific Elective - 2:** Advances in Clinical Research						**4**	**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	1	2	2	3	1	1	3	2	2	3	2
CO2	2	1	3	3	1	2	3	2	3	3	2.3
CO3	2	2	2	3	3	1	2	3	2	2	2.2
CO4	3	2	3	2	1	2	1	1	3	2	2
CO5	3	2	3	2	3	3	3	1	3	3	2.6
CO6	2	3	3	1	3	2	3	3	3	2	2.5
										Mean overall score	**2.26**
											High

Semester	Course Code	Title of the Course	Hours	Credits
3	25PBI3ES02B	**Discipline Specific Elective – 2:** Life Sciences for Competitive Examinations	4	3

Course Objectives
To be able know the history and origin of evolution.
To know the methods of investigating evolutionary changes.
To study the mechanism of speciation.
To comprehend the various biotic and abiotic factors of the ecosystem.
To understand the mechanism of mineral cycling.
To learn about the various ecosystems and conservation methods.

Unit – I: **(12 Hours)**

Emergence of evolutionary thoughts: Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations. Origin of cells and unicellular evolution: Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller; The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes;anaerobic metabolism, and aerobic metabolism.

Unit – II: **(12 Hours)**

Paleontology and evolutionary history: The evolutionary time scale; eras, periods andepoch; major events in the evolutionary time scale; origins of unicellular and multi cellular organisms; major groups of plants and animals; Stages in primate evolution including Homo. Molecular evolution: concepts of neutral evolution, molecular divergence and molecularclocks; molecular tools in phylogeny, classification and identification.

Unit – III: **(12 Hours)**

Mechanisms of speciation and behavior: Speciation; allopatricity and sympatricity; convergent evolution; Sexual selection; co-evolution. Approaches and methods in study of behavior; Proximate and ultimate causation; altruism and evolution; neural basis of learning, memory, cognition, sleep and arousal; biological clocks; social communication; social dominance; use of space and territoriality; mating systems, parental investment and reproductive success; parental care; aggressive behavior; habitat selection and optimality in foraging; migration, orientation and navigation; domestication and behavioral changes.

Unit – IV: **(12 Hours)**

The Environment; biotic and abiotic interactions. Concept of habitat and niche; population ecology; concept of metapopulation. Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community ecology: nature, structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological succession: Types, mechanisms, changes involved in succession & concept of climax.

Unit – V: Ecosystem ecology: **(12 Hours)**

Ecosystem structure, function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Biogeography: major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Conservation biology: principles and management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Verma P. S & V. K. Agarwal, 2003, Cytology, Genetics, Evolution and Ecology, S. Chand & amp; Co. Ltd., New Delhi.
   UNIT-I *Chapter 2 (Pages 8-17), Chapter 3 (Pages 22-44)*
   UNIT-II *Chapter* 1(*Pages* 3-7)
   UNIT-III *Chapter* 10 (*Pages* 124-136)
   UNIT-IV *Chapter* 4 (*Pages* 49-76), *Chapter* 5 (*Pages* 77-93) *and Chapter* 7 (*Pages* 109-126)

UNIT-V *Chapter* 9 (137-153)

2. Sharma P.D., 1999, Ecology and Environment, Rastogi Publishers, Meerut.

Books for Reference:

1. Odum. E.P, 1970, Fundamentals of Ecology, 3rd edition, W.B. Saunders Ltd., U.K.
2. Karl J. Nikias, 1981, Paleobotany, Paleoecology & Evolution, Praeger Pub., USA.
3. Pranav Kumar and Usha Mina. Pathfinder Academy: CSIR-JRF-NET Life Sciences Six Book Combo Set: CSIR-JRF-NET Life Sciences. Edition: 2016. Pathfinder Publication.
4. Rupendra Singh, Dr Madhu Gupta and Anubha Shukla. CSIR NET/JRF Life Sciences MCQ Practice book. Catalyst Center of excellence Pvt. Ltd; Seventh Edition (2017).

Websites and E-Learning Sources:

1. https://collegedunia.com/exams/calvin-cycle-c-3-cycle-definition-stages-diagram-roducts biology-articleid-1723
2. https://www.pnas.org/doi/pdf/10.1073/pnas.68.11.2883
3. https://www.shahucollegelatur.org.in/Department/Studymaterial/sci/Botany/Msc_I__year_botany_sem_II_Plant_physiology_and_metabolism_Unit_Iv_Notse.pdf
4. https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/General_Biology_1e_(OpenStax)/6%3A_Plant_Structure_and_Function/30%3A_Plant_Form_and_Physiology/30.6%3A_Plant_Sensory_Systems_and_Responses
5. https://www.nios.ac.in/media/documents/SrSec314NewE/Lesson-10.pdf
6. https://testbook.com/biology/photosynthesis
7. https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WEDC/es/ES07CD.pdf

CO. No.	CO- Statements	Cognitive Levels (K-levels)
On successful completion of the course, the students will be able to		
CO-1	Discuss the basic theories of evolution	**K1**
CO-2	Explain the topics of the CSIR UGC – NET and SET syllabus thatare not included in the core courses	**K2**
CO-3	Correlate the fossil evidences with evolution	**K3**
CO-4	Analyze the energy transfer within the different ecosystems	**K4**
CO-5	Evaluate the mechanisms of maintaining the environmental health	**K5**
CO-6	Evolve methods of conservation of endangered species	**K6**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**								**Hours**	**Credits**
3	**25PBI3ES02B**	**Discipline specific elective – 2:** Life sciences for Competitive Examinations								**4**	**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	1	3	3	2	2	3	3	2.5
CO2	2	3	1	3	2	3	1	2	3	1	2.1
CO3	3	1	2	3	3	1	3	2	3	3	2.4
CO4	2	3	3	1	2	3	3	1	3	2	2.3
CO5	3	3	3	3	3	1	1	3	3	2	2.5
CO6	2	3	2	3	2	3	2	3	2	2	2.4
										Mean overall score	**2.36**
											High

Semester	Course Code	Title of the Course	Hours/ Weeks	Credits
3	**25SBS3RM01**	Intellectual Property Rights	**4**	**2**

Course Objectives
To understand the concept and procedure of IPR.
To know the status of IPR in India.
To evaluate the difference between patent, copy right and trademark.
To analyse the benefits of patent, copy right and trademark.
To prepare applications for patent, copy right and GI.

UNIT I: IPR Agencies (12 Hours)

Intellectual Property Rights - Introduction, Concept and Theories, Kinds of Intellectual Property Rights, Need for intellectual property right, Advantages and Disadvantages of IPR. International Regime Relating to IPR - TRIPS, WIPO, WTO, GATTS. IPR in India genesis and development.

UNIT II: Patent (12 Hours)

Patent - introduction, Patent acts and its amendments. Patentable and Non patentable inventions. Process and product parent, double patent, patent of addition. Patent application process - Searching a patent, Drafting of a patent, filling of a patent, Types of patent applications-national, regional and international, patent document: specification and claims. Infringement.

UNIT III: Copyright (12 Hours)

Copyright - concepts and principles. Historical background and development of copyright law – Copyright act, Berne Convention, Universal Copyright Convention, WIPO Phonograms and Performances treaty. Conditions for grant of copyright. Copyright in Literary, Dramatic and musical works, sound recording, cinematograph films and computer programme. Right of Broadcasting and performers. Copyright Board - Power and functioning.

UNIT IV: Trademark (12 Hours)

Trademark - introduction, examples of well-known trademark. Historical development of the concept of trademark and trademark law-National and International. Kinds of trademarks. Procedure for registration of trademark. Infringement of trademark.

UNIT V: Geographical Indication (12 Hours)

Geographical Indication - introduction, types. GI laws. Indian GI act. Traditional knowledge and IPR. Public health and Intellectual Property Rights - case study. New plant varieties protection laws – need and benefits. Patenting of microorganism. IPR and Climate change. Patents and Biotechnology.

Teaching Methodology	Chalk and talk, PPT
Assessment Methods	Seminar, Snap Test, MCQ

Books for Study:

1. Venkataraman M. (2015). *An Introduction to Intellectual Property Rights*. Create space Independent Pub. North Charleston.

Books for Reference:

1. Gopalakrishnan N. S., & Agitha, T.G. (2009). *Principles of Intellectual Property*. Eastern Book Company.
2. Ramakrishna, B., & Kumar, A.H.S. (2017). *Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers*. Notion Press.
3. Boyle, J., & Jenkins, J. (2018*). Intellectual Property: Law & the Information Society- Cases and Materials*. Create space Independent Pub. North Charleston.
4. Reddy, D. S. V. (2019). *Intellectual Property Rights - Law and Practice*. Asia Law House.

Websites and eLearning Sources:

1. https://ipindia.gov.in/
2. https://www.annauniv.edu/ipr/files/downloadable/Overview%20of%20IPR.pdf
3. https://www.fao.org/faolex/results/details/en/c/LEX-FAOC110356/

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, students will be able to	
CO1	Understand the concept and procedure of IPR.	**K1**
CO2	Know the status of IPR in India.	**K2**
CO3	Evaluate the difference between patent, copy right and trademark.	**K3**
CO4	Analyse the benefits of patent, copy right and trademark.	**K4**
CO5	Prepare applications for patent, copy right and GI.	**K5**
CO6	Know the plant varieties protection laws.	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
3	**25SBS3RM01**		Intellectual Property Rights							**4**	**2**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	1	3	3	3	2	2	**2.4**
CO2	3	3	3	2	2	3	3	3	2	2	**2.5**
CO3	3	3	3	2	2	3	3	3	2	2	**2.5**
CO4	3	3	2	2	2	3	3	3	2	2	**2.5**
CO5	3	3	3	3	2	3	3	3	2	2	**2.7**
CO6	3	3	2	3	2	3	3	3	2	2	**2.6**
										Mean Overall Score	**2.53 (High)**

Semester	Course Code	Title of the Course	Hours/Weeks	Credits
3	25PBI3SL03	**Self-Learning:** Advanced Nutrition	-	1

Course Objectives
To comprehend the BMR and factors affecting the same
To study the direct and indirect methods of measuring BMR
To know the importance relations of carbohydrates, proteins and fats in normal individual
To study the biological importance of fat and water soluble vitamins
To evaluate the role of macro and micronutrients in the health of the individuals
To understand the significance of nutrition during different age groups

Unit – I: Energy Metabolism:

Basal metabolism – Basal metabolic rate – Factors affecting BMR, - determination of BMR, direct and indirect methods, - Benedict's Roth apparatus, - respiratory quotient – Biological oxygen demand. Anthropometry; Height, Weight, Skin fold thickness and arm circumference -their importance in nutrition.

Unit – II: Introduction to Nutritional Biochemistry:

Carbohydrates; Source of energy; Glycogen, Fiber in diet. Proteins – essential amino acids and non-essential amino acids – sources, functions – relation with Marasmus, Kwashiorkor disease. Protein calorie malnutrition. Biological value of proteins.

Fats: Sources- Saturated and unsaturated fatty acids, essential and non-essential fatty acids – outline of disorders concerned with fatty acid metabolism.

Unit – III: Vitamins:

Fat soluble and water soluble vitamins–their source, daily requirements and deficiency manifestations. Role of Vitamins as co-factors- in Electron transport chain; and enzyme reactions; Vitamins involved in haemopoiesis; Role as antioxidants.

Unit – IV: Minerals:

Micro, macro and trace elements – daily requirements – functions – deficiency manifestations –Role as electrolytes - sodium and potassium. Food fads and Facts.

Unit – V: Nutrition at different Stages of life:

During infancy, School children, adolescence, pregnancy, lactation and aging. Assessment ofnutritional status, - methods – intake, Biochemical and clinical methods.

Books for Study:

1. Swaminathan, M. 2004, Essentials of Food and Nutrition. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
2. Anthony A. Albanase (1972), Newer Methods of Nutritional Biochemistry (AcademicPress, New York)

Books for Reference:

1. Garrow, J. S. and James, W. P. T. 2000. Human Nutrition and Dietetics. (10th Edition). Churchill Livingstone Publishers, UK.
2. Wong, D. W. S. 1996. Mechanism and Theory in Food Chemistry. CBS, New Delhi.

CO. No.	CO- Statements On successful completion of the course, the students will be able to	Cognitive Level (K-level)
CO-1	Study the basic requirement of nutrition at different stages of life	K1
CO-2	Learn the proximate principles of nutrition with reference to RDA	K2
CO-3	Apply the experimental procedures concerned with energy metabolismand nutritional assessment for various disease status and age groups	K3
CO-4	Quantify the nutritional content of the food items	K4
CO-5	Evaluate the disorders associated with nutrition	K5
CO-6	Comprehend the essentials of nutrition for various age groups	K6

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**25PBI3SL03**			**Self-Learning:** Advanced Nutrition						**-**	**1**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	1	3	1	2	3	1	2	2	2	1.9
CO2	3	1	1	1	2	3	1	3	2	3	2.0
CO3	3	1	3	2	3	2	1	3	3	1	2.2
CO4	2	3	3	3	2	3	1	1	3	1	2.2
CO5	3	3	1	3	1	3	2	1	1	2	2.0
CO6	3	3	2	3	2	3	2	3	2	3	2.6
										Mean overall score	**2.15**
											Medium

Semester	Course Code	Title of the Course	Hours	Credits
4	25PBI4CC10	**Core Course – 10:** Advanced Endocrinology	6	5

Course Objectives
To study l the basics and molecular features of hormones and glands
To learn the hormonal regulations of various physiologicalfunctions and signaling mechanisms
To study the signal transduction mediated by cell surface receptors
To analyze the mechanism and role of nuclear receptors
To evaluate the endocrine diseases
To learn the basics and molecular features of hormones and glands

Unit – I: (18 Hours)

Introduction: Hormones - definition; classical and nonclassical endocrinology. Pituitaryhormones and their control by the hypothalamus. Thyroid metabolic hormones. Adrenocorticalhormones. Feedback mechanisms (HPA&HPG). Inactivation and degradation of hormones. Hypothalamus - neurohypophyseal hormones. Hormone resistant syndrome and multiendocrineneoplasia – different types. Melatonins and serotonin – light and dark cycles. RIA and ELISAin Bioassay of hormones. Genetic control of hormone formation**.**

Unit – II: (18 Hours)

Hormones acting through cell surface receptors: Hormones acting through cell surface receptors. Hormone – receptor interaction; multiple hormone subunits, Scatchard analysis; peptide hormone receptors: types of receptors- beta – adrenergic receptor and insulin receptor- structure and mechanism of action. Signal transducers and second messengers- protein kinases, cAMP, IP3, DAG, Calcium and Calmodulin. Eicosanoids and mechanism of action.

Unit – III: (18 Hours)

Molecular endocrinology of insulin resistance: Endocrinology of adipose tissues - leptin, gherlin, adiponectin, resistin. Fetal endocrine programming of adult disorders (FEPAD): Adverse effects of glucocorticoids in programming events. Endocrinology of insulin like growth factors (IGF's) and its binding proteins (IGFBP). Modulation of placental hormones and growth factors in FEPAD.

Unit – IV: (18 Hours)

Reproductive Endocrinology: Genetic, endocrine and biochemical aspects of testis and ovarian differentiation and development. Neuroendocrine perspectives of mammalian reproduction. Endocrine, paracrine and autocrine regulation of spermatogenesis, oogenesis, ovulation and steroidogenesis (Testosterone, 17B-estradiol, Progesterone). Control of synthesis and release of steroid hormones. Structure, function and regulation of male and female accessory sex organs. Transport of steroid hormones in blood. Conception and contraception. Hormonal physiology of parturition and lactation.

Unit – V: (18 Hours)

Nuclear receptors (NR): **General Features, Ligands that act via** nuclear receptor and its sub classes (Orphan receptor and variant receptors). Domain structure of NR - hormone binding domain, antigenic domain and DNA binding domain. Hormone response elements. Detailed study of thyroxine, estrogen, androgen, vitamin D, glucocorticoids, Peroxisome proliferator activated receptor and Liver X Receptor. PPAR in insulin resistance. Receptor activation – upregulation and down regulation. Selective estrogen receptor modulator. Endocrine responsive cancer - breast, endometrial and prostate cancers.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Thomas M. Devlin (Editor), "Textbook of Biochemistry with Clinical Relationshipmatrix s", 7th Edition, John Wiley & Sons, Inc. (E Book)
   UNIT-II *Chapter 22 – 22.1 to 22.8*
   UNIT-II *Chapter 13.4, 13.8, 13.9, 13.10, 13.11, 13.12* **UNIT-V** *Chapter 22.8*
2. Arthur C. Guyton and John E. Hall., "Textbook of Medical Physiology" 11th Edition, Elsevier Saunders, Elsevier Inc. 1600 John F. Kennedy Blvd., Suite 1800 Philadelphia, Pennsylvania 19103-2899

UNIT-I *Unit XIV - Chapter – 75, 76, 77, 79* **UNIT-II** *Unit XIV - Chapter - 78*
UNIT-IV *Unit XIV - Chapter – 80, 81, 82*

3. Franklyn F. Bolander. "Molecular Endocrinology" 3rd Edition. Academic Press An imprintof Elsevier, 525 B Street, Suite 1900, San Diego, California 92101-4495, USA.
UNIT V Chapter 6 (Pages - 125-146
4. John W. Baynes and Marek H. Dominiczak. "Medical Biochemistry" 4th Edition, Saunders, Elsevier (Ebook).
UNIT-I *Chapter – 39* **UNIT-II** *Chapter - 21*
UNIT-III *Chapter - 40* **UNIT-V** *Chapter - 17*
5. Dinesh Puri. "Textbook of Medical Biochemistry" 3rd Edition, Elsevier A division of Reed Elsevier India Private Limited, Registered Office: 622, Indra prakash Building, 21 Barakhamba Road, New Delhi 110 001.
UNIT-II *Chapter 29, 30 and 31*
6. Wilson and Foster, 1992, Text book of Endocrinology, (8thedn), W. B. Saunders, USA.

Books for Reference:

1. Robert, K. Murray *et al*, 2003, Harper's Biochemistry (25th Edition), Mc Graw HillPublishers (Asia), India.
2. Arthur C. Guyton and Hall, 2006, Text Book of Medical Physiology, Elsevier India Pvt.Ltd., New Delhi.
3. Mac. E. Hadley and Jon. E. Levin, 2009, Endocrinology 6th ed., Darling Kindersly Pvt.Ltd., India.

Websites and eLearning Sources:

1. https://www.onlinebiologynotes.com/hormones-properties-functions-and-classification/
2. https://training.seer.cancer.gov/anatomy/endocrine/hormones.html
3. https://www.ncbi.nlm.nih.gov/books/NBK20/
4. https://www.open.edu/openlearn/science-maths-technology/cell-signalling/content-section-1.3
5. https://www.cdc.gov/diabetes/basics/insulin-resistance.html
6. https://endocrinenews.endocrine.org/insulin-resistance-new-insights-into-development
7. diagnosis-and-treatment/
8. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3365799/
9. https://www.annualreviews.org/doi/10.1146/annurev.med.53.082901.104018

CO. No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	Recall the basics and molecular features of hormones and glands	**K1**
CO-2	Comprehend the hormonal regulations of various physiological functions and signaling mechanisms	**K2**
CO-3	Study the signal transduction mediated by cell surface receptors	**K3**
CO-4	Understand the mechanisms of obesity mediated diabetes mellitus	**K4**
CO-5	Evaluate the endocrine diseases	**K5**
CO-6	Analyze the mechanism and role of nuclear receptors	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
4	**25PBI4CC10**			**Core Course 10** – Advanced Endocrinology						**6**	**5**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	3	2	3	2	3	1	2.5
CO2	2	3	3	3	3	3	1	1	3	2	2.4
CO3	3	2	1	2	3	3	2	1	2	3	2.2
CO4	3	2	3	1	2	3	2	2	1	3	2.2
CO5	2	3	1	3	2	3	2	1	3	3	2.3
CO6	2	2	3	2	2	3	3	2	2	1	2.2
										Mean overall score	**2.3**
											High

Semester	Course Code	Title of the Course	Hours	Credits
4	25PBI4CC11	**Core Course - 11:** Pharmaceutics and Nanotechnology	6	5

Course Objectives
To comprehend the characteristics and types of tablet preparation in pharma industry
To understand the methodologies involved in the process of making capsules and injections
To be able to study the materials involved in the packaging of medicines and cosmetics
To know the types and methods involved in various drug delivery systems
To study the properties and types of nanoparticles in various fields
To know the methods involved in the characterization of the nanoparticles

Unit – I: (18 Hours)

Tablets: Characteristics, advantages and disadvantages. Types of tablets, excipients, granulation methods and machinery involved. Tablet compression operation-single punch androtary tablet presses, processing problems, evaluation, packaging. Tablet coating: Types- sugar coating, film coating, compression coating, electrostatic and enteric coating. Filmforming materials, formulation of coating solution, equipment for coating, processing problems in coating, evaluation.

Unit – II: (18 Hours)

Capsules: Advantages and disadvantages of capsules. Materials and method of production of hard gelatin capsule, size of capsules, Formulation, method of filling, equipment involved, finishing techniques and evaluation. Storage of capsules. Soft gelatin capsules-shell and capsule content, manufacture, processing and control. Sterilization of injections, formulations, aerosols, ophthalmic preparations, surgical ligatures and sutures, Blood products and plasma substitutes.

Unit – III: (18 Hours)

Packaging materials: Types of glasses and plastics employed for packing and their evaluation.Cosmetics. Introduction, fundamentals of cosmetic science. Formulation, preparation, packaging and evaluation of following Cosmetics - cosmetics for skin and face, Nail polish, lipstick, rouge, Hair preparation - Shampoo, Hair dyes, depilatories, shaving cream, after shave lotion.Oral hygiene preparation - dentifrices, mouth washes.

Unit – IV: (18 Hours)

Controlled drug delivery systems: Advantages of controlled drug delivery systems. a) An introduction to novel drug delivery systems- Liposomes, niosomes, nanoparticles and osmotically controlled systems b) Micro encapsulation c) Transdermal drug delivery systems-Formulation and evaluation.

Unit – V: (18 Hours)

Introduction to Nanotechnology: Properties and Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Bucky balls, Nanotubes), Green synthesis,characterization of Nano material; Absorption, Fluorescence, and Resonance; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging. Applications of nanotechnology in medicine & health, food, agriculture, livestock, aquaculture, forestry and sustainable environment.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Theory and practice of industrial pharmacy; by Leon Lachman, Herbert. A. Lieberrman, Joseph. L. Kanig; Third edition; Lea & Febiger.
   UNIT-I *(Sec III)* **UNIT-II** *(Sec III, Sec IV)* **UNIT-III** *(Sec IV)*
2. Dr. Mustafa Ersoz, Dr. Arzum isitan Meltem Balaban, Nanotechnology 1 (Fundamentals of Nanotechnology), 1st Edition – October 2018.
   UNIT-V *(Sec 1, Sec 3)*
3. Pharmaceutics, The Science of Dosage Form Design: Michael. E. Aulton; Secondedition; English language book society/Churchill Livingstone.

UNIT-IV *Chapter 3(Pages 213-234)*

Books for Reference:

1. Pharmaceutical dosage forms: Tablets, Volume 1, 2, 3; Herbert. A. Lieberman, LeonLachman & Joseph. B. Schwartz; Marcel Dekker INC.
2. Nanobiotechnology: Concepts, Applications and Perspectives, Christ of M. Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley-VCH; 1 edition, 2004.
3. NanoBiotechnology: BioInspired Devices and Materials of the Future by OdedShoseyov and Ilan Levy, Humana Press; 1st edition 2007.

Websites and eLearning Sources:

1. https://pharmaguddu.com/solid-dosage-forms-tablets/
2. https://www.pharmaguideline.com/2017/09/types-and-functionality-of-tablet-coating.html
3. https://www.stockmeier.com/en/knowledge/chemicals/specialty-chemicals/example formulations/
4. https://www.facescanada.com/
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9118483/
6. https://www.hindawi.com/journals/jnm/2016/7372306/
7. https://www.geeksforgeeks.org/nanoparticles-types-production-and-uses/
8. https://nanocomposix.com/pages/nanoparticle-characterization-techniques

Course Outcomes		
CO No.	**CO- Statements** On successful completion of the course, the students will be able to	**Cognitive Level (K-level)**
CO-1	Discuss various drug delivery systems	**K1**
CO-2	Explain the methods of quality control in pharmaceutical industry	**K2**
CO-3	Apply the methods in the preparation of tablets and capsules	**K3**
CO-4	Analyze the various types of glasses used in packaging of medicinal preparations	**K4**
CO-5	Synthesize and characterize various nanoparticles	**K5**
CO-6	Application of Nanotechnology in various fields	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
4	**25PBI4CC11**			**Core Course – 11:** Pharmaceutics and Nanotechnology					**6**		**5**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	1	1	2	2	3	3	2	1	2
CO2	2	3	1	1	2	3	2	2	1	3	2
CO3	2	1	2	3	2	1	1	2	3	1	1.8
CO4	2	2	2	3	2	2	2	2	3	1	2.1
CO5	2	2	3	2	2	1	2	3	3	2	2.2
CO6	3	2	3	3	2	2	3	2	2	3	2.5
	Mean overall score										**2.10**
											High

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25PBI4CP04	**Core Practical - 4:** Hematology, Biochemical Analysis and Urology	8	4

Course Objectives
To expose the basic concepts in phlebotomy in clinical biochemistry
To demonstrate various methods of administration of xenobiotics to the experimental animals
To analyze biochemical parameters of the diabetic patients
To analyze the levels of clinical marker enzymes in various diseases
To evaluate the clinical situation based on the levels of clinical parameters
To demonstrate clinical research involving lab animals

1. Biochemical analysis of blood

- Estimation of blood glucose (2 methods)
- Estimation of serum proteins
- Estimation of plasma fibrinogen
- Estimation of A: G ratio in serum
- Estimation of blood urea (2 methods)
- Estimation of serum uric acid
- Estimation of serum creatinine
- Estimation of serum triglycerides
- Estimation of serum cholesterol
- Estimation of serum phospholipids
- Estimation of serum calcium
- Estimation of serum bilirubin

2. Hematological studies

- Collection of Blood
- Estimation of hemoglobin content.
- Total RBC count.
- Total WBC count.
- Determination of Packed Cell Volume
- Determination of erythrocyte indices (Wintrobe's Constants)
- Differential WBC count (DC).
- Absolute Eosinophil count (AEC)
- Total platelet count
- Determination of clotting time
- Determination of ESR
- Grouping of blood and Rh typing

3. Enzyme assays

- Determination of serum alkaline phosphatase
- Determination of serum acid phosphatase

4. Urology

- Identification of normal (Collection, Preservation, Color, Odour, Specific gravity, pH and Volume)
- Screening of abnormal constituents
- Urinary crystals and deposits

5. Miscellaneous

- Estimation of clinical parameters (Glucose and creatinine)using semi-automated analyzer
- Routes of administration of drugs/Xenobiotics
- Dissection of animals and aseptic removal of individual organs
- Laboratory animal handling and maintenance

Books for Reference:

1. Praful. B. Godkar, 2014, Text book of Medical laboratory technology; III Edition,Volume I and II, Bhalani Publishing house.
2. Alan H. Gowenhock, Varley's Practical Clinical Biochemistry, 6th Edition; CBSpublishers.

3. Kanai L. Mukerjee, Volume 1, 2 and 3. Medical Laboratory Technology, 2nd Edition, TataMcGraw Hill Education Private Limited. New Delhi.

Course Outcomes		
CO. No.	**CO-Statements**	**Cognitive Level (K-level)**
	On successful completion of the course, the students will be able to	
CO-1	Describe the concept of Phlebotomy in clinical biochemistry	**K1**
CO-2	Understand various modes of administration of xenobiotics to the experimental animals	**K2**
CO-3	Apply various blood parameters of the Diabetic patients	**K3**
CO-4	Analyze the levels of clinical marker enzymes in various diseases	**K4**
CO-5	Evaluate the clinical situation based on the level of the parameters	**K5**
CO-6	Comprehend the animal handling and dissection techniques	**K6**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**							**Hours**		**Credits**
4	**25PBI4CP04**	**Core Practical - 4:** Hematology, Biochemical Analysis and Urology							**8**		**4**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	3	2	1	3	1	3	2.3
CO2	3	3	2	1	3	2	3	1	2	3	2.3
CO3	3	2	3	3	3	2	3	1	3	2	2.5
CO4	3	3	3	2	3	2	1	3	1	3	2.4
CO5	3	3	2	3	3	3	3	1	2	3	2.6
CO6	3	2	3	2	3	2	2	3	3	1	2.4
	Mean overall score										**2.41**
											High

Semester	Course Code	Title of the Course	Hours	Credits
4	25PBI4ES03A	**Discipline Specific Elective – 3:** Fundamentals of Forensic Science	4	3

Course Objectives
To understand the concepts of forensic examination
To learn the concepts of crime scene investigation and collection of samples from the spot
To gain knowledge on the court procedures regarding the crime scene management
To learn the methods of analyzing poisonous chemicals and liquors from biosamples
To learn the mechanisms of evaluating tool marks, fire arms
To learn the experimental procedures concerned with biosamples from autopsy

Unit – I: **(12 Hours)**

Forensic science: Definitions, History and Development. Crime scene management and investigation; collection, preservation, packaging and forwarding of physical and trace evidence for analysis. Legal and court procedure pertaining to expert testimony.

Unit – II: **(12 Hours)**

Fresh blood – grouping and typing of fresh blood samples including enzyme types. Analysis ofstains of blood and allied body fluids for their groups and enzyme tests. Disputed paternity andmaternity problems – DNA extraction and profiling techniques- RFLP. Wild life forensics – Scope, evidences and identification.

Unit – III: **(12 Hours)**

Analysis of illicit liquor including methyl and ethyl alcohol and alcohol in body fluids and breathe. Analysis of chemicals in trap cases (Petroleum product, Chemical examination of insecticides, pesticides and psychotropic drugs – Sedatives, stimulants, opiates and drugs of abuse). Detection of poisons from viscera, tissues and body fluids.

Unit – IV: **(12 Hours)**

Classification of fire arms, ammunition and their compositions. Forensic examination and identification of cartridges, bullets, fire arms, bombs and explosives. Tool marks – meaning, type and examination. Photography - types application in criminal investigations and forensic evidence examination.

Unit – V: **(12 Hours)**

History, classification, search, lifting and examination of fingerprints, development of latent fingerprints by various methods. Medico-legal aspects of wounds, Post-mortem examination andPM changes, asphyxia death, sexual offences, infanticide. Forensic psychiatry and lye detection.

Teaching Methodology	Chalk and talk, PPT, Biological specimens
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. Text book of Forensic Medicine and Toxicology; Fifth Edition by Krishan Vij; 2011; Elsevier Publications
   UNIT-I *Chapter I and II* **UNIT-III** *Chapter 41*
   UNIT-IV *Chapter 3* **UNIT-V** *Chapter 14, 15, 16, 17*
2. Blood stain pattern analysis: Third Edition by Tom Bevel and Ross M Gardiner.2008:CRC press.
   UNIT-II *Chapter 1,2,3,4*
3. Text Book of Medical Jurisprudence; Sixth Edition by Rai Bahadur Jaising; Butterworthand Co press.
   UNIT- C*hapter I*
   UNIT-II *Chapter I*
   UNIT-III *Chapter 08*
   UNIT-IV *Chapter 12*
   UNIT-V *Chapter 15*

Books for Reference:

1. Crime Scene Photography by Edward M. Robinson: Second Edition: Elsevier Publication 2010.
2. Criminal Law and Justice by Noel Cross: Sage Publications 2010.
3. Drugs of Abuse by Raphel C. Wong; Humana press 2010.
4. Forensic Criminology by Wein A Patherick and Brent E. Turvey, 2010.

Websites and E-Learning Sources:

1. https://pressbooks.bccampus.ca/criminalinvestigation/chapter/chapter-8-crime-scene-management/
2. https://www.unodc.org/documents/Wildlife/Wildlife_Forensics_Brochure.pdf
3. https://ycmou.ac.in/media/publication/other_book/DVM_OB_157.pdf
4. https://www.fingerprintexpert.in/blog-details/forensic-photography
5. https://evawintl.org/wp-content/uploads/10420.pdf

CO No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	Describe thorough knowledge about the basics of forensic science	**K1**
CO-2	Compare knowledge on sample collection from crime scene and wild life forensics	**K2**
CO-3	Apply the knowledge on crime scene management and legal court procedures	**K3**
CO-4	Analyze poisonous chemicals and illicit liquor from victimsin a crime scene	**K4**
CO-5	Evaluate tool marks and recognize finger prints and other evidences from the crime scene	**K5**
CO-6	Give possible suggestions to the judicial	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
4	**25PBI4ES03A**			**Discipline Specific Elective – 3:** Fundamentals of Forensic Science					**4**		**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	1	3	2	2	2	2	1	1	2	1.8
CO2	3	2	2	3	2	2	2	3	2	2	2.3
CO3	3	2	1	2	2	1	3	2	3	2	2.1
CO4	2	3	2	3	2	1	2	2	2	3	2.2
CO5	2	2	3	2	2	1	2	2	3	3	2.2
CO6	2	2	3	2	2	1	2	2	3	3	2.2
										Mean overall score	**2.12**
											High

Semester	Course Code	Title of the Course	Hours	Credits
4	25PBI4ES03B	**Discipline Specific Elective - 3:** Neuro biochemistry	4	3

Course Objectives
The main objectives of the course are
To investigate the chemical processes involved in central nervous system functioning and its anatomy.
To understand the chemical aspects of synthesis, metabolism, and release of neurotransmitters.
To study the role of neurochemistry in behavioral concept.
Evaluation of neurological disease states.
To understand about the diagnostic tools of neurology.

Unit – I: **(12 Hours)**

Neuromorphology and neurocellular anatomy: Central nervous system (CNS) and peripheral nervous system (PNS), autonomous nervous system, somatic nervous system, dendritis and axons, neurofilaments. Spinal cord: Topographical anatomy, spinal nerves, grey and white matter of spinal cord.

Unit – II: **(12 Hours)**

Developmental Neurobiology: Organogenesis and neuronal multiplication, axonal and dendritic growth, glial multiplication and myelination, growth in size, regeneration and repair mechanisms, plasticity.

Unit – III: **(12 Hours)**

Neurophysiology: Excitation and conduction, generation and conduction of action potential, saltatory conduction, ion channels and transport of ions. Synaptic transmission, Neurotransmitters and Neurohormones – chemistry, synthesis, storage and release, Blood Brain CSF barrier–Characteristics, transport systems, Biochemistry of vision

Unit – IV: **(12 Hours)**

Learning and Memory: Correlation of behavioral and biochemical events, measurement of learning and memory, agents affecting learning and memory, biochemical correlates of excitation, learning and behavior. **Neurodegenerative diseases:** Parkinson's, alzheimar's disease, amyotrophic lateral sclerosis, senile dementia. Biochemical theories of mental disorder: chemistry of neuroleptics and anxiolytics and Schizophrenia

Unit – V: **(12 Hours)**

Diagnostic Neurology: Electroencephalography, Digital Electroneurogram, Electromyogram computerized tomography, basics of functional MRI, digital subtraction imaging, SPECT scans of brain, intrathecal administration of antispasticity drugs, beta interferons in demyelination, opiates in intractable pain, Fluorescently tagged study of neurons in diseases in animal models in vivo and in tissue cultures in-vitro.

Teaching Methodology	PPT, Demonstration and video lecture
Assessment Methods	Seminar, Snap Test, MCQ, Online test (JosTel), Group Discussion

Books for Study:

1. C. Brady, S. Brady, G. Siegel, G. Siegel, R. W. Albers, D. L. Price, Basic Neurochemistry, Academic Press (ISBN 978-0-12-374947-5), 2012
   Unit I- Chapter I page 3-26, 101-165, 180. Chapter –II page- 235-300,
   Unit II- Chapter I page 3-26, 101-165, 180. Chapter –II page- 235-300
   Unit-III- Chapter III- page 411-493.
   Unit-IV- Chapter IV – page-533-582, 679-872, 961-982.
2. Bear: Neuroscience: Exploring the Brain, 2ndedition, Lippincott Williams &Wilkins, 2001.
   Unit-I chapter 13- page -423-451
   Unit-III –chapter 2 page-23, Chapter -3, 4, 5, 6, 7- page- 75-167, Chapter- 10-page- 309
   Unit-IV- chapter 25- page 761-795.
3. Current Diagnosis and treatment Neurology, Second Edition, John C.M. Brust. Mc Graw Hill, LANGE Medical book.
   Unit-V Chapter 2 – page -4 -8, Chapter 3 – page 13-16, 16-21, 21-24.

Books for Reference:

1. Siegel et al., Basic Neurochemistry, 6th Edition, Lippincott -Williams-Wilkins, 1999.
2. Kandel et al., Principles of Neural science, 4 Edition, McGraw-Hill Medical, 2000.
3. Zegmond, Fundamentals of Neuroscience, 1st Edition, Academic Press, 1999
4. Bear: Neuroscience: Exploring the Brain, 2nd edition, Lippincott Williams & Wilkins, 2001
5. Basic Neurochemistry: Principles of Molecular, Cellular, and Medical Neurobiology, 8th Edition by Scott Brady, George Siegel, R. Wayne Albers, Donald Price. ISBN-13: 978-0123749475
6. Neuroscience: Exploring the Brain (4th Edition) by Mark F. Bear, Barry W. Connors, Michael A. Paradiso. ISBN-13: 978-0781778176

Websites and E-Learning Sources:

1. https://courses.lumenlearning.com/wm-biology2/chapter/the-central-and-peripheral-nervous-systems/
2. https://www.elearning.raghunathpurcollege.ac.in/files/A1AF192A15859944500.pdf
3. https://www.kenhub.com/en/library/physiology/neurotransmitters
4. https://www.physio-pedia.com/Neurodegenerative_Disease
5. https://pmc.ncbi.nlm.nih.gov/articles/PMC162295/

Course outcomes		
CO. No.	**CO- Statements**	**Cognitive Levels (K-levels)**
On successful completion of the course, the students will be able to		
CO-1	Gain knowledge about CNS functioning	**K1**
CO-2	Understand about neurophysiology	**K2**
CO-3	Correlate the function of various neurotransmitters	**K3**
CO-4	Analyze the types of neurodegenerative disorders and its symptoms	**K4**
CO-5	Evaluate the usage of various diagnostic tools related to neurology	**K5**
CO-6	Create a new, user friendly and cost effective diagnostic instruments	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours**		**Credits**
4	**25PBI4ES03B**		**Discipline Specific Elective - 3:** Neuro biochemistry						**4**		**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	3	3	2	2	2	3	2.5
CO2	2	3	1	3	2	3	1	2	3	2	2.2
CO3	3	2	2	3	3	2	3	2	3	3	2.6
CO4	2	3	3	2	2	3	3	2	3	2	2.5
CO5	3	3	3	3	3	1	1	3	3	2	2.5
CO-6	3	2	2	2	1	3	2	3	2	2	2.2
										Mean overall score	**2.41**
											High