

# M Sc BIOCHEMISTRY

LOCF SYLLABUS 2023



**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 TANSCHÉ 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 110 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.

**Common Core (CC):** A common core course is a shared educational element encompassing fundamental topics across disciplines within a school. It promotes interdisciplinary comprehension and collaboration among students by providing a foundational understanding of key subjects essential for academic and professional success across diverse fields of study.

**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.

**Generic Elective Courses (EG):** 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 generic elective courses offered by other disciplines within the college, enhancing the diversity of their learning experience.

**Ability Enhancement Course (AE):** 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 (SE):** 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-paced Learning (SP):** This course promotes independent learning habits among students and they have to undergo the course outside the regular class hours within a specified timeframe.

**Comprehensive Examinations (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 five semesters (2 - 6). 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:

23	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 - Elective

AE - Ability Enhancement Course

SP - Self-paced Learning

EG - Generic Elective

PW - Project and Viva Voce

CE - Comprehensive Examination

OR - Outreach Programme

IS – Internship

## EVALUATION PATTERN

### Continuous Internal Assessment

SI No	Component	Marks Alloted
1	Mid Semester Test	30
2	End Semester Test	30
3	*Three Components (15 + 10 + 10)	35
4	Library Referencing (30 hours)	5
<b>Total</b>		<b>100</b>

Passing minimum: 50 marks

\* The first component is a compulsory online test (JosTEL platform) comprising 15 multiple choice questions (10 questions at K1 level and 5 questions at K2 level); The second and the third components are decided by the course in-charge.

### 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						$7 \times 1 = 7$
B (compulsory)			5					$5 \times 3 = 15$
C (either...or type)				3				$3 \times 6 = 18$
D (2 out of 3)	For courses with K5 as the highest cognitive level, one K4 and one K5 question is compulsory. (Note: two questions on K4 and one question on K5)				1	1*		2 × 10 = 20
	For courses with K6 as the highest cognitive level: <b>Mid Sem:</b> two questions on K4 and one question on K5; <b>End Sem:</b> two questions on K5 and one question on K6)				Mid Sem			
						End Sem		
					1	1	1*	
<b>Total</b>							<b>60</b>	

\* Compulsory

## Question Paper Blueprint for Semester Examination

Duration: 3 Hours				Maximum Marks: 100		
UNIT	Section A (Compulsory)	Section B (Compulsory)	Section C (Either...or type)	Section D (3 out of 5)		
	K1	K2	K3	K4	K5	K6
UNIT I	2	2	2	2*	2*	1*
UNIT II	2	2	2			
UNIT III	2	2	2			
UNIT IV	2	2	2			
UNIT V	2	2	2			
<b>Marks</b>	<b>10 × 1 = 10</b>	<b>10 × 3 = 30</b>	<b>5 × 6 = 30</b>	<b>3 × 10 = 30</b>		

\* For courses with K6 as the highest cognitive level wherein one question each on K4, K5 and K6 is compulsory.  
(Note: two questions each on K4 and K5 and one question on K6)

### Evaluation Pattern for One/Two-credit Courses

Title of the Course	CIA	Semester Examination	Total Marks
• Ability Enhancement Course	20 + 10 + 20 = 50	50 (A member from the Department other than the course instructors)	100
• Self-paced Learning • Comprehensive Examination	25 + 25 = 50	50 (CoE)	100
• Internship	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:

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

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

Where,

$C_i$  - credit earned for the Course  $i$

$Gp_i$  - Grade Point obtained for the Course  $i$

$M_i$  - 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 imbued with ethical values and social concern will be able to appreciate cultural diversity, promote social harmony and ensure sustainable environment.

### **Programme Specific Objectives (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.

## PROGRAMME STRUCTURE

Semester	Specification	Number of Courses	Hours	Credits
1 - 4	Core Course	10	51	50
1 - 4	Core Practical	4	24	19
1, 2, 4	Elective	4	20	14
1	Ability Enhancement Course	1	2	1
2	Self-paced Learning	1	-	2
2	Skill Enhancement Course	1	4	3
2, 3	Generic Elective	2	8	6
3	Common Core	1	5	4
2 - 4	Extra Credit Course	3	-	(9)
4	Project Work and Viva Voce	1	6	5
4	Comprehensive Examination	1	-	2
2 - 4	Outreach Programme (SHEPHERD)	-	-	4
<b>Total</b>		<b>28</b>	<b>120</b>	<b>110(9)</b>

PROGRAMME PATTERN							
Course Details					Scheme of Exams		
Sem	Course Code	Title of the Course	Hours	Credits	CIA	SE	Final
1	23PBI1CC01	<b>Core Course - 1:</b> Basics of Biochemistry	6	6	100	100	100
	23PBI1CC02	<b>Core Course - 2:</b> Biochemical and Molecular Techniques	6	6	100	100	100
	23PBI1CP01	<b>Core Practical - 1:</b> Biomolecules and Biochemical Techniques	6	4	100	100	100
	23PBI1ES01	<b>Elective - 1:</b> Microbiology and Immunology	5	3	100	100	100
	23PBI1ES02	<b>Elective - 2:</b> Energy and Drug Metabolism	5	3	100	100	100
	23PBI1AE01	<b>Ability Enhancement Course:</b> Herbal Technology	2	1	100	-	100
<b>Total</b>			<b>30</b>	<b>23</b>			
2	23PBI2CC03	<b>Core Course - 3:</b> Molecular Biology	4	4	100	100	100
	23PBI2CC04	<b>Core Course - 4:</b> Bioenergetics and Enzymology	4	4	100	100	100
	23PBI2CC05	<b>Core Course - 5:</b> Genetic Engineering	4	3	100	100	100
	23PBI2CP02	<b>Core Practical - 2:</b> Enzymology, Physiology and Molecular Techniques	5	4	100	100	100
	23PBI2SP01	<b>Self-paced Learning:</b> Advanced Nutrition*	-	2	50	50	50
	23PBI2ES03A	<b>Elective - 3:</b> Developmental Biology	5	4	100	100	100
	23PBI2ES03B	<b>Elective - 3:</b> Life Sciences for Competitive Exams - 1					
	23PSS2SE01	<b>Skill Enhancement Course:</b> Soft Skills	4	3	100	-	100
	-	<b>Generic Elective - 1 (WS):</b> Refer <a href="#">ANNEXURE 1</a>	4	3	100	100	100
-	Extra Credit Courses (MOOC/Certificate Courses) - 1	-	(3)				
<b>Total</b>			<b>30</b>	<b>27(3)</b>			
3	23PBI3CC06	<b>Core Course - 6:</b> Human Physiology	6	6	100	100	100
	23PBI3CC07	<b>Core Course - 7:</b> Pharmaceuticals and Nanotechnology	5	5	100	100	100
	23PBI3CC08	<b>Core Course - 8:</b> Advances in Clinical Research	5	5	100	100	100
	23PBI3CP03	<b>Core Practical - 3:</b> Immunology, Andrology, Hormone Assay and Miscellaneous	5	5	100	100	100
	23SBS3CC01	<b>Common Core:</b> Intellectual Property Rights	5	4	100	100	100
	-	<b>Generic Elective - 2 (BS):</b> Refer <a href="#">ANNEXURE 2</a>	4	3	100	100	100
	-	Extra Credit Courses (MOOC/Certificate Courses) - 2	-	(3)			
<b>Total</b>			<b>30</b>	<b>28(3)</b>			
4	23PBI4CC09	<b>Core Course - 9:</b> Clinical Biochemistry	5	5	100	100	100
	23PBI4CC10	<b>Core Course - 10:</b> Advanced Endocrinology	6	6	100	100	100
	23PBI4CP04	<b>Core Practical - 4:</b> Biochemical Analysis of Blood and Hematological Studies	8	6	100	100	100
	23PBI4ES04A	<b>Elective - 4:</b> Life Sciences for Competitive Exams - 2	5	4	100	100	100
	23PBI4ES04B	<b>Elective - 4:</b> Forensic Science					
	23PBI4PW01	Project Work and Viva Voce	6	5	100	100	100
	23PBI4CE01	Comprehensive Examination*	-	2	50	50	50
	-	Extra Credit Courses (MOOC/Certificate Courses) - 3	-	(3)			
<b>Total</b>			<b>30</b>	<b>28(3)</b>			
2 - 4	23PCW4OR01	Outreach Programme (SHEPHERD)	-	4			
1 - 4	<b>Total (2 years)</b>		<b>120</b>	<b>110 (9)</b>			

\*- for grade calculation 50 marks are converted into 100 in the mark statements

<b>Passed by</b>	<b>Board of Studies held on 18.12.2023</b>
<b>Approved by</b>	<b>48th Academic Council Meeting held on 27.03.2024</b>

**ANNEXURE 1**  
**Generic Elective - 1 (WS)\***

<b>Course Details</b>		
<b>School</b>	<b>Course Code</b>	<b>Title of the Course</b>
<b>SBS</b>	23PBT2EG01	<a href="#">Medical Biotechnology</a>
	23PBO2EG01	<a href="#">Medicinal Botany</a>

*\*Offered to students from other Departments within School*

**ANNEXURE 2**  
**Generic Elective - 1 (BS)\***

<b>Course Details</b>		
<b>School</b>	<b>Course Code</b>	<b>Title of the Course</b>
<b>SCS</b>	23PCA3EG02	<a href="#">Web Design</a>
	23PCS3EG02	<a href="#">Advances in Computer Science</a>
	23PDS3EG02	<a href="#">Information Security and Ethics</a>
	23PMA3EG02	<a href="#">Operations Research</a>
<b>SLAC</b>	23PEN3EG02	<a href="#">English for Effective Communication</a>
<b>SMS</b>	23PCO3EG02	<a href="#">Basics of TallyPrime</a>
	23PCC3EG02	<a href="#">Dynamics of Human Behaviour in Business</a>
	23PCP3EG02	<a href="#">Social Psychology</a>
	23PEC3EG02	<a href="#">Managerial Economics</a>
	23PHR3EG02	<a href="#">Counselling and Guidance</a>
<b>SPS</b>	23PCH3EG02	<a href="#">Health Science</a>
	23PEL3EG02	<a href="#">Computer Hardware and Networks</a>
	23PPH3EG02A	<a href="#">Physics for Competitive Exams</a>
	23PPH3EG02B	<a href="#">Nanoscience</a>

*\*Offered to students from other Schools*

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PBI1CC01	Core Course - 1: Basics of Biochemistry	6	6

### 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: Carbohydrates (18 Hours)

Carbohydrates- Classification, structure (configurations and conformations, anomeric forms), function and properties of monosaccharides, mutarotation, Disaccharides and oligosaccharides with suitable examples. Polysaccharides - Homopolysaccharides (starch, glycogen, cellulose, inulin, dextrin, agar, pectin, dextran). Heteropolysaccharides - Glycosaminoglycans- source, structure, functions of hyaluronic acid, chondroitin sulphates, heparin, keratan sulphate, Glycoproteins - proteoglycans. O-Linked and N-linked glycoproteins. Biological significance of glycan. Blood group polysaccharides. Bacterial cell wall (peptidoglycans, teichoic acid) and plant cell wall carbohydrates.

#### UNIT II: Lipids (18 Hours)

Lipids - Classification of lipids, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, glycolipids, sphingolipids and steroids - Biological importance. Eicosanoids- classification, structure and functions of prostaglandins, thromboxanes, leukotrienes. Lipoproteins - Classification, structure, transport (endogenous and exogenous Pathway) and their biological significance.

#### UNIT III: Amino Acids (18 Hours)

Overview of Amino acids - classification, structure and properties of amino acids, biological role. Non-Protein amino acids and their biological significance. Proteins - classification based on composition, structure and functions. Primary, secondary, super secondary (motifs) (Helix-turn-helix, helix-loop-helix, Beta-alpha-beta motif, Rosemann Rossmann fold, Greek key), tertiary and quaternary structure of proteins.

#### UNIT IV: Membrane Proteins (18 Hours)

Membrane structure-fluid mosaic model. Membrane Proteins - Types and their significance. Cytoskeleton proteins - actin, tubulin, intermediate filaments. Biological role of cytoskeletal proteins. Structural characteristics of collagen and hemoglobin. Determination of amino acid sequence. Chemical synthesis of a peptide, Forces involved in stabilization of protein structure. Ramachandran plot. Folding of proteins. Molecular chaperons - Hsp 70 and Hsp 90 - biological role.

#### UNIT V: Nucleic Acids (18 Hours)

Nucleic acids - types and forms (A, B, C and Z) of DNA. Watson-Crick model-Primary, secondary and tertiary structures of DNA. Triple helix and quadruplex DNA. Mitochondrial and chloroplast DNA. DNA super coiling (calculation of Writhe, linking and twist number). Determination of nucleic acid sequences by Maxam Gilbert and Sanger's methods. Forces stabilizing nucleic acid structure. Properties of DNA and RNA. C-value, C-value paradox, Cot curve. Structure and role of nucleotides in cellular communications. Major and minor classes of RNA, their structure and biological functions.

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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### Books for Study

1. Murray, R. K. *et al.* (2000). *Harper's biochemistry*. Appleton and Lange Stanford Publishers.
2. Lehninger, A. L. *et al.* (1993). *Principles of biochemistry*. Worth Publishers. Inc.
3. Rawn, J.D. (1989). *Biochemistry*. Neil Patterson Publ.

### Books for Reference

1. Stryer, I. (1988). *Biochemistry*, (2nd Ed.). W.H. Freeman & Co.
2. White, A. *et al.* (1959). *Principles of biochemistry*. McGraw Hill Book Co.
3. Voet, D., & Voet, J. G. (2011). *Biochemistry*, (4th Ed.). John Wiley and Sons.

### Websites and eLearning Sources

1. [https://bio.libretexts.org/Bookshelves/Biochemistry/Book%3A\\_Biochemistry\\_Online\\_\(Jakubowski\)](https://bio.libretexts.org/Bookshelves/Biochemistry/Book%3A_Biochemistry_Online_(Jakubowski))
2. <https://www.thermofisher.com/in/en/home/life-science/protein-biology/protein-biologylearning-center/protein-biology-resource-library/pierce-protein-methods/proteinglycosylation.html>
3. <https://ocw.mit.edu/courses/biology/7-88j-protein-folding-and-human-diseasespring-2015/study-materials/>
4. <https://www.open.edu/openlearn/science-maths-technology/science/biology/nucleicacids-and-chromatin/content-section-3.4.2>
5. <https://www.genome.gov/genetics-glossary/Cell-Membrane>
6. <https://nptel.ac.in/content/storage2/courses/102103012/pdf/mod3.pdf>

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	explain the chemical structure and functions of carbohydrates	K1
CO2	using the knowledge of lipid structure and function	K2
CO3	describe the various levels of structural organization of proteins and the role of proteins in biological system	K3
CO4	apply the knowledge of proteins in cell-cell interactions	K4
CO5	applying the knowledge of nucleic acid sequencing in research and diagnosis	K5
CO6	integrate the metabolic pathways of different metabolites	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
1	23PBI1CC01	Core Course - 1: Basics of Biochemistry									6	6
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	1	2	2	2	1	2	2	3	2	1	1.9	
CO3	2	2	3	2	1	2	3	3	2	1	2.1	
CO4	3	1	3	2	1	2	2	3	2	1	2.0	
CO5	2	3	3	2	1	2	3	1	3	1	2.1	
CO6	3	2	2	3	1	2	3	1	3	1	2.1	
<b>Mean Overall Score</b>											<b>2.03 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PBI1CC02	Core Course - 2: Biochemical and Molecular Techniques	6	6

Course Objectives
To understand the various techniques used in biochemical investigation and microscopy.
To explain chromatographic techniques and their applications.
To explain electrophoretic techniques.
To comprehend the spectroscopic techniques and demonstrate their applications in biochemical investigations.
To acquire knowledge of radio labeling techniques and centrifugation.
To apply the knowledge to biomedical research.

**UNIT I: General Approaches in Research and Microscopy (18 Hours)**

General approaches to biochemical investigation, cell culture techniques and microscopic techniques. Organ and tissue slice technique, cell distribution and homogenization techniques, cell sorting, and cell counting, tissue Culture techniques. Cryopreservation, Biosensors- principle and applications. Principle, working and applications of light microscope, dark field, phase contrast and fluorescent microscope. Electron microscope- Principle, instrumentation of TEM and SEM, Specimen preparation and applications-shadow casting, negative staining and freeze fracturing.

**UNIT II: Chromatographic Techniques (18 Hours)**

Basic principles of chromatography- adsorption and partition techniques. Chiral Chromatography and counter current Chromatography. Adsorption Chromatography - Hydroxy apatite chromatography and hydrophobic interaction Chromatography. Affinity chromatography. Gas liquid chromatography-principle, instrumentation, column development, detectors and applications. Low pressure column chromatography - principle, instrumentation, column packing, detection, quantitation and column efficiency, High pressure liquid chromatography- principle, instrumentation, delivery pump, sample injection unit, column packing, development, detection and application. Reverse HPLC, capillary electro chromatography and perfusion chromatography.

**UNIT III: Electrophoretic Techniques (18 Hours)**

General principles of electrophoresis, supporting medium, factors affecting electrophoresis, Isoelectric focusing-principle, ampholyte, development of pH gradient and application. PAGE-gel casting-horizontal, vertical, slab gels, sample application, detection-staining using CBB, silver, fluorescent stains. SDS PAGE-principle and application in molecular weight determination principle of disc gel electrophoresis, 2D PAGE. Electrophoresis of nucleic acids-agarose gel electrophoresis of DNA, pulsed field gel electrophoresis- principle, apparatus, application. Electrophoresis of RNA, curve. Microchip electrophoresis and 2D electrophoresis, Capillary electrophoresis.

**UNIT IV: Spectroscopic Techniques (18 Hours)**

Basic laws of light absorption- principle, instrumentation and applications of UV-Visible, IR, ESR, NMR, Mass spectroscopy, Turbidimetry and Nephelometry. Luminometry (Luciferase system, chemiluminescence). X - ray diffraction. Atomic absorption spectroscopy - principle and applications - Determination of trace elements

**UNIT V: Radiolabeling Techniques and Centrifugation (18 Hours)**

Nature of radioactivity-detection and measurement of radioactivity, methods based upon ionisation (GM counter) and excitation (scintillation counter), autoradiography and applications of radioactive isotopes, biological hazards of radiation and safety measures in handling radioactive isotopes. Basic principles of Centrifugation. Preparative ultracentrifugation - Differential centrifugation, Density gradient centrifugation. Analytical ultracentrifugation - Molecular weight determination.

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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## Books for Study

1. Upadhyay, A. U. K., & Nath, N. (2014). *Biophysical chemistry principles and techniques*, (4th Ed.). Himalaya Publishing House.
2. Kothari, C. R. (2004). *Research methodology, methods and techniques*, (2nd Ed.). New Age International Publishers.
3. Freifelder, D. M. (1982). *Physical biochemistry: Applications to biochemistry and molecular biology*. W. H. Freeman.
4. Boyer, R. F. (2012). *Biochemistry laboratory: Modern theory and techniques*, (2nd Ed.). Prentice Hall.
5. Rajan, K. (2011). *Analytical techniques in biochemistry and molecular biology*. Springer.
6. Segel, I. H. (1976). *Biochemical calculations*, (2nd Ed.). John Wiley and Sons.
7. Robyt, J. F. (2015). *Biochemical techniques: Theory and practice*, (1st Ed.). CBS Publishers & Distributors.

## Books for Reference

1. Daniel, W. W. (2006). *Biostatistics: A foundation for analysis in the health sciences*, (9th Ed.). John Wiley and Sons Inc.
2. Attwood, T. K., & Parry-Smith, D. J. (1999). *Introduction to bioinformatics*. Pearson Education Ltd.
3. Boyer, R. F. (1993). *Modern experimental biochemistry*, (2nd Ed.). Benjamin- Cummings Publishing.

## Websites and eLearning Sources

1. <https://www.kau.edu.sa/Files/0017514/Subjects/principals%20and%20techniques%20of%20biochemistry%20and%20molecular%20biology%207th%20ed%>
2. [principals%20and%20techniques%20of%20biochemistry%20and%20molecular%20biology%207th%20ed%](https://www.kau.edu.sa/Files/0017514/Subjects/principals%20and%20techniques%20of%20biochemistry%20and%20molecular%20biology%207th%20ed%)

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K - Level)
	On successful completion of this course, the students will be able to	
CO1	attain good knowledge in modern used in biochemical investigation and microscopy and apply the experimental protocols to plan and carry out simple investigations in biological research	K1
CO2	demonstrate knowledge to implement the theoretical basis of chromatography in upcoming practical course work	K2
CO3	demonstrate knowledge to implement the theoretical basis of electrophoretic techniques in research work	K3
CO4	tackle more advanced and specialized spectroscopic techniques that are pertinent to research	K4
CO5	tackle more advanced and specialized radioisotope and centrifugation techniques that are pertinent to research work	K5
CO6	apply the knowledge in biomedical research	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
1	23PBI1CC02	Core Course - 2: Biochemical and Molecular Techniques									6	6
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	1	2	3	2	1	2	2	3	2	1	2.0	
CO3	2	2	3	2	1	2	3	3	2	1	2.1	
CO4	3	2	3	2	1	2	3	3	2	1	2.2	
CO5	2	3	3	2	1	2	3	1	3	1	2.1	
CO6	3	3	3	2	1	2	3	1	3	1	2.2	
<b>Mean Overall Score</b>											<b>2.1 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PBI1CP01	Core Practical - 1: Biomolecules and Biochemical Techniques	6	4

### 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 like lactate and tryptophan and minerals like calcium and iron from various sources.
To achieve training in subcellular fractionation and to identify them by markers.
To achieve training in various chromatographic techniques.
To perform the isolation and identification of the organelles of a cell using differential centrifugation.

### UNIT I: Biochemical Studies, Estimation of Macromolecules and UV Absorption

1. Isolation and estimation of glycogen from liver.
2. Isolation and estimation of DNA from animal tissue.
3. Isolation and estimation of RNA from yeast.
4. Purification of Polysaccharides -Starch and assessment of its purity.
5. Denaturation of DNA and absorption studies at 260 nm.
6. Denaturation of Protein and absorption studies at 280 nm.

### UNIT II: Colorimetric estimations

1. Estimation of Pyruvate
2. Estimation of tryptophan.

### UNIT III: Estimation of Minerals

1. Estimation of calcium
2. Estimation of iron

### UNIT IV: Plant Biochemistry

1. Qualitative analysis Phytochemical screening
2. Estimation of Flavonoids -Quantitative analysis

### UNIT V: Group Experiments

1. Fractionation of sub-cellular organelles by differential centrifugation-Mitochondria and nucleus
2. Identification of the separated sub-cellular fractions using marker enzymes (any one)
3. Separation of identification of lipids by thin layer chromatography.
4. Separation of plant pigments from leaves by column chromatography
5. Identification of Sugars by Paper Chromatography
6. Identification of Amino acids by Paper Chromatography

### Books for Study

1. Godkar, P. B. (2014). *Text book of medical laboratory technology*, (3rd Ed.). Vol I and II. Bhalani Publishing house.
2. Gowenlock, A. H. (2002). *Varley's practical clinical biochemistry*, (6th Ed.). CBS publishers.
3. Sadasivam, S. & Manickam, A. (2010). *Biochemical methods*, (3rd Ed.). New Age International (P) Ltd.
4. David, T. P. (1988). *Practical biochemistry*, (3rd Ed.). Tata McGraw-Hill Publishers.

## Books for Reference

1. Plummer, D. (2001). *An introduction to practical biochemistry*, (3rd Ed.). McGraw Hill Education (India) Private Ltd.
2. Jayaraman, J. (2011). *Laboratory manual in biochemistry*. New age publishers.
3. Varley, H. (2006). *Practical clinical biochemistry*, (6th Ed.). CBS Publishers.
4. Debiyi, O. & Sofowora, F. A. (1978). *Phytochemical screening of medical plants*. (vol. 3). Iloyidia.
5. Chavhan, S. A., & Shinde, S. A. (2019). *A guide to chromatography techniques*, (1st Ed.).
6. Katoch, R. (2011). *Analytical techniques in biochemistry and molecular biology*. Springer.

## Websites and eLearning Sources

1. [https://www.researchgate.net/publication/313745155\\_Practical Bio chemistry A Student Companion](https://www.researchgate.net/publication/313745155_Practical_Bio_chemistry_A_Student_Companion)
2. <https://doi.org/10.1186/s13020-018-0177-x>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5368116/>
4. <https://www.life.illinois.edu/biochem/455/Lab%20exercises/2Photometry/spectrophotometry.pdf>
5. <https://ijpsr.com/bft-article/determination-of-total-flavonoid-and-phenol-content-inmimusops-elengi-linn/?view=fulltext>
6. <https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry.pdf>

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	acquire knowledge and skill in the techniques used in the isolation, purification and estimation of different biomolecules that are widely employed in research	K1
CO2	get acquainted with Principle, Instrumentation and method of Performing UV absorption studies of DNA, Protein and interpreting the alteration occurred during the process of denaturation	K2
CO3	be fine-tune in handling the instruments like colorimeter, spectrophotometer and will be able to estimate the biomolecules and minerals from the given samples	K3
CO4	in addition to acquiring skill in performing various biochemical techniques can also learn to detect presence of phytochemicals and quantify them in the plant sample	K4
CO5	develop skill in analytical techniques like subcellular fractionation, Paper, Column and Thin layer Chromatography and the group experiments will enable them to build learning skills like team work, Problem solving, Communication ability	K5
CO6	perform phytochemical screening and quantification enabling them to give an insight on phytochemicals this will be useful for future research	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
1	23PBI1CP01	Core Practical - 1: Biomolecules and Biochemical Techniques									6	4
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	1	2	2	2	2	2	2.4	
CO2	2	3	2	3	1	2	2	2	2	2	2.1	
CO3	2	2	2	3	1	2	2	1	2	1	1.8	
CO4	3	2	3	3	1	2	2	1	2	1	2.0	
CO5	2	3	3	2	1	2	3	1	3	1	2.1	
CO6	3	2	3	2	1	3	2	1	3	2	2.2	
<b>Mean Overall Score</b>											<b>2.11 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PBIIES01	Elective - 1: Microbiology and Immunology	5	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 counteracting preservative measures and to know about probiotic nature of microorganisms

To gain knowledge on pathogenic mediation by microorganisms and preventive measures as well

To comprehend the features of antimicrobial agents, their mechanism of action along with the side effects and to explore natural remedial measures against microbes

To be able to exploit the various features of microorganisms for the beneficial industrial production

#### UNIT I: Taxonomy (15 Hours)

Taxonomical classification - bacteria, viruses (DNA, RNA), algae, fungi and protozoa. Distribution and role of microorganisms in soil, water and air. Charaka's classification of microbes, lytic cycle and lysogeny. Types of culture media, isolation of pure culture, growth curve and the measurement of microbial growth.

#### UNIT II: Food Spoilage (15 Hours)

Contamination and spoilage of foods - cereals, cereal products, fruits, vegetables, meat, fish, poultry, eggs, milk, and milk products. General principles of traditional and modern methods of food preservation - Removal or inactivation of microorganisms, boiling, steaming, curing, pasteurization, cold processing, freeze drying, irradiation, vacuum packing, control of oxygen and enzymes. Microbes involved in preparation of fermented foods - cheese, yoghurt, curd, pickles, rice pan cake, appam, ragi porridge (!"#)\$% #) and bread.

#### UNIT III: Food Poisoning (15 Hours)

Food poisoning- bacterial food poisoning, Salmonella, Clostridium botulinum (botulism), Staphylococcus aureus, fungal food poisoning - aflatoxin, food infection - Clostridium, Staphylococcus and Salmonella. Pathogenic microorganisms, E. coli, Pseudomonas, Klebsilla, Streptococcus, Haemophilus, & Mycobacterium, causes, control, prevention, cure and safety. Food microbiological screening- Real time PCR, ELISA, Aerobic and anaerobic Plate Count, dye reduction method, anaerobic lactic acid bacteria, anaerobic sporeformers, Hazard analysis critical control point (HACCP)

#### UNIT IV: Chemotherapy (15 Hours)

Antimicrobial chemotherapy, General characteristics of antimicrobial agents. Mechanism of action - sulfonamides, sulphones, and PAS. Penicillin, streptomycin- spectra of activity, mode of administration, mode of action, adverse effects, and sensitivity test., Antiviral and antiretroviral agents, Antiviral RNA interference, natural intervention (Natural immunomodulators routinely used in Indian medical philosophy).

#### UNIT V: Immune System (15 Hours)

Immune system- definition and properties. Cells of the immune system - neutrophils, eosinophils, basophils, mast cells, monocytes, macrophages, dendritic cells, natural killer cells, and lymphocytes (B cells and T cells). Lymphoid organs- Primary and Secondary; structure and functions. Antigens and Complement System: definition, properties- antigenicity and immunogenicity, antigenic determinants and haptens. Antigen - antibody interactions - molecular mechanism of binding. Affinity, avidity, valency, cross reactivity and multivalent binding. Immunoglobulins & Immune Response: Structure, classes and distribution of antibodies. Antibody diversity. Immune system in health & disease, Transplantation immunology- graft rejection and HLA antigens. Immunological techniques, Flow cytometry and its application.

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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### Books for Study

1. Ananthanarayan, R., & Jayaram Paniker, C. K. (2007). *Text book of microbiology*, (7th Ed.). Orient Longman Ltd.
2. Prescott, L. M., & Klein, D. A. (2007). *Microbiology*, (7th Ed.). Mc Graw-Hill.

### Books for Reference

1. Michael, J. P. Jr. (2001). *Microbiology*, (5th Ed.). McGraw Hill Education (India) Private Limited.
2. Frazier, W. C., & Vanitha, N. M. (2010). *Food microbiology*, (5th Ed.). McGraw-Hill Education (India) Private Limited.
3. Willey, J., & Sherwood, L. (2011). *Prescott's microbiology*, (8th Ed.). McGraw-Hill Education.
4. Paniker, A., & Kapil, A. (2013). *Textbook of microbiology*, (9th Ed.). Orient Black Swan.
5. Owen, J. K. (2013). *Immunology (Kindt, Kuby immunology)*, (7th Ed.). W.H. Freeman & Co.
6. Brooks, G. F., & Carroll, K. C. (2013). *Jawetz Melnick & Adelbergs medical microbiology*, (26th Ed.). McGraw Hill Education.
7. Greenwood, D. (2012). *Medical microbiology*. Elsevier Health.

### Websites and eLearning Sources

1. <https://www.ijam.co.in/index.php/ijam/article/view/1326> (Krumi (Microorganisms) in Ayurveda- a critical review)
2. Virtual Lectures in Microbiology and Immunology, University of Rochester
3. <https://www.frontiersin.org/articles/10.3389/fphar.2020.578970/full#h9>
4. <https://www.frontiersin.org/articles/10.3389/fmicb.2018.02151/full>
5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7559905/>

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	classify (by both ancient and modern modes) different types of microorganisms and explain life cycle of the microbes	K1
CO2	recognize the microorganisms involved in decay of foods and will be able to apply various counteracting measures. The students also will be able to relate the role of certain beneficial microbes in day-to-day's food consumption.	K2
CO3	understand the common pathogenic bacterial and fungi that cause toxic effects and will be able to employ curative measures	K3
CO4	analyse various features of wide variety of antimicrobial agents along with their mode of action, in addition, being able to apprehend the valuable potentials of traditional and easily available herbs	K4
CO5	apply knowledge gained in production of industrially important products as both pharmaceutical and nutraceutical	K5
CO6	apply the knowledge of immunology in daily life	K6

<b>Relationship Matrix</b>												
<b>Semester</b>	<b>Course Code</b>	<b>Title of the Course</b>									<b>Hours</b>	<b>Credits</b>
<b>1</b>	<b>23PBI1ES01</b>	<b>Elective - 1: Microbiology and Immunology</b>									<b>5</b>	<b>3</b>
<b>Course Outcomes</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>	
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>		
<b>CO1</b>	2	2	3	2	1	2	3	2	2	1	<b>2.0</b>	
<b>CO2</b>	2	2	3	2	1	2	3	3	2	1	<b>2.2</b>	
<b>CO3</b>	2	2	3	2	1	2	3	3	2	1	<b>2.1</b>	
<b>CO4</b>	3	2	3	2	1	2	3	3	2	1	<b>2.2</b>	
<b>CO5</b>	2	3	3	2	1	2	3	1	3	1	<b>2.1</b>	
<b>CO6</b>	3	2	3	2	1	2	3	2	3	1	<b>2.2</b>	
<b>Mean Overall Score</b>											<b>2.13 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PBI1ES02	Elective - 2: Energy and Drug Metabolism	5	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 (15 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 (15 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 F<sub>0</sub>F<sub>1</sub> ATPase, ATP-ADP cycle. Inhibitors of oxidative phosphorylation ionophores, protonophores. Regulation of oxidative phosphorylation.

**UNIT III: Photosynthesis and Dark Reactions (15 Hours)**

Light reaction-Hills reaction, absorption of light, photochemical event. Photo ETC-cyclic and non-cyclic electron flow. Photophosphorylation-role of CF<sub>0</sub>-CF<sub>1</sub> ATPase. Dark reaction- Calvin cycle, control of C<sub>3</sub> pathway, and Hatch-Slack pathway (C<sub>4</sub> pathway), Photorespiration. Synthesis and degradation of starch.

**UNIT IV: Metabolic Pathways (15 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 (15 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.

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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**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.

- Metzler, D. E. (2003). *The chemical reactions of living cells*, (2nd Ed.). Academic Press.
- Zubay, G. L. (1999). *Biochemistry*, (4th Ed.). Mc Graw-Hill.
- Devlin, R. M. (1983). *Plant physiology*, (4th Ed.). PWS publishers.
- Taiz, L., & Zeiger, E. (2010). *Plant physiology*, (5th Ed.). Sinauer Associates Inc.

### Websites and eLearning Sources

- <https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch21/gibbs.php>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7767752/>
- #:~:text=The%20mitochondrial%20electron%20transport%20chain,cellular%20ATP%20t hrough%20oxidative%20phosphorylation.
- [https://www.researchgate.net/figure/Oxidative-phosphorylation-in-mitochondriaelectron-transport-chain-ETC-and-proton\\_fig1\\_230798915](https://www.researchgate.net/figure/Oxidative-phosphorylation-in-mitochondriaelectron-transport-chain-ETC-and-proton_fig1_230798915)
- <https://www.lyndhurstschools.net/userfiles/84/Classes/851/photosynthesis%20light%20&%20dark%20reactions%20ppt.pdf?id=560837>
- <https://bajan.files.wordpress.com/2010/05/amphibolic-nature-of-krebs-cycle.pdf>
- <https://www.sciencedirect.com/topics/medicine-and-dentistry/xenobioticmetabolism#:~:text=Xenobiotic%20metabolism%20can%20be%20defined,more%20readily%20excreted%20hydrophili>

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	23PBIIES02	Elective - 2: Energy and Drug Metabolism									5	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	
<b>Mean Overall Score</b>											<b>2.15 (High)</b>	



Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PBI1AE01	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: Introduction

Herbal medicines: history and scope - definition of medical terms.

#### UNIT II: Indian System of Medicine

Role of medicinal plants in Indian systems of medicine; Ayurveda, Yoga, Siddha, Unani and Homeo.

#### UNIT III: Pharmacognosy

Drug Formulations - Types, Advantages and Disadvantages. Drug adulteration - types, methods of drug evaluation.

#### UNIT IV: Phytochemistry

Active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic). Biological testing of herbal drugs-Screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).

#### UNIT V: Conservation of herbs

Medicinal plant banks micro propagation of important species (*Withania somnifera*).

Teaching Methodology	Videos, PPT, Demonstration and Creation of models
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#### Books for Study

- Chopra, R. N., Nayar, S. L., & Chopra, I. C. (1956). *Glossary of Indian Medicinal Plants*. C.S.I.R
- Kanny, L. D., & Bahadur, R. (1984). *The Indigenous Drugs of India*. International Book Distributors.

#### Books for Reference

- Agnes, A. (1999). *Herbal Plants and Drugs*. Mangal Deep Publications.
- Sivarajan, V. V., & Balachandran, I. (1994). *Ayurvedic drugs and their plant source*. Oxford IBH publishing Co
- Miller, L., & Bryan, M. (1998). *Ayurveda and Aromatherapy*. Banarsidass.
- Green, A. (2000). *Principles of Ayurveda*. Thomsons.

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	comprehend on indigenous system of medicine in their day to day life	K4
CO2	correlate the medicinal uses with their formulations	K5
CO3	isolate and prepare medicines from natural sources	K6

<b>Relationship Matrix</b>											
<b>Semester</b>	<b>Course Code</b>	<b>Title of the Course</b>								<b>Hours</b>	<b>Credits</b>
<b>1</b>	<b>23PBI1AE01</b>	<b>Ability Enhancement Course: Herbal Technology</b>								<b>2</b>	<b>1</b>
<b>Course Outcomes</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	2	2	3	2	1	2	3	2	2	1	<b>2.0</b>
<b>CO2</b>	2	3	2	2	1	2	3	2	3	1	<b>2.2</b>
<b>CO3</b>	2	2	3	2	1	2	3	3	2	1	<b>2.1</b>
<b>Mean Overall Score</b>											<b>2.1 (High)</b>

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PBI2CC03	Core Course - 3: Molecular Biology	4	4

### Course Objectives

To recall the different types of biotransformation reactions involving enzyme
To predict the bioenergetics of enzyme mediated catalysis
Apply the use of enzymes in various fields
Analyze the mechanism of action of selected enzymes
Evaluate the rate of enzyme action (kinetics) and design the methodology of purification of enzymes
Apply practical knowledge on biosensor development and enzyme engineering

#### UNIT I: Introduction (12 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.

##### Organization of Chromosome

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 (12 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.

##### Extra chromosomal DNA

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 (12 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 - structure and function. Replication of RNA - RNA and DNA mediated.

##### Recombination

Homologous and non-homologous recombination - Site specific recombinations & transposition of DNA.

#### UNIT IV: Transcription (12 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.

##### Translation

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 consequences****(12 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 versus somatic mutants, insertional mutagenesis. DNA repair mechanism: thymine dimer, light activation, excision, recombinational, SOS and mismatch repair.

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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**Books for Study**

1. Harvey, L., Arnold, B., & Chris, A. K. (2003). *Molecular cell Biology*. (5th Ed.). W. H. Freeman & Co Ltd.

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

2. David, F. (2008). *Molecular Biology*. (2nd Ed.). Narosa Publications.

**UNIT-I Chapter VIII UNIT-II Chapter XX UNIT-III Chapter IX**

**UNIT-IV Chapter XII UNIT-V Chapter X, XX IV**

3. Jeffrey, M.C., & Rober E. H. (2000). *The Cell: A Molecular Approach ASM Press*

**UNIT-I Chapter IV UNIT-II Chapter VI UNIT-III Chapter VI**

**UNIT-IV Chapter VII UNIT-V Chapter VI, XVIII**

**Books for Reference**

1. Ajoy, P. (2007). *Textbook of Cell and Molecular Biology*. Books and Allied
2. De Robertis & De Robertis. (1990). *Cell and Molecular Biology*. Saunders
3. Gerald, K. (2008). *Cell and Molecular Biology*, (5th Ed.). John Wiley and Sons
4. Lewin's. (2017). *GENES XII*, (12th Ed.). Jones and Bartlett Publishers, Inc;

**Websites and eLearning Sources**

1. <https://ncert.nic.in/ncerts/l/lebo106.pdf>
2. <https://www.caister.com/cimb/v/v13/37.pdf>
3. [https://www.researchgate.net/publication/316085336\\_Transposons\\_in\\_Eukaryotes\\_Structures\\_Mechanisms\\_and\\_Applications](https://www.researchgate.net/publication/316085336_Transposons_in_Eukaryotes_Structures_Mechanisms_and_Applications)
4. [https://projects.iq.harvard.edu/files/lifesciences1abookv1/files/9\\_-\\_transcription\\_revised\\_9-24-2018.pdf](https://projects.iq.harvard.edu/files/lifesciences1abookv1/files/9_-_transcription_revised_9-24-2018.pdf)
5. [https://projects.iq.harvard.edu/files/lifesciences1abookv1/files/10\\_-\\_the\\_genetic\\_code\\_and\\_translation\\_revised\\_9-24-2018.pdf](https://projects.iq.harvard.edu/files/lifesciences1abookv1/files/10_-_the_genetic_code_and_translation_revised_9-24-2018.pdf)
7. <https://www.nature.com/scitable/topicpage/ribosomes-transcription-and-translation-14120660/>
8. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6693886/>

<b>Course Outcomes</b>		
<b>CO No.</b>	<b>CO-Statements</b>	<b>Cognitive Levels (K - Level)</b>
	On successful completion of this course, the students will be able to	
<b>CO1</b>	recall the pioneering experiments involved in molecular biology	<b>K1</b>
<b>CO2</b>	predict the mechanisms concerned with the mobile genetic elements	<b>K2</b>
<b>CO3</b>	apply the isolation procedures of nucleic acids	<b>K3</b>
<b>CO4</b>	analyze the steps involved in the induction of transcription	<b>K4</b>
<b>CO5</b>	evaluate the errors and correction mechanisms of informational molecules and synthesize the DNA molecules artificially	<b>K5</b>
<b>CO6</b>	evaluate the chromosomal defect of the diseases and the mechanisms of DNA repair	<b>K6</b>

<b>Relationship Matrix</b>												
<b>Semester</b>	<b>Course Code</b>	<b>Title of the Course</b>									<b>Hours</b>	<b>Credits</b>
<b>2</b>	<b>23PBI2CC03</b>	<b>Core Course - 5: Molecular Biology</b>									<b>4</b>	<b>4</b>
<b>Course Outcomes</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>	
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>		
<b>CO1</b>	2	2	3	2	2	3	2	3	2	3	<b>2.4</b>	
<b>CO2</b>	3	2	2	3	2	3	2	2	3	3	<b>2.5</b>	
<b>CO3</b>	3	2	3	2	2	3	3	3	2	2	<b>2.5</b>	
<b>CO4</b>	3	2	3	3	2	3	3	2	2	2	<b>2.5</b>	
<b>CO5</b>	3	2	3	2	2	3	3	2	2	3	<b>2.5</b>	
<b>CO6</b>	3	2	3	2	3	2	3	2	3	3	<b>2.6</b>	
<b>Mean Overall Score</b>											<b>2.5 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PBI2CC04	Core Course - 4: Bioenergetics and Enzymology	4	4

Course Objectives
To recall the different types of biotransformation reactions involving enzymes
To predict the bioenergetics of enzyme mediated catalysis
Apply the use of enzymes in various fields
Analyze the mechanism of action of selected enzymes
Evaluate the rate of enzyme action (kinetics) and design the methodology of purification of enzymes
Apply practical knowledge on biosensor development and enzyme engineering

**UNIT I: Thermodynamics (12 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 (12 Hours)**

Historical aspects of enzymology, nomenclature and classification of enzymes according to IUB-EC-1964. Units of enzyme activity. Turn over number, specific activity. 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 Ion Exchange), solubility difference and selective adsorption (Adsorption chromatography, Affinity Chromatography). Criteria of purity.

**UNIT III: Criteria of chemical reactions (12 Hours)**

Collision & transition state theories, specificity of enzymes. Active site - definition, organization and determination of active site residues. Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Coenzymes - structure and functions. Mechanism of enzyme action - lysozyme, chymotrypsin, carboxypeptidase and DNA polymerase. Isoenzymes. Multienzymes system- mechanism of action and regulation of pyruvate dehydrogenase, LDH and fatty acid synthase complex.

**UNIT IV: Kinetics of catalyzed reaction (12 Hours)**

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

**UNIT V: Applications of Enzymes (12 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.

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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**Books for Study**

1. Gilbert, H.F. *Basic Concepts in Biochemistry*, (2nd Ed.). McGraw-Hill Health Professions Division.

**Unit-I Chapter 14, Chapter 24**

**Unit-IV Chapter 7, Chapter 8**

- Rodwell, V.W., Bender, D., Botham, K.M., Kennelly, P.J., Weil, P.A. (2018) *Harper's Illustrated Biochemistry*, (26th Ed.). McGraw- Hill, Medical Publishing Division.

**Unit-III Section 1**

- Price., & Stevens, (1999). *Fundamentals of Enzymology*, Oxford University Press

**Unit-II Chapter 3, Chapter 9 Unit-V Chapter 10**

- Dixon, M., & Webb, J.F., (1979). *Enzymes*, Longman Publishing, London.
- Price., & Stevens, (1999). *Fundamentals of Enzymology*, Oxford University Press

**Books for Reference**

- Trevor, P. (1991). *Understanding Enzymes*, (3rd Ed.). Ellis Harwood
- Lehninger, A. H. *et al.*, (1993). *Principles of Biochemistry*, Worth Publ. Inc.,
- Berg, J.M., & John, L., Tymoczko., & Lubert, S. (2007). *Biochemistry*, (6th Ed.). W H Freeman & Co

**Websites and eLearning Sources**

- <https://ncert.nic.in/ncerts/l/kech106.pdf>
- <https://iubmb.org/wp-content/uploads/sites/10116/2018/11/A-Brief-Guide-to-Enzyme-Classification-and-Nomenclature-rev.pdf>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4692135/>
- <https://www.news-medical.net/life-sciences/Enzyme-Kinetics.aspx>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4692135/>

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K - Level)
	On successful completion of this course, the students will be able to	
CO1	discern the types of transformation reactions mediated by enzymes	K1
CO2	predict the bioenergetics of enzyme mediated catalysis	K2
CO3	apply the use of enzyme mechanisms and significance of isozymes	K3
CO4	evaluate the enzyme action mathematically	K4
CO5	analyse the methods of enzyme regulation	K5
CO6	exploit the enzymes for clinical purpose and for the fabrication of biosensors	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
2	23PBI2CC04	Core Course - 4: Bioenergetics and Enzymology									4	4
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	3	3	3	2	2	3	2	3	1	2.4	
CO2	2	2	3	2	1	2	2	3	2	1	2.0	
CO3	2	3	3	3	1	3	3	3	3	1	2.5	
CO4	3	3	3	2	1	2	3	3	2	2	2.4	
CO5	3	3	3	3	1	3	3	1	3	1	2.4	
CO6	3	3	3	2	2	3	3	2	3	1	2.5	
<b>Mean Overall Score</b>											<b>2.36 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PBI2CC05	Core Course - 5: Genetic Engineering	4	3

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: Enzymes in Genetic Engineering (12 Hours)**

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

#### **UNIT II: Expression cassette (12 Hours)**

Promoters (constitutive, inducible, tissue specific), terminators, reporters, markers (antibiotic resistant - Streptomycin, herbicide resistant - DDT, antimetabolite - Methotrexate), Vectors in gene cloning - Plasmids (pBR322, pUC), Bacteriophages (Phage  $\lambda$ , M13), cosmids, phagemids, yeast plasmid vector, viral vectors (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 (12 Hours)**

Transformation - physical method (electroporation, micro-injection, particle bombardment, liposome mediated transfer), chemical method (PEG mediated, DEAE Dextran mediated, CaPO<sub>4</sub> 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 (12 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 (12 Hours)**

Principles, methods and applications - 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.

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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#### **Book for Study**

- Glick, R., & Pasternak, J.J. (2002). *Molecular Biotechnology*, (3rd Ed.). ASM Press  
**UNIT-II Chapter IV, VII UNIT-III Chapter V UNIT-V Chapter XX**
- Old, R.W., & Primrose, S.B. (1989). *Principles of gene manipulation*, (4th Ed.). Blackwell Scientific 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 Reference

1. David, M.G., (1984). *Gene Cloning-The Mechanisms of DNA Manipulations*. Chapman and Hall
2. Ernst, L.W., (2002). *From Genes to Clones -Introduction to Gene Technology*. VCR Publication.
3. Watson, J.D. (1992). *Recombinant DNA* W. H. Freeman.

## Websites and eLearning Sources

1. <https://www.sciencedirect.com/science/article/pii/S0002961005808414>
2. <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/restriction-enzyme>
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%20script200331121203033636.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 Levels (K - Level)
	On successful completion of this course, the students will be able to	
CO1	apply various principles of genetic engineering and enzymes involved with it	K1
CO2	execute the methods of gene transfer in prokaryotes and eukaryotes	K2
CO3	exploit the analytical procedures involved in nucleic acid study	K3
CO4	construct gene cassettes and vectors	K4
CO5	follow the protocols of recombinant selection and screening	K5
CO6	protect their intellectual properties and use genomic library	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
2	23PB12CC05	Core Course - 5: Genetic Engineering									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	1	2	3	2	1	2	2	3	2	1	2.0	
CO3	2	2	3	2	1	2	3	3	2	1	2.1	
CO4	3	2	3	2	1	2	3	3	2	1	2.2	
CO5	2	3	3	2	1	2	3	1	3	1	2.1	
CO6	2	3	2	3	1	2	2	2	2	1	2.0	
<b>Mean Overall Score</b>											<b>2.06 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PBI2CP02	Core Practical - 2: Enzymology, Physiology and Molecular Techniques	5	4

### 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

### ENZYMOLGY

1. Assay of acid phosphatase.
2. Factors influencing reaction rates of acid Phosphatase.
  - i) Effect of Temperature.
  - ii) Effect of Time.
  - iii) Effect of pH.
  - iv) Effect of Enzyme concentration.
  - v) 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 Reference

1. Lansing, M. P., John, P. H., & Klein, D.A. (2007). *Microbiology*, (7th Ed.). Mc Graw Hill
2. James, G.C., & Sherman, N. (2005). *Microbiology - A Laboratory Manual*. (7th Ed.). Pearson education India
3. Glick, R. & Pasternak, J. J. (2002). *Molecular Biotechnology* (3rd Ed.). ASM Press
4. Old, R.W., & Primrose, S.B. (1989). *Principles of gene manipulation*, (4th Ed.). Blackwell Scientific Publications
5. Praful, B. G. (2014). *Text book of medical laboratory technology*, (3rd Ed.). Volume I and II, Bhalani Publishing house.
6. Alan, H. G, *Varley's Practical Clinical Biochemistry*, (6th Ed.). CBS publishers.

### Websites and eLearning Sources

1. <https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry.pdf>
2. <https://www.youtube.com/watch?v=vq759wKCCUQ>
3. <https://www.youtube.com/watch?v=f6HtqolhKqo>
4. <https://www.youtube.com/watch?v=8jVNcT5Dapk>
5. <https://www.youtube.com/watch?v=eIVAkFENfxI>

Course Outcomes		
CO No.	CO- Statements	Cognitive Levels (K- Level)
	On successful completion of this course, the students will be able to	
CO1	describe the isolation procedures of the enzymes	K1
CO2	explain the factors affecting the enzyme action and the importance of the blood circulation and changes in the physiology of the circulation during exercise	K2
CO3	apply the knowledge to study the effect of various factors over the activity of different enzymes	K3
CO4	analyze the patterns of cardiac cycle during normal and in exercise condition	K4
CO5	evaluate the banding pattern in protein	K5
CO6	exploit the preparation of synthetic seeds	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
2	23PBI2CP02	Core Practical - 2: Enzymology, Physiology and Molecular Techniques									5	4
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	3	3	3	2	2	3	2	3	3	2.6	
CO2	2	2	3	2	2	2	2	3	2	3	2.3	
CO3	2	3	3	3	2	3	3	3	3	3	2.8	
CO4	3	3	3	2	2	2	3	3	2	3	2.6	
CO5	3	3	3	3	2	3	3	3	3	3	2.9	
CO6	3	3	3	2	2	3	3	2	3	3	2.7	
<b>Mean Overall Score</b>											<b>2.65 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PBI2SP01	Self-paced Learning: Advanced Nutrition	-	2

### 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

Carbohydrate: 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 of nutritional 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.
2. Anthony, A. A. (1972). *Newer Methods of Nutritional Biochemistry* (Academic Press)

#### Books for Reference

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

Course Outcomes		
CO No.	CO- Statements	Cognitive Levels (K- Level)
	On successful completion of this course, the students will be able to	
CO1	study the basic requirement of nutrition at different stages of life	K1
CO2	learn the proximate principles of nutrition with reference to rda	K2
CO3	apply the experimental procedures concerned with energy metabolism	K3
CO4	assess nutritional requirements for various disease status and age groups	K4
CO5	quantify the nutritional content of the food items	K5
CO6	evaluate the disorders associated with nutrition	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
2	23PBI2SP01	Self-paced Learning: Advanced Nutrition									-	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	2	1	3	1	2	3	1	2	2	2	1.9	
CO2	3	1	1	1	2	3	1	3	2	3	2	
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	
<b>Mean Overall Score</b>											<b>2.15(Medium)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PBI2ES03A	Elective - 3: 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 diseases

#### 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 normal development, Polyphenisms and plasticity, Learning system.

Teaching Methodology
Videos, PPT, Demonstration and Creation of models

#### Books for Study

- Chattopadhyay, S. (2016). *An Introduction to Developmental Biology*. Books and Allied (P) Ltd.  
**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)**
- Scott, F. G. (2010). *Developmental Biology*, (9th Ed.). Sinauer Associates Inc.  
**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. Handbook of Cardiac Anatomy, Physiology, and Devices, (3rd Ed.). Springer International Publishing Switzerland (2015) (eBook).

### Unit IV - Part - II Chapter - 3 - 3.1 to 3.6

4. Schoenwolf., Bleyl., Brauer., & Francis-West. "Larsen's Human Embryology" (5th Ed.). Elsevier, Churchill Livingstone, 1600 John F. Kennedy Blvd. Ste19103-2899 (Ebook).

### Unit II Chapter - 1(Pages 14-38)

### Unit III Chapter - 4 (Pages 82-107)

#### Books for Study

1. Gilbert S.F. (2010). *Developmental Biology*, (9th Ed.). Sinauer Associates Inc.
2. Chattopadhyay, S. (2016). *An Introduction to Developmental Biology*. Books and Allide (P) Ltd.

#### Books for Reference

1. Alberts B. *et al.* (2002). *Molecular Biology of the Cell*, (3rd Ed.). Garland Science
2. Harvey, L., Arnold, B., & Paul, M. (2008). *Molecular Cell biology*, (5th Ed.). W. H. Freeman and Company

#### Websites and eLearning Sources

1. [http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp\\_content/S000035ZO/P001308/M027365/ET/1519022717M18CellAdhesionmoleculesChemokinesQuad1.pdf](http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000035ZO/P001308/M027365/ET/1519022717M18CellAdhesionmoleculesChemokinesQuad1.pdf)
2. [https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp\\_content/S001174BS/P001198/M011310/ET/1526902570P3M7Celladhesionandrecognition\\_ET.pdf](https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001198/M011310/ET/1526902570P3M7Celladhesionandrecognition_ET.pdf)
3. <https://rupress.org/jcb/article/220/10/e202102146/212606/The-cell-biology-of-fertilization-Gamete>
4. <https://www.ncbi.nlm.nih.gov/books/NBK9901/>
5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8863375/>
6. <https://www.ncbi.nlm.nih.gov/books/NBK9997/>
7. <https://ncert.nic.in/textbook/pdf/kebt108.pdf>
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\\_Microevolution.pdf](https://shs.hal.science/halshs_01498604/file/NicoglouPhenotypic_Plasticity_From_Microevolution.pdf)
11. <https://scholar.archive.org/work/pgnorpq2mzh2vgx7s7jrjxhgvq/access/wayback/http://pdfs.semanticscholar.org/1e3f/5e54f12aa69d2c340049301a8942bd53f01b.pdf>

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K - Level)
CO1	describe the cellular basis and embryonic development	K1
CO2	elucidate the process and mechanisms of sex determination in mammals	K2
CO3	assign the gene function to the phenotype of an organism	K3
CO4	analyze mechanisms of the development of various organs	K4
CO5	evaluate the role of environment in the developmental process	K5
CO6	apprehend the various genetic diseases	K6

<b>Relationship Matrix</b>											
<b>Semester</b>	<b>Course Code</b>		<b>Title of the Course</b>							<b>Hours</b>	<b>Credits</b>
<b>2</b>	<b>23PBI2ES03A</b>		<b>Elective - 3: Developmental Biology</b>							<b>5</b>	<b>4</b>
<b>Course Outcomes</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	2	3	2	2	3	2	2	2	2	2	<b>2.2</b>
<b>CO2</b>	2	3	3	2	1	2	3	3	3	3	<b>2.5</b>
<b>CO3</b>	2	2	3	2	3	3	2	2	3	3	<b>2.5</b>
<b>CO4</b>	2	3	2	3	2	3	2	3	3	2	<b>2.5</b>
<b>CO5</b>	2	3	2	2	1	2	3	2	3	3	<b>2.3</b>
<b>CO6</b>	3	2	3	2	2	3	3	3	2	3	<b>2.6</b>
<b>Mean Overall Score</b>										<b>2.43 (High)</b>	



Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PBI2ES03B	Elective - 3: Life Sciences for Competitive Exams - 1	5	4

### Course Objectives

To gain knowledge on the basics in classification and naming plants and herbarium preparation
To comprehend systematic classification of plants and animals
To study the biosynthesis and biological role of plant hormones and ecosystem
To recognize the correlation between photosynthesis, photoperiodism and nitrogen metabolism
To appreciate the mechanism of photosynthesis and dark reactions in plants
To be able to exploit the pollutants and various method of bioremediation

#### UNIT I: Basics of Taxonomy (15 Hours)

Principles & methods of taxonomy, classical & modern methods of taxonomy of plants, animals and microorganisms. Levels of structural organization: Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Herbarium preparation.

#### UNIT II: System of classifications (15 Hours)

Outline classification of plants, animals & microorganisms, structural details: Important criteria used for classification in each taxon. Classification of plants (Bentham and Hooker), animals (Whitaker's) and microorganisms. Prokaryote and eukaryote cell: structural and function of cell wall, mitochondria, chloroplast, ribosomes, E.R., Golgi complex and nucleus.

#### UNIT III: Plant hormones and Nitrogen metabolism: (15 Hours)

Plant hormones - Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Sensory photobiology & Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. Nitrogen metabolism- Nitrate and ammonium assimilation.

#### UNIT IV: Photosynthesis and plant physiology: (15 Hours)

Photosynthesis - Light reaction and dark reaction fixation C<sub>3</sub>, C<sub>4</sub> and CAM pathways, photorespiratory pathway. Translocation of water, ions, solutes and macromolecules from soil-xylem and phloem, transpiration, introduction to sec metabolites. Stress physiology. Response of plants to biotic (pathogens and insects) and abiotic (water, temp and salt) stresses.

#### UNIT V: Environmental hazards and management: (15 Hours)

Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Bioremediation; Phytoremediation; Solid waste management: toxic effects and treatments, methods, technologies for management of hospital waste - incineration, autoclaving, mechanical/chemical, microwave, plasma torch, detoxification, advanced wet oxidation and thermal, dry heat.

Teaching Methodology	Videos, PPT, Demonstration and Creation of models
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#### Books for Study

- Verma, P. S & Agarwal, V. K. (2003). *Cytology, Genetics, Evolution and Ecology*, S. Chand & Co Ltd.,  
**UNIT-II** Chapter 5 (Pages 112-153), Chapter 6(Pages 154-165), Chapter 7 (Pages 166-174), Chapter 10 (pages 191-219), Chapter 12(Pages 243-256), Chapter 14 (Pages 280-292).  
**UNIT-I** Section 1 (Pages 5-16), Section 3 (pages 182-192).  
**UNIT-III** Chapter 17 (Pages 494-505), Chapter 19 (Pages 546-562), Chapter 20 (Pages 584-612), Chapter 21 (Pages 622-641), Chapter 22 (Pages 650-667), Chapter 23(pages 674-690), Chapter 25 (Pages 720-748).

- Bir, B., Manchikatla Venkat Rajam Leela Sahijram K.V. Krishnamurthy Editors, Plant Biology and Biotechnology, Volume I: Plant Diversity, Organization, Function and Improvement. **UNIT-IV Chapter 22** (Pages 569-591).  
**UNIT-V Chapter 1**(Pages 3-32), *Chapter 2* (33-49), *Chapter 4* (pages 61-103)
- Verma, S.K. (1999). *Text Book of Plant Physiology*. S.Chand & Co Ltd.,

#### Books for Reference

- Lawrence, G.H. M. (1995). *The Taxonomy of Vascular Plants*, Mac Millan Publishers
- Noggle, G.R., & Fritz, G.J. (1976). *Introductory Plant Physiology*, Prentice-Hall Publishers.

#### Websites and eLearning Sources

- <https://collegedunia.com/exams/calvin-cycle-c-3-cycle-definition-stages-diagram-roducts-biology-articleid-1723>
- <https://www.pnas.org/doi/pdf/10.1073/pnas.68.11.2883>
- [https://www.shahucollegelatur.org.in/Department/Studymaterial/sci/Botany/Msc\\_I\\_\\_year\\_botany\\_sem\\_II\\_Plant\\_physiology\\_and\\_metabolism\\_Unit\\_Iv\\_Notse.pdf](https://www.shahucollegelatur.org.in/Department/Studymaterial/sci/Botany/Msc_I__year_botany_sem_II_Plant_physiology_and_metabolism_Unit_Iv_Notse.pdf)
- [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](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)
- <https://www.nios.ac.in/media/documents/SrSec314NewE/Lesson-10.pdf>
- <https://testbook.com/biology/photosynthesis>
- [https://ec.europa.eu/echo/files/evaluation/watsan2005/annex\\_files/WEDC/es/ES07CD.pdf](https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WEDC/es/ES07CD.pdf)

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K- Level)
	On successful completion of this course, the students will be able to	
CO1	describe the fundamental knowledge on plant kingdom classification	K1
CO2	demonstrate the preparation of herbarium	K2
CO3	illustrate the mechanisms of action of hormones and its role in physiology	K3
CO4	analyze the principles of ecosystems	K4
CO5	evaluate the bioremediation and phytoremediation	K5
CO6	apply the protocol for the protection of environment	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
2	23PB12ES03B	Elective - 3: Life Sciences for Competitive Exams - 1									5	4
Course Outcomes	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO 4	PSO 5		
CO1	2	2	1	2	3	3	3	2	3	3	2.4	
CO2	2	3	3	1	1	2	3	3	2	3	2.3	
CO3	2	1	3	2	3	1	2	3	3	2	2.2	
CO4	2	3	1	2	3	1	2	3	1	3	2.1	
CO5	2	1	2	3	2	2	3	1	3	3	2.2	
CO6	2	3	2	3	3	2	3	3	2	2	2.5	
<b>Mean Overall Score</b>											<b>2.28 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PSS2SE01	Skill Enhancement Course: Soft Skills	4	3

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

<b>Teaching Methodology</b>	Chalk and talk, Lectures, Demonstrations, PPT.
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**Book for Study**

- 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**

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

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	23PSS2SE01		Skill Enhancement Course: Soft Skills					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	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
<b>Mean Overall Score</b>											<b>2.8 (High)</b>

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	23PBI3CC06	Core Course - 6: Human Physiology	6	6

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: General and Cellular Physiology (18 Hours)**

Cell as the living unit of the body. The internal environment- homeostasis. Control systems, organization of a cell, transport across cell membranes, 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: Gastro-intestinal System (18 Hours)**

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 of peptic ulcer, gastrointestinal hormones and their actions, absorption of carbohydrates, fats and proteins, vitamins, water and electrolytes.

#### **UNIT III: Cardio-vascular and Respiratory Physiology (18 Hours)**

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: Nerve and Muscle Physiology (18 Hours)**

General design of nervous system: Classification and Properties 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: Renal Physiology (18 Hours)**

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, aviation physiology, space physiology, deep sea diving & hyperbaric condition

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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#### **Books for Study**

- Arthur, C. & John, E. H. *Textbook of Medical Physiology*, (11th Ed.). Elsevier Saunders.
  - Unit-I** Chapter 1 (Page No. 3-6)
  - Unit-II** 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
- Chatterjea, M.N. & Shinde, R. *Textbook of Medical Biochemistry*, (8th Ed.). Jaypee Brothers

Medical Publishers. (P) Ltd.

**Unit-I** Chapter 7 (Page No. 97-108)

3. Chatterjee, C.C. (2007). *Human Physiology*. Vol. I and Vol. II. Kalyani Publishers.

**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. L. (2015). *Handbook of Cardiac Anatomy, Physiology, and Devices*, (3rd Ed.). Springer International Publishing.

**Unit-III** art I - Chapter 1.2.4

5. Arthur, C. G. (2005). *Text Book of Medical Physiology*. WB Saunders's.

6. Chatterjee, C.C. (1985). *Human Physiology*, (11th Ed.). Vol I & Vol II. Kalyani Mukerjee Publications.

### Books for Reference

1. Kathleen, J. W. W., & Waugh, A. (1998). *Ross and Wilson Anatomy and Physiology in Health and Illness*, (8th Ed.). Churchill Livingstone.
2. Gerald, J. T. & Sandra Reynolds. (2003). *Principles of Anatomy and Physiology*, (10th Ed.). John Wiley and Sons. Inc. Pub.
3. White, A., Handler, P., & Emil, L. S. (1983). *Principles of Biochemistry*, (6th Ed.). Tata Mc Graw - Hill Publishing Company.

### 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](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](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](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	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	describe the anatomy of the human body	K1
CO2	understand the mechanism of gastrointestinal tract	K2
CO3	apply the knowledge in relating the structure with the functions of nervous system	K3
CO4	analyze the interrelationships within and between anatomical and physiological systems of the human body	K4
CO5	evaluate the influence of environment and feelings in the physiological processes	K5
CO6	apply the gained knowledge in promoting good health and well being	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
3	23PBI3CC06	Core Course - 6: Human Physiology									6	6
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	
<b>Mean Overall Score</b>											<b>2.46 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	23PBI3CC07	<b>Core Course - 7:</b> Pharmaceutics and Nanotechnology	5	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: Tablets (15 Hours)**

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

**UNIT II: Capsules (15 Hours)**

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: Packaging materials (15 Hours)**

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: Controlled drug delivery systems (15 Hours)**

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: Introduction to Nanotechnology (15 Hours)**

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.

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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**Books for Study**

- Lachman, L., Herbert, A. L., & Joseph, L. K. *Theory and Practice of Industrial Pharmacy*, (3rd Ed.). Lea & Febiger.

**UNIT-I** (Sec III)

**UNIT-II** (Sec III, Sec IV)

**UNIT-III** (Sec IV)

- Ersoz, M., & Balaban, A.M. (2018). *Nanotechnology I (Fundamentals of Nanotechnology)*, (1st Ed.).

**UNIT-V** (Sec 1, Sec 3)



3. Michael, E. A. *Pharmaceutics, The Science of Dosage Form Design*, (2nd Ed.). English language book society/Churchill Livingstone.

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

**Books for Reference**

1. Herbert, A. L., LeonLachman & Joseph, B. S. *Pharmaceutical Dosage Forms*. Marcel Dekker INC. Tablets, Volume 1, 2, 3.
2. Christ of M. Niemeyer (Editor) & Chad, A. M. (Editor). (2004). *Nanobiotechnology: Concepts, Applications and Perspectives*, (1st Ed.). Wiley-VCH.
3. Shoseyov, O., & Levy, I. (2007). *Nano Bio Technology: Bio Inspired Devices and Materials of the Future*, (1st Ed.). Humana Press.

**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	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	discuss various drug delivery systems	K1
CO2	explain the methods of quality control in pharmaceutical industry	K2
CO3	apply the methods in the preparation of tablets and capsules	K3
CO4	analyze the various types of glasses used in packaging of medicinal preparations	K4
CO5	explain the properties of nanoparticles	K5
CO6	synthesize and characterize various nanoparticles	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
3	23PBI3CC07	Core Course - 7: Pharmaceutics and Nanotechnology									5	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	1	1	2	2	3	3	2	1	2.0	
CO2	2	3	1	1	2	3	2	2	1	3	2.0	
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	
<b>Mean Overall Score</b>											<b>2.10 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	23PBI3CC08	Core Course - 8: Advances in Clinical Research	5	5

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 (15 Hours)**

Introduction to clinical research, terminologies and definition in clinical research, origin and history of clinical research, difference between clinical research and clinical practice, types of clinical 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 (15 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 (15 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 (15 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 (15 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.

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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#### **Books for Study**

- Lawrence, M. F. *Fundamentals of Clinical Trials*, (5th Ed.). Springer Publications.  
**UNIT-I** Chapter 1, 2  
**UNIT-II** Chapter 3, 4  
**UNIT-IV** Chapter 15, 16  
**UNIT-V** Chapter 18
- David, M., & Simon, D. (2004). *Text Book of Clinical Trials*. John Wiley Publications.

- UNIT-I** Chapter 1,2  
**UNIT-II** Chapter 6,7,8  
**UNIT-III** Chapter 4  
**UNIT-V** Chapter 7,8

**Books for Reference**

1. Brody, T. (2016). *Clinical Trials*, (2nd Ed.). Elsevier Publications. Unit IV:Chapter 25.
2. John, I. G. (2002). *Principle and Practice of Clinical Research*, (2nd Ed.).
3. WHO. (2001). *Health Research Methodology*, (2nd Ed.).

**Websites and eLearning Sources**

1. <https://www.youtube.com/watch?v=BBTqkHQjUzg>
2. <https://www.cancer.org/cancer/managing-cancer/making-treatment-decisions/clinical-trials/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/fdds.v.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](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](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-and-safety/pharmacovigilance>
14. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5372399/>

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	discuss the basic introductory knowledge on the clinical research	K1
CO2	compare the protocols related to the clinical trial procedures in India and abroad	K2
CO3	apply the GLP in clinical research lab	K3
CO4	test the activity of the newly formulated drugs in experimental animals	K4
CO5	evaluate the formulations preparation and usage of the newly revealed drug for human consumption	K5
CO6	design the protocols for clinical trials	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
3	23PBI3CC08	Core Course - 8: Advances in Clinical Research									5	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	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	3	3	2	2	3	3	3	2	3	3	2.7	
<b>Mean Overall Score</b>											<b>2.30 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	23PBI3CP03	<b>Core Practical - 3:</b> Immunology, Andrology, Hormone Assay and Miscellaneous	5	5

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

### I. Immunology techniques

1. Widal test - rapid slide test for typhoid
2. VDRL test - test for syphilis
3. Latex agglutination test for rheumatoid factor and Pregnancy

### II. Histopathology

### III. Andrology

1. Total sperm count.
2. Motility Test.
3. Fructose estimation.

### IV. Hormone Assay

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

### V. Miscellaneous

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

### VI. Visit to National Research centers.

#### Books for Reference

1. Richard, K., Goldsby, A., Thomas, J. K., & Barbara, A. O. (2000). *Immunology*, (4th Ed.). W.H. Freeman and Company
2. Ivan, M. R., & Peter, J. D. (2005). *Roitt's Essential Immunology*, (10th Ed.). Blackwell Scientific Publishers.

#### Websites and eLearning Sources

1. <https://www.anamollabs.com/widalantigens.html>
2. <https://www.youtube.com/watch?v=cFRk6CoupDs>
3. [https://www.youtube.com/watch?v=R-rK\\_WfSOcY](https://www.youtube.com/watch?v=R-rK_WfSOcY)
4. <https://www.anamollabs.com/asolatex.html>
5. <https://www.youtube.com/watch?v=7dkzPNzTUtE>
6. <https://www.youtube.com/watch?v=PJV-DJ5gVAI>
7. <https://www.youtube.com/watch?v=f667gI4IVMM>
8. [https://www.youtube.com/watch?v=dg\\_ID86hRlg](https://www.youtube.com/watch?v=dg_ID86hRlg)
9. <https://www.youtube.com/watch?v=qAoa94WBaIc>

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	discuss the immune techniques used in the clinical diagnosis	K1
CO2	demonstrate sperm morphology, sperm count and its viability	K2
CO3	design protocols for the isolation of secondary metabolites from plant source	K3
CO4	analyze the results of various diagnostic procedures by ELISA	K4
CO5	evaluate disease progression and design the methodologies for the diagnosis of various disease	K5
CO6	apply the histopathological screening of the various organs in animal models	K6

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
3	23PBI3CP03	Core Practical - 3: Immunology, Andrology, Hormone Assay and Miscellaneous								5	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	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	3	2	3	3	3	2	3	3	3	2	2.7
<b>Mean Overall Score</b>										<b>2.50 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	23SBS3CC01	<b>Common Core:</b> Intellectual Property Rights	5	4

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 (15 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 (15 Hours)**  
Patent - Introduction, Patent acts and its amendments. Patentable and Non patentable inventions. Process and product patent, 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 (15 Hours)**  
Copy right - concepts and principles. Historical background and development of copyright law - Copy right 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 (15 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 (15 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.

<b>Teaching Methodology</b>	PPT, videos and practical demonstration
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#### Book 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 LawHouse.

#### 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, the 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	23SBS3CC01	Common Core: Intellectual Property Rights									5	4
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	3	2	2	1	2	2	2	2	2	2.2	
CO2	2	3	2	2	1	2	2	2	2	3	2.1	
CO3	2	2	3	2	2	2	2	2	2	3	2.2	
CO4	2	2	2	3	2	2	2	2	2	3	2.2	
CO5	2	2	2	2	3	1	2	2	2	2	2.2	
CO6	2	3	2	2	1	2	2	2	2	3	2.2	
<b>Mean Overall Score</b>											<b>2.22 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	23PBI4CC09	Core Course - 9: Clinical Biochemistry	5	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 (15 Hours)

**Blood and body fluids:** Collection and preservation, Disturbances in Blood clotting - haemophilia A and haemophilia B. Haemoglobin in anaemias-sickle cell, thalassemia, abnormal haemoglobins. Porphyrins and porphyrinurias. Anticoagulants. 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 (15 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 lipoproteinemia, hypocholesteremic agents, hypertension -causes and its management. Lipid storage diseases- fatty liver & obesity.

#### UNIT III (15 Hours)

**Protein deficiency diseases:** Plasma proteins - their significance and variation in health and diseases. 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 (15 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 (15 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, angina pectoris, myocardial infarction. Cardiac markers in infarction - LDH, creatine kinase. Serology - Serological tests in infectious diseases and viral infections. **Pregnancy:** Amniotic fluid and maternal serum in ailment and in pregnancies.

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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#### Books for Study

1. M. N. Chatterjea & Rana Shinde. *Textbook of Medical Biochemistry*, (8th Ed.). Jaypee Brothers Medical Publishers (P) Ltd.

**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)
- Gundu, H.R R., Eastlund, T., & Latha, J. (Editors). *Handbook of Blood Banking and Transfusion Medicine*. Jaypee Brothers Medical Publishers (P) Ltd.  
**Unit I** Chapter 1-10
  - Puri, D. *Textbook of Medical Biochemistry*. (3rd Ed.). Elsevier A division of Reed Elsevier India Private Limited.  
**Unit V** Chapter - 34 (Pages 695-697)
  - Thomas, M. D. (Editor). *Textbook of Biochemistry with Clinical Relationship Matrixs*, (7th Ed.). John Wiley & Sons Inc.  
**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 19.11 and 19.21
  - John, W. B., & Marek, H. D. *Medical Biochemistry*, (4th Ed.). Saunders Elsevier (Ebook).  
**Unit I** Chapter 4  
**Unit II** Chapter 21
  - Devlin. (1997). *Textbook of Biochemistry (with Clinical Relationship Matrix)*. John Wiley.
  - Chatterjee, M.N., & Shinde, R. (1995). *Text book of Medical Biochemistry*, (2nd Ed.). Jaypee Brothers Medical Publishers Private Limited.

### Books for Reference

- Henry, R. J., Cannon, D. C., & Winkelman, J. W. (1974). *Clinical Chemistry: Principles and Techniques*, (2nd Ed.). Harper and Row Hagerstown.
- Cantrow., & Trumper. (1962). *Clinical Biochemistry*, (6th Ed.). VY.B. Saunders Company.
- Luxton, R. (2008). *Clinical Biochemistry*, (2nd Ed.). Scion Publishing Ltd.
- John, W. B., & Marek, H. D. *Medical Biochemistry*, (4th Ed.). Saunders Elsevier (Ebook).

### Websites and eLearning Sources

- <https://www.jstor.org/stable/4576855>
- <https://extranet.who.int/lqsi/sites/default/files/attachedfiles/LQMS%205-3%205-6%20Sample%20collection%20transport.pdf>
- <https://my.clevelandclinic.org/health/diseases/14083-hemophilia>
- <https://www.mayoclinic.org/diseases-conditions/hemophilia/symptoms-causes/syc-20373327>
- <https://www.nhlbi.nih.gov/health/sickle-cell-disease>
- <https://www.mayoclinic.org/diseases-conditions/sickle-cell-anemia/symptoms-causes/syc-20355876>
- <https://my.clevelandclinic.org/health/diseases/14508-thalassemias>
- <https://www.webmd.com/a-to-z-guides/porphyria-symptoms-causes-treatment>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7171462/>
- <https://step1.medbullets.com/pathology/106028/cell-injury>
- <https://my.clevelandclinic.org/health/diseases/7104-diabetes>
- <https://www.healthline.com/health/diabetes>
- <https://my.clevelandclinic.org/health/diseases/23921-hypercholesterolemia>
- <https://www.healthline.com/health/cholesterol/hypocholesterolemia>
- <https://rarediseases.org/rare-diseases/maple-syrup-urine-disease/>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6331359/>
- <https://my.clevelandclinic.org/health/diseases/4755-gout>
- <https://medlineplus.gov/hepatitis.html>
- <https://my.clevelandclinic.org/health/diseases/15367-adult-jaundice>
- <https://www.slideshare.net/YESANNA/gastric-function-tests-44375354>
- <https://onlinelibrary.wiley.com/doi/full/10.1046/j.1365-2036.2003.01495.x>
- [https://www.physio-pedia.com/Renal\\_Function\\_Test\\_\(RFT\)](https://www.physio-pedia.com/Renal_Function_Test_(RFT))
- <https://www.advocatehealth.com/health-services/advocate-heart-institute/conditions/ischemic->

heart-disease

24. <https://www.britannica.com/science/serological-test>

25. <https://www.hey.nhs.uk/pathology/departmentofinfection/virology/serology/>

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	discuss thoroughly about the biochemical basis of various diseases and disorders	K1
CO2	understand the mechanisms of blood clotting and the related disorders	K2
CO3	apply a wide range of protocols in clinical biochemistry analysis	K3
CO4	analyze the symptoms of various diseases	K4
CO5	evaluate various diagnostic procedures for diseases and disorders and initiate blood banking	K5
CO6	initiate clinical biochemistry lab	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
4	23PBI4CC09	Core Course - 9: Clinical Biochemistry									5	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	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	3	2	3	3	3	2	3	2	3	2.7	
<b>Mean Overall Score</b>											<b>2.46 (High)</b>	

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	23PBI4CC10	Core Course - 10: Advanced Endocrinology	6	6

Course Objectives
To learn the molecular anatomy of endocrine system
To comprehend the basis of hormonal physiology
To understand the mechanism of signal transductions mediated by the endocrine system
To know the mechanism of second messengers in signal transduction
To learn the physiology mediated by nuclear receptor
To understand the endocrinology of diseases

#### UNIT I (18 Hours)

**Introduction:** Hormones - Definition; classical and nonclassical endocrinology. Pituitary hormones and their control by the hypothalamus. Thyroid metabolic hormones. Adrenocortical hormones. Feedback mechanisms (HPA&HPG). Inactivation and degradation of hormones. Hypothalamus - neurohypophyseal hormones. Hormone resistant syndrome and multiendocrine neoplasia - different types. Melatonins and serotonin - light and dark cycles. 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, IP<sub>3</sub>, DAG, Calcium and Calmodulin. Eicosanoids and mechanism of action.

#### UNIT III (18 Hours)

**Molecular endocrinology of insulin resistance:** Endocrinology of adipose tissues - leptin, ghrelin, adiponectin, resistin. Endocrinology of insulin like growth factors (IGF's) and its binding proteins (IGFBP). Fetal endocrine programming of adult disorders (FEPAD): Adverse effects of glucocorticoids in programming events. 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, 17 $\beta$ -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. Apoptosis - steroid hormone action at cell level. 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.

<b>Teaching Methodology</b>	Videos, PPT, Demonstration and Creation of models
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#### Books for Study

1. Thomas, M. D. (Editor). *Textbook of Biochemistry with Clinical Relationship Matrixs*, (7th Ed.). 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**

- Arthur, C. G., & John, E. H. *Textbook of Medical Physiology*, (11th Ed.). Elsevier Saunders, Elsevier Inc.  
**Unit-I Unit XIV - Chapter - 75, 76, 77, 79, Unit-II Unit XIV - Chapter - 78**  
**Unit-IV Unit XIV - Chapter - 80, 81, 82,**
- Franklyn, F. B. *Molecular Endocrinology*, (3rd Ed.). Academic Press An imprint of Elsevier.  
**Unit V Chapter 6 (Pages - 125-146)**
- John, W. B., & Marek, H. D. *Medical Biochemistry*, (4th Ed.). SaundersElsevier (Ebook).  
**Unit-I Chapter - 39, Unit-II Chapter - 21**  
**Unit-III Chapter - 40, Unit-V Chapter - 17**
- Puri, D. *Textbook of Medical Biochemistry*, (3rd Ed.). Elsevier A division of Reed Elsevier India Private Limited.  
**Unit-II Chapter 29, 30 and 31**
- Devlin. (1997). *Textbook of Biochemistry (with clinical Relationship Matrix)*. John Wiley.
- Wilson., & Foster. (1992). *Textbook of Endocrinology*, (8th Ed.). W. B. Saunders.

### Books for Reference

- Robert, K. M. *et al.* (2003). *Harper's Biochemistry*, (25th Ed.). Mc Graw Hill Publishers.
- Arthur, C. G., & Hall. (2006). *Text Book of Medical Physiology*. Elsevier India Pvt.Ltd.
- Mac, E. H., & Jon, E. L. (2009). *Endocrinology*, (6th Ed.). Darling Kindersly Pvt.Ltd.

### Websites and eLearning Sources

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

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	recall the basics and molecular features of hormones and glands	K1
CO2	comprehend the hormonal regulations of various physiological functions and signaling mechanisms	K2
CO3	study the signal transduction mediated by cell surface receptors	K3
CO4	analyze the mechanism and role of nuclear receptors	K4
CO5	learn the endocrinology of sex determination and development	K5
CO6	evaluate the endocrine diseases	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
4	23PBI4CC10	Core Course - 10: Advanced Endocrinology									6	6
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	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	3	2	3	2	2	3	3	2	2	3	2.5	
<b>Mean Overall Score</b>											<b>2.35 (High)</b>	

Semester	Course Code	Title of the Course	Hours / Week	Credits
4	23PBI4CP04	<b>Core Practical - 4:</b> Biochemical Analysis of Blood and Hematological Studies	8	6

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				

### I. Biochemical analysis of blood

1. Estimation of blood glucose (2 methods)
2. Estimation of serum proteins
3. Estimation of plasma fibrinogen
4. Estimation of A: G ratio in serum
5. Estimation of blood urea (2 methods)
6. Estimation of serum uric acid
7. Estimation of serum creatinine
8. Estimation of serum triglycerides
9. Estimation of serum cholesterol
10. Estimation of serum phospholipids
11. Estimation of serum calcium
12. Estimation of serum bilirubin

### II. Hematological studies

1. Collection of Blood
2. Estimation of hemoglobin content
3. Total RBC count
4. Total WBC count
5. Determination of Packed Cell Volume
6. Differential WBC count (DC)
7. Absolute Eosinophil count (AEC)
8. Total platelet count
9. Determination of clotting time
10. Determination of ESR
11. Grouping of blood and Rh typing

### III. Enzyme assays

1. Determination of serum alkaline phosphatase
2. Determination of serum acid phosphatase

### IV. Urology

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

### V. Miscellaneous

1. Estimation of clinical parameters (sugar, Hb, Cholesterol, Proteins and creatinine) using semi-automated analyzer.
2. Routes of administration of drugs/Xenobiotics.
3. Dissection of animals and aseptic removal of individual organs.

- Laboratory animal handling and maintenance.

### Books for Reference

- Praful, B. G. (2014). *Text book of Medical laboratory technology*, (3rd Ed.). Volume I and II. Bhalani Publishing house.
- Alan, H. G. *Varley's Practical Clinical Biochemistry*, (6th Ed.). CBSpublishers.
- Kanai, L. M. *Medical Laboratory Technology*, (2nd Ed.). Volume 1, 2 and 3. TataMcGraw Hill Education Private Limited.

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	demonstrate the concept of Phlebotomy in clinical biochemistry	K1
CO2	understand various modes of administration of xenobiotics to the experimental animals	K2
CO3	apply various blood parameters of the Diabetic patients	K3
CO4	analyze the levels of clinical marker enzymes in various diseases	K4
CO5	evaluate the clinical situation based on the level of the parameters	K5
CO6	do research with animal experimentation	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
4	23PBI4CP04	Core Practical - 4: Biochemical Analysis of Blood and Hematological Studies									8	6
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	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	3	2	3	3	3	2	2	3	3	2.7	
<b>Mean Overall Score</b>											<b>2.46 (High)</b>	

Semester	Course Code	Title of the Course	Hours / Week	Credits
4	23PBI4ES04A	Elective - 4: Life Sciences for Competitive Exams - 2	5	4

Course Objectives
To understand the basic mechanisms of evolution
To expose to the topics of UGC/CSIR-NET/SET syllabus
To correlate the fossil evidences with evolution
To analyze the energy transfer between and within the different ecosystems
To comprehend the mechanism of speciation
To evaluate the mechanisms of maintaining the environmental health and to become eco conscious

#### UNIT I (15 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 (15 Hours)

**Paleontology and evolutionary history:** The evolutionary time scale; eras, periods and epoch; 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 molecular clocks; molecular tools in phylogeny, classification and identification.

#### UNIT III (15 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 (15 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 (15 Hours)

**Ecosystem ecology:** 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	Videos, PPT, Demonstration and Creation of models
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#### Books for Study

1. Verma, P. S., & V. K. Agarwal. (2003). *Cytology, Genetics, Evolution and Ecology*. S. Chand & Co. Ltd.

**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. Verma, P. S., & Agarwal, V.K. (2003). *Cytology, Genetics, Evolution and Ecology*. S. Chand & Co. Ltd.
3. Sharma, P. D. (1999). *Ecology and Environment*. Rastogi Publishers.

#### Books for Reference

1. Odum, E.P. (1970). *Fundamentals of Ecology*, (3rd Ed.). W.B. Saunders Ltd.
2. Karl, J. N. (1981). *Paleobotany, Paleoecology & Evolution*. Praeger Pub.
3. Kumar, P., & Usha, M., Pathfinder Academy. (2016). *CSIR-JRF-NET Life Sciences Six Book Combo Set: CSIR-JRF-NET Life Sciences*. Pathfinder Publication.
4. Singh, R., Madhu, G. & Shukla, A. (2017). *CSIR NET/JRF Life Sciences MCQ Practice book*, (7th Ed.). Catalyst Center of excellence Pvt. Ltd.

#### Websites and eLearning Sources

1. <https://www.genome.gov/25520238/online-education-kit-1900-rediscovery-of-mendels-work>
2. <https://evolution.berkeley.edu/the-history-of-evolutionary-thought/1800s/early-concepts-of-evolution-jean-baptiste-lamarck/>
3. [https://www.f.waseda.jp/sidoli/LE201\\_11\\_Darwin.pdf](https://www.f.waseda.jp/sidoli/LE201_11_Darwin.pdf)
4. [https://kb.osu.edu/bitstream/handle/1811/3937/1/V52N04\\_177.pdf](https://kb.osu.edu/bitstream/handle/1811/3937/1/V52N04_177.pdf)
5. [https://doc.rero.ch/record/200124/files/PAL\\_E3902.pdf](https://doc.rero.ch/record/200124/files/PAL_E3902.pdf)
6. [https://www.etsu.edu/uschool/faculty/tadlockd/documents/bio\\_chp18sec3\\_show2019.pdf](https://www.etsu.edu/uschool/faculty/tadlockd/documents/bio_chp18sec3_show2019.pdf)
7. <https://www.expil.com/t/behavioral-isolation-definition-examples-10494>
8. <https://www.studyiq.com/articles/ecological-succession/>
9. <https://www.montana.edu/scree/teaching/bioe-370/documents/Biol%20303%20niches.pdf>
10. <https://microbiologynote.com/structure-and-function-of-ecosystems/>

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K-Level)
CO1	discuss the basic theories of evolution	K1
CO2	explain the topics of the CSIR UGC - NET and SET syllabus that are not included in the core courses	K2
CO3	correlate the fossil evidences with evolution	K3
CO4	analyze the energy transfer within the different ecosystems	K4
CO5	evaluate the mechanisms of maintaining the environmental health	K5
CO6	develop the mechanism of environmental protection	K6

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
4	23PB14ES04A	Elective - 4: Life Sciences for Competitive Exams - 2									5	4
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	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	3	2	2	3	2	2	3	3	3	2	2.5	
Mean Overall Score											2.38 (High)	



Semester	Course Code	Title of the Course	Hours / Week	Credits
4	23PBI4ES04B	Elective - 4: Forensic Science	5	4

Course Objectives
To have thorough knowledge about the basics of forensic science
To know the methods of sample collection from crime scene and wild life forensics
To understand the management of crime situation and legal procedures
To analyze poisonous chemicals and illicit liquors from victims in a crime scene
To evaluate tool marks and recognize finger prints from crime scene
To assess the forensic situation and give judgment

#### UNIT I (15 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 (15 Hours)

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

#### UNIT III (15 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 (15 Hours)

Classification of firearms, 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 (15 Hours)

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

Teaching Methodology	Videos, PPT, Demonstration and Creation of models
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#### Books for Study

- Vij, K. (2011). *Text book of Forensic Medicine and Toxicology*, (5th Ed.). Elsevier Publications  
 UNIT-I Chapter I and II  
 UNIT-III Chapter 41  
 UNIT-IV Chapter 3  
 UNIT-V Chapter 14, 15, 16, 17
- Bevel, T., & Ross, M. G. (2008) *Blood stain pattern analysis*, (3rd Ed.). CRC press.  
 UNIT-II Chapter 1,2,3,4
- Jaising, R.B. *Text Book of Medical Jurisprudence*, (6th Ed.). Butterworthand Co press.  
 UNIT-I Chapter I  
 UNIT-II Chapter I  
 UNIT-III Chapter 08  
 UNIT-IV Chapter 12  
 UNIT-V Chapter 15

#### Books for Reference

- Edward, M. R. (2010). *Crime Scene Photography*, (2nd Ed.). Elsevier Publication.

2. Cross, N. (2010). *Criminal Law and Justice*. Sage Publications
3. Raphael, C. W. (2010). *Drugs of Abuse*. Humana press.
4. Wein, A. P., & Brent, E. (2010). *Forensic Criminology*. Turvey.

### Websites and eLearning Sources

1. <https://www.rcboe.org/cms/lib/GA01903614/Centricity/Domain/2900/CH%201%20Forensic%20Science%20History.pptx>
2. <https://www.ojp.gov/pdffiles1/nij/248572.pdf>
3. <https://www.forensicsciencesimplified.org/csi/how.html>
4. [https://projects.nfstc.org/property\\_crimes/Crime\\_Scene\\_Procedures\\_III.pdf](https://projects.nfstc.org/property_crimes/Crime_Scene_Procedures_III.pdf)
5. [https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp\\_content/S000016FS/P000692/M011458/ET/1453183615FSC\\_P5\\_M14\\_e-text.pdf](https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000692/M011458/ET/1453183615FSC_P5_M14_e-text.pdf)
6. [https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp\\_content/S001608/P001743/M027854/ET/1521090303MODULE15.pdf](https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001608/P001743/M027854/ET/1521090303MODULE15.pdf)
7. [https://www.unodc.org/documents/organized-crime/Firearms/Firearms\\_classification.pdf](https://www.unodc.org/documents/organized-crime/Firearms/Firearms_classification.pdf)
8. [http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp\\_content/S000016FS/P000690/M011416/ET/1516186963FSC\\_P3\\_M5\\_e-text.pdf](http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000690/M011416/ET/1516186963FSC_P3_M5_e-text.pdf)
9. <https://nvlpubs.nist.gov/nistpubs/ir/2018/NIST.IR.8215.pdf>
10. <https://pubmed.ncbi.nlm.nih.gov/21156902/>
11. <https://www.tandfonline.com/doi/abs/10.1080/14789940412331337353>

Course Outcomes		
CO No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, the students will be able to	
CO1	describe thorough knowledge about the basics of forensic science	K1
CO2	compare knowledge on sample collection from crime scene and wild life forensics	K2
CO3	apply the knowledge on crime scene management and legal court procedures	K3
CO4	analyze poisonous chemicals and illicit liquor from victims in a crime scene	K4
CO5	evaluate tool marks and recognize finger prints and other evidences from the crime scene and give possible suggestions to the judicial	K5
CO6	able to analyze and judge crime scenes	K6

Relationship Matrix											
Semester	Course Code		Title of the Course					Hours	Credits		
4	23PBI4ES04B		Elective - 4: Forensic Science					5	4		
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	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	2	3	3	3	3	3	2	2	2.5
<b>Mean Overall Score</b>											<b>2.18 (High)</b>