BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI-620024

B.Sc. BIOCHEMISTRY

CHOICE BASED CREDIT SYSTEM–LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(Applicable to the candidates admitted from the academic year 2026-2027 onwards)

Sem	Part	Courses	Title	Ins. Hrs.	Credits	Exam. Hours	Maximum Marks		
							Int.	Ext.	Total
I	I	Ability Enhancement Course – I (AEC - I)	(Tamil$ / Other Languages+, #)	6	3	3	30	70	100
	II	Ability Enhancement Course – II (AEC - II)	English Course - I	6	3	3	30	70	100
	III	Core Course -1 (CC - 1)	Biomolecules	4	4	3	30	70	100
		Core Practical - 1 (CP - 1)	Biomolecules (P)	4	4	3	40	60	100
		Allied Course – 1 (AC - 1)	Chemistry I	4	4	3	30	70	100
		Allied Practical - I (AP-I)	Chemistry (P)	2	**	**	**	**	**
	IV	Value Education		2	2	3	30	70	100
		Interdisciplinary Course – 1 (IDC - 1) #	One Course from Outside Department	2	2	3	30	70	100
	Total			**30**	**22**	--	--	--	**700**
II	I	Ability Enhancement Course – III (AEC - III)	(Tamil$ / Other Languages+, #)	6	3	3	30	70	100
	II	Ability Enhancement Course – IV (AEC - IV)	English Course - II	6	3	3	30	70	100
	III	Core Course- 2(CC - 2)	Biochemical techniques	4	4	3	30	70	100
		Core Practical - 2 (CP - 2)	Biochemical Techniques (P)	4	4	3	40	60	100
		Allied Course – 2 (AC - 2)	Chemistry II	4	4	3	30	70	100
		Allied Practical - I (AP-I)	Chemistry (P)	2	4	3	40	60	100
	IV	Skill Enhancement Course - 1(SEC - 1) ##	Naan Mudhalvan Course	2	2	3	30	70	100
		Interdisciplinary Course – 2 (IDC - 2) #	One Course from Outside Department	2	2	3	30	70	100
	Total			**30**	**26**	--	--	--	**800**

III	I	Ability Enhancement Course – V(AEC - V)	(Tamil$ / Other Languages+, #)	6	3	3	30	70	100
	II	Ability Enhancement Course – VI (AEC - VI)	English Course - III	6	3	3	30	70	100
	III	Core Course- 3 (CC - 3)	Cell Biology	4	4	3	30	70	100
		Core Practical - 3 (CP - 3)	Cell Biology (P)	4	4	3	40	60	100
		Allied Course – 3 (AC - 3)	Microbiology I	4	4	3	30	70	100
		Allied Practical - II (AP-II)	Microbiology (P)	2	**	**	**	**	**
	IV	Skill Enhancement Course - 2 (SEC - 2) ##	Naan Mudhalvan Course	2	2	3	30	70	100
		Interdisciplinary Course – 3 (IDC - 3) $$	One Course from Outside Department	2	2	3	30	70	100
		Health & Wellness @		--	1	--			100
	Total			**30**	**23**	--	--	--	**800**
	I	Ability Enhancement Course – VII (AEC - VII)	(Tamil$ / Other Languages+, #)	6	3	3	30	70	100
IV	II	Ability Enhancement Course – VIII (AEC - VIII)	English Course - IV	6	3	3	30	70	100
	III	Core Course- 4 (CC - 4)	Enzymology	4	4	3	30	70	100
		Core Practical - 4 (CP - 4)	Enzymology (P)	4	4	3	40	60	100
		Allied Course – 4 (AC - 4)	Microbiology II	4	4	3	30	70	100
		Allied Practical - II (AP-II)	Microbiology (P)	2	4	3	40	60	100
	IV	Skill Enhancement Course - 3 (SEC - 3) ##	Naan Mudhalvan Course	2	2	3	30	70	100
		Interdisciplinary Course – 4 (IDC - 4) $$	One Course from Outside Department	2	2	3	30	70	100
	Total			**30**	**26**	--	--	--	**800**
	Summer Internship / Industrial Activity during the Summer Vacation after II Year								

V	III	Core Course - 5 (CC - 5)	Human Physiology	4	4	3	30	70	100
		Core Course - 6 (CC - 6)	Intermediary Metabolism	5	4	3	30	70	100
		Core Course - 7 (CC - 7)	Molecular Biology	5	4	3	30	70	100
		Core Course - 8 (CC - 8)	Clinical Biochemistry	5	4	3	30	70	100
		Core Practical - 5 (CP - 5)	Molecular and Clinical Biochemistry (P)	5	4	3	40	60	100
	IV	Skill Enhancement Course - 4 (SEC - 4)	Biomedical Instrumentation	2	2	3	30	70	100
		Skill Enhancement Course - 5 (SEC - 5) ##	Naan Mudhalvan Course	2	2	3	30	70	100
		Introduction to Disaster Management		2	2	3	30	70	100
		Summer Internship / Industrial Activity @@	(with Viva-Voce)	--	2	--	20	80	100
	Total			**30**	**28**	--	--	--	**900**
VI	III	Core Course - 9 (CC - 9)	Endocrinology	4	4	3	30	70	100
		Core Course- 10 (CC - 10)	Biotechnology and Plant Biochemistry	5	4	3	30	70	100
		Core Course- 11 (CC - 11)	Immunology	5	4	3	30	70	100
		Core Project Work (CPW) @@	Project Work (with Viva-Voce)	6	4	3	20	80	100
	IV	Value Added Course	General Studies for Competitive Examinations	2	1	--	30	70	100
		Skill Enhancement Course - 6 (SEC - 6)	Herbs and Phytotherapeutics	2	2	3	30	70	100
		Skill Enhancement Course - 7 (SEC - 7) ##	Naan Mudhalvan Course	2	2	3	30	70	100
		Environmental Studies		2	2	3	30	70	100
		Gender Studies		2	1	3	30	70	100
		Extension Activities *		--	1	--	--	--	--
	Total			**30**	**25**	**--**	**--**	**--**	**900**
	Grand Total			**180**	**150**	--	**--**	**--**	**4900**

Allied Papers

First Year Students
Chemistry

Second Year Students
Microbiology

SKILL ENHANCEMENT COURSE (SEC)			
Sl. No.	**Title of paper**	**Sl. No.**	**MANDATORY Naan Mudhalvan Scheme##**
1.	Basics of Bioinformatics	1.	**2nd Semester:**
2.	Biostatistics		
3.	Medical Laboratory Technology	2.	**3rd Semester:**
4.	Pharmacovigilance		
5.	Forensic Science	3.	**4th Semester:**
6.	Biomedical Instrumentation		
7.	Herbs and Phytotherapeutics	4.	**5th Semester:**
--		5.	**6th Semester:**

INTERDISCIPLINARYCOURSE(IDC) FOR WHO HAVE OPT TAMIL AS PART-I (for other Department Students only)	
1st Semester	Basic Biochemistry
2nd Semester	Lifestyle Diseases and Treatment
3rd Semester	Nutritional Biochemistry
4th Semester	First Aid Management

INTERDISCIPLINARYCOURSE(IDC)# FOR WHO HAVE NOT OPT TAMIL AS PART - I		
Those who have studied Tamil upto 10th+2 but opt for other languages in degree	1st Semester	Special Tamil - I
	2nd Semester	Special Tamil – II
Those who have not studied Tamil in school level	1st Semester	Basic Tamil – I
	2nd Semester	Basic Tamil – II
Those students who opt for either special Tamil (or) Basic Tamil as IDCs, have to choose 2 more IDCs courses in their 3rd and 4th Semester from Outside his/her department.		

INTERDISCIPLINARY COURSE(IDC) $$ FOR NCCCADETS ONLY	
NCC Course is a Compulsory Course for the NCC Cadets in the 3rd Semester:	**NCC Course is a Compulsory Course for the NCC Cadets in the 4th Semester:**
Introduction to NCC	1. Special Subject Army **(or)** 2. Special Subject Navy **(or)** 3. Special Subject Air force
Those students who opt for NCC Courses as IDCs, have to choose 2 more IDCs courses in their 1st and 2nd Semester from Outside his/her department.	

SUMMARY OF CURRICULUM STRUCTURE OF UG PROGRAMMES

Sl. No.	Part	Type so of the Courses	No.of Courses	Credits for each Course	Total Credits	Marks
1.	I	Ability Enhancement Course	4	3	12	400
2.	II	Ability Enhancement Course	4	3	12	400
3.	III	Core Course	11	4	44	1100
4.		Core Practical	5	4	20	500
5.		Allied Course (AC)	4	4	16	400
6.		Allied Course Practical (AP)	2	4	8	200
7.		Core Project Work (CPW)	1	4	4	100
8.	IV	Skill Enhancement Course (SEC)	7	2	14	700
9.		Interdisciplinary Course (IDC)	4	2	8	400
10.		Value Education	1	2	2	100
11.		Health and Wellness	1	1	1	100
12.		Introduction to Disaster Management	1	2	2	100
13.		Summer Internship / Industrial Activity	1	1	1	100
14.		Value Added Course	1	2	2	100
15.		Environmental Studies	1	2	2	100
16.		Gender Studies	1	1	1	100
17.		**EXTENSION ACTIVITIES** (NCC / NSS / SPORTS / ANTI DRUG CELL / YRC & Any Other Activities	--	1	1	--
Total			**49**	**-**	**150**	**4900**

<table>
<tr><td>$</td><td>For those who have studied Tamil upto10th+2(Regular Stream)</td></tr>
<tr><td>+</td><td>Syllabus for other Languages should be on par with Tamil at degree level</td></tr>
<tr><td>#</td><td>Those who have studied Tamil upto10th+2 but opt for other languages in degree level under Part-I should study special Tamil and those who have not studied Tamil in the school level should study Basic Tamil in Part–IV under the Interdisciplinary Course.</td></tr>
<tr><td>**</td><td>Examination at the end of the next semester</td></tr>
<tr><td>##</td><td>Naan Mudhalvan Scheme: As per the Naan Mudhalvan Scheme instructions, 5 courses from 2nd to 6th semester should be studied under Skill Enhancement Course.</td></tr>
<tr><td>$$</td><td>NCC Course is one of the Choices in the Interdisciplinary Course. Only the NCC Cadets are eligible to choose this course. However, NCC Course is a Compulsory Course for the NCC Cadets.</td></tr>
<tr><td>@</td><td>Health and Wellness: Assessments:

• Use self-reflective worksheets to assess their understanding
• submit the worksheets to internal audit / external audit
• Every student’s activity report should be documented and the same have to be assessed by the Physical Director with Mentor. The evaluation should be for 100 marks. No examination is required.

Scheme of Evaluation:

<table>
<tr><th>Part</th><th>Description</th><th>Marks</th></tr>
<tr><td>A</td><td>Report</td><td>40</td></tr>
<tr><td>B</td><td>Attendance</td><td>20</td></tr>
<tr><td>C</td><td>Activities (Observation During Practice)</td><td>40</td></tr>
<tr><td colspan="2">Total</td><td>100</td></tr>
</table>
</td></tr>
<tr><td>@@</td><td>Summer Internship / Industrial Activity

Internship will be carried our during the summer vacation after the second year. Viva-Voce will be conducted by the college and Marks shall be send to the University and the same will be included in the 5th semester Mark Statement.

Summer Internship / Industrial Activity& Project Work

Scheme of Evaluation:

<table>
<tr><th>Description</th><th>Marks</th></tr>
<tr><td>Report</td><td>80</td></tr>
<tr><td>Viva-Voce</td><td>20</td></tr>
<tr><td>Total</td><td>100</td></tr>
</table>
</td></tr>
<tr><td>*</td><td>Extension Activities shall be outside instruction hours.</td></tr>
</table>

Programme outcomes (PO):

PO1	**Communication Skill:** Mandatory language courses facilitate to become proficient in communication, culturally aware, and more employable in both Indian and global contexts. Improve presentations skill, debates, and professional communication.
PO 2	**Disciplinary Knowledge:** Learn in-depth complex scientific concepts, demonstrate their ability to explain and apply their knowledge. Consistent in learning by earning extra credits in specialized courses within the science domain and enhance disciplinary knowledge.
PO 3	**Critical thinking:** Field and academic visits will help students to develop observation skills, grasping ability, collect and interpret data and propose models that will help them to understand hypotheses and conclusions.
PO 4	**Analytical Reasoning:** Through the interactions, students will develop skills of critical reading of texts, identifying gaps in knowledge, formulating scientific questions, and on will recognizing the synthesis of new ideas.
PO 5	**Scientific Reasoning:** Skill oriented courses will provide details on principles, conduct of proper calibration and use of scientific instrumentation and appropriate use of scientific techniques in experimental design
PO 6	**Self-directed Learning:** Preparation of field reports helps them to present their results and discussion in a written format that is typically required for their future professions.
PO 7	**Reflective Thinking:** All core courses with laboratory components will provide exposure to a wide range of research techniques, therein enhancing their understanding of the application of techniques in their domain.
PO 8	**Problem Solving:** Students will develop the ability to reason, apply numerical concepts, and equations in their fields of study for interpreting scientific data and drawing relevant scientific conclusions.
PO 9	**Research-related Skills:** Students undertaking a internship will have the opportunity to design, develop and execute their own research ideas in their experiments, thus expanding their knowledge of research methods and laboratory skills.
PO10	**Lifelong Learning:** Ability to understand the gaps in knowledge and skill, adapt to technological change, engage in self-directed learning.

Year: I **CORE COURSE-1** **Semester: I**

BIOMOLECULES

Code: **(Theory)** **Credit: 4**

Course Objectives

- To expose the importance of biological macromolecules.
- To study the influence and role of structure in reactivity of biomolecules.
- To understand the role of biomolecules and their functions.
- To understand the biochemical pathways and metabolic significance of major biomolecules in living systems.
- To analyze the relationship between the structure, properties, and biological functions of carbohydrates, proteins, lipids, and nucleic acids.

Unit I: Carbohydrates: Structure, Classification and Biological Functions

Carbohydrates: Definition, classification – monosaccharide, oligosaccharides and polysaccharides; occurrence, structure and functions of monosaccharide - glucose and fructose. General properties with reference to glucose, anomer, epimer, enantiomer and mutarotation. Structure, occurrence, properties and biological importance of disaccharides - sucrose, lactose and maltose. Polysaccharides - starch, glycogen and heparin.

Unit II: Amino Acids and Proteins: Structure, Properties and Functions

Amino acids and Proteins: Amino acids- Definition, Structure, properties and classification based on structure, chemical nature. Essential and non-essential amino acids. Proteins - Definition, classification based on shape, solubility, chemical composition, Properties and functions. Structure- Primary, Secondary, tertiary and quaternary.

Unit III: Fatty Acids and Lipids: Classification, Properties and Biological Significance

Fatty acids and Lipids: Fatty acids - Definition, structure, classification– saturated fatty acids, unsaturated fatty acids. Essential and non-essential fatty acids. Physical and Chemical properties - emulsification, saponification number, rancidity, acid number, iodine number and Reichert – Meissl number. Structure, function and classification of lipids- simple, compound– glycolipids, phospholipids, sphingolipids and derived lipids - steroids.

Unit IV: Nucleic Acids: Structure, Types and Functions

Nucleic acids: Bases, nucleosides and nucleotides, phosphodiester linkage. Types of Nucleic acids –DNA and RNA; DNA – types-A, B, Z, double helical structure, properties and functions. Denaturation and renaturation. RNA – types-mRNA, tRNA, rRNA – structure and functions.

Unit V: Vitamins: Classification, Structure and Biological Roles

Vitamins: Definition and classification. Water soluble vitamins - Structure and functions of vitamin C, Thiamine, Riboflavin, Niacin, Pyridoxine, Biotin, Pantothenic acid, Folic acid and Cobalamin. Fat soluble vitamins - Structure and functions of vitamins A, D, E and K.

UNIT VI: Current Contours: (Self-directed learning activities for Continuous Internal Assessments Only):

Use of proteins, peptides and nucleic acids in fluorescent detection systems – In Disease diagnosis, Environmental monitoring and Food safety testing.

References

1. Deb AC. 2016. Fundamentals of Biochemistry. 7th edition, NCBA Publishers, New Delhi.
2. Jain JL, Sunjay Jain and Nitin Jain. 2018. Fundamentals of Biochemistry. Updated edition. 2020. S. Chand Publishers, New Delhi.
3. Poonam Agarwal. 2020. Review of Biochemistry. 5th edition. CBS Publishers, New Delhi.
4. Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, 2003. Harper's Illustrated Biochemistry, 26th edition, McGraw-HillMedical Publishers, New York.
5. Vasudevan DM, Sreekumari S., and Kannan Vaidyanathan. 2018. The Textbook of Biochemistry for Medical Students, 9th Edition, JaypeeBrothers Medical Publishers, New Delhi.
6. AmbikaShanmugam, 2016. Fundamentals of Biochemistry, 8th Edition. Wolters Kluwer India Pvt Ltd.
7. Nelson, D. L. and Cox, M. M. 2008. Lehninger Principles of Biochemistry.Freeman, 5th edn.
8. Harper's Illustrated Biochemistry.2023. 32nd edition -Mc-Graw Hill Medical.
9. Sathayanarayana, U. 2021. Biochemistry. 4th Revised Edition by Booksand Allied (P) Ltd., India.
10. Donald Voet and Judith Voet. 2017. Biochemistry, 2nd edition, JohnWiley & Sons Inc, New York.

Course Outcomes (COs):

Upon successful completion of this course the students would be able to:

CO1: Explain the classification, structure, properties, and biological functions ofcarbohydrates including monosaccharides, disaccharides, and polysaccharides.
CO2: Describe the classification, structural organization, properties, and biologicalsignificance of amino acids and proteins.
CO3: Analyze the structure, classification, properties, and physiological functions of fatty acids and lipids.
CO4: Explain the structure, types, properties, and biological roles of nucleic acids(DNA and RNA).
CO5: Illustrate the classification, structure, functions, and nutritional significance ofwater-soluble and fat-soluble vitamins.

Mapping with Programme Outcomes

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	-	-	-	-	-	1	2
CO2	3	2	1	-	-	-	1	-	1	2
CO3	3	3	2	1	1	1	1	-	1	2
CO4	3	3	2	1	-	-	-	1	1	2
CO5	3	2	1	-	1	1	-	1	1	2

Correlation level: 1 – Low 2 – Moderate 3 - High

Year: I	CORE PRACTICAL-1 BIOMOLECULES	Semester: I
Code:	(Practical)	Credit: 4

Course Objectives

- To instil skill in students enabling them to apprehend the wider knowledge about principles and techniques to be employed for the analysis of biomolecules under investigation.
- To perform estimations to quantify important biomolecules from various sources.
- To achieve training in various qualitative analysis for carbohydrates, proteins and lipids.
- To perform screening and quality analysis enabling them to give an insight on quality of lipids and this will be useful for students in future.
- To provide hands-on training in biochemical techniques for the extraction, purification, and analysis of biomolecules from biological samples.

Biochemical studies and estimation of macromolecules

1. Qualitative analysis – Carbohydrates, amino acids, proteins and lipids
2. Estimation of reducing sugar by Benedict's quantitative method
3. Estimation of Ascorbic Acid (titrimetric method)
4. Determination of Acid Number of oil
5. Determination of Iodine number of oil
6. Determination of Saponification of oil
7. Estimation of Amino Acid by Formal Titration

Books Recommended

1. David Plummer (2017) 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. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011).

Course Outcomes (COs):

After successful completion of this course, students will be able to:

CO1: Perform qualitative analysis and identify major biomolecules such as carbohydrates, amino acids, proteins, and lipids using standard biochemical tests.

CO2: Estimate the concentration of reducing sugars and ascorbic acid using quantitative biochemical methods and interpret the results.

CO3: Determine physicochemical properties of oils through the estimation of acid number, iodine number, and saponification value.
CO4: Apply titrimetric techniques for the quantitative estimation of amino acids and other biochemical constituents with accuracy and precision.
CO5: Analyze experimental data, prepare laboratory reports, and evaluate the biochemical significance of the obtained results**.**

Mapping with Programme Outcomes

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	2	1	2	3	1	1	1	1	2
CO2	3	3	2	3	3	1	1	1	1	2
CO3	3	3	2	3	3	1	2	1	1	2
CO4	2	3	2	3	3	1	1	1	2	2
CO5	2	3	3	3	2	1	1	2	3	3

Correlation level: 1 – Low 2 – Moderate 3 - High

Year: I **INTERDISCIPLINARY COURSE 1** **Semester: I**

BASIC BIOCHEMISTRY

Code: **(Theory)** **Credits: 2**

COURSE OBJECTIVE:

- Understand the chemical basis of life and the role of biomolecules in living systems.
- Explain the structure, classification, and functions of carbohydrates, proteins, lipids and nucleic acids.
- Develop knowledge of biological buffers, pH and biochemical reactions in physiological conditions.
- Describe the structure–function relationship of biomolecules in metabolism.
- Provide insights into molecular mechanisms underlying biological processes.

UNIT I: FOUNDATIONS OF LIFE

Elements found in living organisms. Biological significance of water, weak interactions in aqueous systems, ionization of water, pH, pKa. Henderson–Hassel Balch equation, biological buffer systems: body fluids and their principal buffers.

UNIT II: CARBOHYDRATES

Carbohydrate – Definition, Classification and its biological significance. Monosaccharides: stereoisomers, enantiomers, epimers, mutarotation. Sugar derivatives: amino sugars, sugar alcohol, sugar acids, deoxy sugar and glycosides. Disaccharides: sucrose, lactose and maltose. Polysaccharides: homo and hetero polysaccharides, mucopolysaccharides and glycoproteins.

UNIT III: PROTEINS AND AMINO ACIDS

Proteins - Classification and structures: Primary, Secondary, Tertiary and Quaternary structures. Properties: isoelectric point, zwitterions and precipitation reactions. Globular and fibrous proteins: structure and functions of haemoglobin, collagen, elastin and keratin. Peptide bond: planarity and dihedral angles, Ramachandran plot. Coenzymes and their role in metabolism.

UNIT IV: LIPIDS

Classification and Properties. Fatty acids: Saturated, unsaturated and essential fatty acids; Rancidity, Saponification number, Iodine number, Acid number and Reichert–Meissel number. Structure and biological functions of Triacylglycerol, Phospholipids, Cholesterol and Plant sterols.

UNIT V: NUCLEIC ACIDS

Chemistry of purine and pyrimidine, nucleosides and nucleotides. Types of DNA: structure and properties of A, B and Z-DNA. Denaturation, renaturation, Tm and hyperchromicity. Effect of acid and alkali on DNA and RNA. Types and functions of RNA: rRNA, mRNA, tRNA.

UNIT VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Recent Nobel Prize-winning discoveries in biochemistry and molecular biology.

RECOMMENDED BOOKS:

1. Text book of Biochemistry for medical students – D.M.Vasudevan, 10th Edition, Jaypee Brothers Medical Publishers.
2. Fundamentals of Biochemistry - Donald Voet, Judith G. Voet, Charlotte W.Pratt, 6th Edition (2024 approx.) Wiley.
3. Fundamentals of Biochemistry - J. L. Jain, Sunjay Jain, Nitin Jain ,8th Edition , S. Chand & Company.
4. Biochemistry- Amit Krishna De, Revised editions (commonly 7th–8th edition range) New Central Book Agency / S. Chand.

REFERENCES:

1. Lehninger AL, Nelson DL and Cox MM, Lehninger principles of biochemistry (7th ed.), New York: W.H. Freeman, 2017.
2. Voet D, Voet JG and Pratt CW, Principles of biochemistry (4th ed.) Singapore: John Wiley & Sons, Inc., 2012.
3. Harper—s Biochemistry-Rober K. Murray, Daryl K. Grammer, McGraw Hill, Lange Medical Books. 25th edition.
4. Berg JM, Stryer L, Tymoczko J and Gatto G, Biochemistry (9th ed.), New York: WH Freeman, 2019.

E- SOURCES:

1. https://archive.org/details/lehninger-principles-of-biochemistry-7th-edition
2. https://openstax.org/details/books/biochemistry
3. https://archive.org/details/molecular-biology-of-the-cell
4. https://biochemistryfreeandeasy.com
5. https://archive.org/details/principles-of-biochemistry

COURSE OUTCOMES (COs):

After successful completion of this course, students will be able to:

CO1: Explain the importance of water, pH, and buffer systems in biological systems.
CO2: Classify and describe the structure and functions of carbohydrates and their derivatives.
CO3: Analyze the structure and properties of proteins and amino acids, including their biological roles.
CO4: Understand the classification and functional significance of lipids.
CO5: Describe the structure and function of nucleic acids and genetic materials.

CO–PO Mapping Table

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	2	1	–	–	–	-	1
CO2	3	2	1	1	1	–	–	–	-	1
CO3	3	3	2	2	1	–	–	–	1	1
CO4	3	2	2	1	1	–	1	–	-	1
CO5	3	3	2	2	1	–	–	–	1	1

Correlation level: 1 – Low 2 – Moderate 3 - High

Year: I **CORE COURSE 2** **Semester: II**

BIOCHEMICAL TECHNIQUES

Code: **(Theory)** **Credit: 4**

Course Objectives:

- To understand the basic principles, instrumentation and applications of electrochemical techniques and centrifugation techniques.
- To learn about the various chromatographic techniques.
- To know the techniques and applications of electrophoresis.
- To study the principles, instrumentation and applications of colorimeter and spectrophotometers.
- To explore the knowledge of radioisotopes, radioactive decay and detection techniques

Unit I: pH Meter and Centrifugation

pH Scale, Acid and Base, Buffer solution, pH meter, standard and Reference electrodes, Henderson Hasselbach equation.

Centrifuge – principles, instrumentation, types and applications of centrifuges. svedberg unit, Differential centrifugation, Density gradient centrifugation. Analytical ultracentrifuge and its applications.

Unit II: Chromatography

Stationary phase, mobile phase - Paper, Thin layer chromatography, principle, instrumentation and applications of Gel filtration (size exclusion) ,Ion exchange chromatography, Affinity chromatography, Gas chromatography (GC) and High performance liquid chromatography (HPLC).

Unit III: Electrophoresis

Principle, instrumentation and applications of Paper and Cellulose acetate electrophoresis, starch gel electrophoresis, SDS-PAGE (SDS-Poly Acrylamide Gel Electrophoresis), Agarose Gel Electrophoresis and immuno electrophoresis.

Unit IV: Colorimeter and Spectrophotometer

Beer-Lambert's Law, principle, instrumentation and applications of Colorimeter, UV-Visible spectrophotometer, Mass spectrophotometer and atomic absorption spectrophotometer.

Unit V: Radioisotope Detection Techniques

Radioactive isotopes, Types of Decay- alpha, beta, gamma, Unit of Radio activity, Radioactive detection and measurement – principle, instrumentation and applications of Geiger Muller Counter and Scintillation Counter – Applications of radioactive tracing in biology.

Unit VI: Current contours– (Self-directed learning activities for Continuous Internal Assessments Only):

Principle, types and applications of compound and phase contrast microscopes, western blot and southern blot techniques.

Recommended Books:

1. Upadhayay, Upadhyay and Nath, Biophysical Chemistry – Principles and Techniques, Himalaya Publishing House, Pvt. Ltd, 4th edition, Himalaya Publishing House, 2016
2. Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 5th edition, Cambridge University Press, 2000.
3. Chatwal and Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House, 2025.
4. Veerakumari S, Bioinstrumentation, 1st edition, MJP Publishers, 2009.
5. Sharma R K, Basic Techniques in Biochemistry and Molecular Biology, Dreamtech Press, 2020.
6. Basha, M. Electrophoresis. In: Analytical Techniques in Biochemistry. Springer Protocols Handbooks. Humana, New York, NY. 2020.
7. Terrance G Cooper, The Tools of Biochemistry, Wiley India Pvt Ltd, 2007.
8. https://www.britannica.com/science/chromatography
9. https://www.youtube.com/watch?v=xgxFBQZYXlE
10. https://www.youtube.com/watch?v=7onjVBsQwQ8

COURSE OUTCOMES (COs):

After successful completion of this course, students will be able to:

CO1: Remembering the techniques of pH meter and centrifuges.
CO2: Differentiate and evaluate various chromatographic techniques based on their principles, separation mechanisms, and applications.
C03: Develop the instrumentation of electrophoresis in various fields
CO4: Updated the knowledge of instrumentation and applications of spectrophotometers
CO5: Understand theimportance of radioactive isotopes and applications of radioactive substances in biological sciences

Mapping with Program Outcomes:

COs\ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10
CO 1	2	3	-	3	-	2	3	3	-	3
CO 2	3	3	-	3	-	1	2	3	-	3
CO 3	3	3	-	3	-	2	2	3	-	3
CO 4	3	2	-	3	-	-	-	3	-	3
CO 5	3	1	-	3	-	2	2	3	-	3

Correlation level: 1 – Low 2 – Moderate 3 - High

Year: I **CORE PRACTICAL-2** **Semester: II**

BIOCHEMICAL TECHNIQUES

Code: **(Practical)** **Credit: 4**

Course Objectives:

- To Equip the reagent preparation skill.
- To Acquire the knowledge about the technique skill the laboratory instruments.
- To impart the practical knowledge and to apply the various biomedical instruments.
- To improve the knowledge of electrophoresis and ultra centrifuge.
- To update the knowledge various analytical and preparative methods.

Experiments

1. Preparations of Reagents
   a. Standard Solution – 100 ml, 250 ml
   b. Percentage solution – 0.5%, 2%
   c. Molar solution - 0.1 M, 1 M
   d. Normal solution – 1N, 2/N
2. Preparation of Buffer solution
   a. Phosphate buffer
   b. Bicarbonate buffer
   c. Citrate buffer
3. Check pH of your blood and urine by using pH meter.
4. Separation of sugars and aminoacids by paper chromatography.
5. Separation of lipids by using TLC.
6. Separate plant pigments from flowers and leaves by coloumn chromatography.
7. Quantify the chlorophyll content in onion leaves by colorimeter.
8. Estimate the glycogen amount in goat muscle /liver by using the UV spectrophotometer.
9. Demonstrate the subcellular organelle separation by using differential centrifugation.
10. Demonstrate the separation of protein by SDS-PAGE.

Recommended Books:

1. David Plummer An Introduction to Practical Biochemistry (3rd ed) McGraw Hill Education (India) Private Ltd (2001).
2. Jayaraman, J, Laboratory Manual in Biochemistry, New age publishers (2011).
3. Sarin A. Chavhan, Sushilkumar A. Shinde. A Guide to Chromatography Techniques Edition:1 (2019).
4. Sadasivam S and ManickamA,. Biochemical Methods, 4h edition, NewAge International Publishers, (2016).
5. KatochRajan, Analytical techniques in Biochemistry and Molecular Biology; Springer (2011).
6. https://www.researchgate.net/publication/313745155_Practical_Bio chemistry_A_Student_Companion

7. https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry.pdf

Course Outcomes (COs):

Upon successful completion of this course the students would be able:

CO1: Reagent preparations for qualitative and quantitative methods of biochemical estimations

CO2: Apply the applications of chromatography
CO3: Separate various proteins and nucleic acids using the instrumentation of chromatographic techniques in various fields.

CO4: Quantify the biological components using with spectrophotometers.
CO5: Demonstrate the electrophoretic techniques

Mapping with Program Outcomes:

COs\ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10
CO 1	3	3	3	3	-	3	3	3		3
CO 2	3	3	3	3	-	3	3	2	2	3
CO 3	3	3	3	3	-	3	3	3	2	3
CO 4	3	2	2	3	-	3	3	3		3
CO 5	3	3	3	3	-	3	3	1		3

Correlation level: 1 – Low 2 – Moderate 3 - High

Year: I **INTERDISCIPLINARY COURSE 2** **Semester: II**

LIFESTYLE DISEASES AND TREATMENT

Code: **(Theory)** **Credit: 2**

Course Objectives

- Understand the etiology, pathophysiology and risk factors associated with major lifestyle diseases.
- Analyse the impact of dietary habits, physical inactivity, stress and environmental factors on chronic diseases.
- Evaluate conventional and lifestyle-based therapeutic strategies used in prevention and management of non-communicable diseases.
- Develop preventive and evidence-based intervention approaches for promoting long-term health and wellness.
- Examine the role of public health policies, health education and community-based interventions in reducing the burden of lifestyle diseases and improving quality of life.

UNIT I: Introduction to Lifestyle Diseases

Concept and classification of lifestyle diseases. Epidemiology of non-communicable diseases (NCDs). Risk factors: genetic, environmental, behavioural and socioeconomic. Urbanisation and changing lifestyle patterns. Oxidative stress and inflammation in chronic diseases. Preventive healthcare concepts. Public health burden of NCDs in India

UNIT II: Metabolic and Cardiovascular Disorders

Obesity and metabolic syndrome. Type 2 diabetes mellitus. Insulin resistance and glucose metabolism, Hypertension and cardiovascular diseases, Dyslipidemia and atherosclerosis. Dietary and pharmacological management. Role of exercise and lifestyle interventions.

UNIT III: Stress-Related and Degenerative Disorders

Stress physiology and neuroendocrine regulation, Anxiety, depression and sleep disorders, Psychosomatic disorders, neurodegenerative diseases and ageing, Cancer as a lifestyle-associated disease, Role of antioxidants and nutraceuticals, Yoga, meditation and mindfulness therapy.

UNIT IV: Modern Therapeutic and Preventive Approaches

Lifestyle medicine and behavioural therapy, Nutritional therapeutics and medical nutrition therapy, Functional foods and nutraceuticals, Physical activity and rehabilitation strategies, Personalised medicine and precision nutrition, Digital health monitoring and wearable technologies, Preventive screening and early diagnosis.

UNIT V: Community Health and Disease Prevention

Public health policies for NCD prevention, National and global health initiatives, Community nutrition and awareness programs, Health education and lifestyle counselling, Occupational health and workplace wellness, Geriatric lifestyle management, Sustainable healthcare practices, Holistic approaches to wellness.

UNIT VI: Current Contours (Self-directed learning activities for Continuous Internal Assessments Only):

Global trends and transition in non-communicable diseases. Impact of urbanization, industrialization and modern living on health. Environmental and occupational lifestyle hazards. Food marketing, consumer behaviour and nutrition misinformation. Socioeconomic determinants of health and health inequities. Childhood obesity and adolescent lifestyle disorders. Women's health issues related to lifestyle and hormonal imbalance. Role of community participation and policy-making in disease prevention. Health economics and burden of chronic diseases. Future strategies in public health, preventive medicine and sustainable wellness models.

Recommended References:

1. Lifestyle Medicine – by James M. Rippe, 4th edition, 2023. Publisher – CRC Press, Boca Raton.
2. Preventive and Social Medicine – by K. Park, 27th edition, 2023. Publisher – Banarsidas Bhanot Publishers, Jabalpur.
3. Textbook of Human Nutrition – by Mahtab S. Bamji, N. Pralhad Rao and Vinodini Reddy, 4th edition, 2017. Publisher – Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Nutrition and Dietetics – by Shubhangini A. Joshi, 5th edition, 2022. Publisher – McGraw Hill Education, New Delhi.
5. Krause's Food and the Nutrition Care Process – by Janice L. Raymond and Kelly Morrow, 16th edition, 2023. Publisher – Elsevier, St. Louis.
6. Advanced Nutrition and Human Metabolism – by Sareen S. Gropper and Jack L. Smith, 8th edition, 2021. Publisher – Cengage Learning.
7. Exercise Physiology: Nutrition, Energy, and Human Performance – by William D. McArdle, Frank I. Katch and Victor L. Katch, 10th edition, 2022. Publisher – Wolters Kluwer.
8. Public Health Nutrition – by Sari Edelstein, 4th edition, 2022. Publisher – Jones & Bartlett Learning.
9. Community Nutrition in Action: An Entrepreneurial Approach – by Marie A. Boyle, 8th edition, 2021. Publisher – Cengage Learning.
10. Functional Foods and Nutraceuticals – by Rotimi E. Aluko, 2nd edition, 2023. Publisher – Springer Nature.
11. Principles of Nutrigenetics and Nutrigenomics: Fundamentals of Individualized Nutrition – by Raffaele De Caterina and J. Alfredo Martinez, 1st edition, 2019. Publisher – Academic Press, Elsevier.

12. WHO Guidelines on Physical Activity and Sedentary Behaviour – World Health Organization, 2020. Publisher – WHO Press, Geneva.
13. ICMR-NIN Dietary Guidelines for Indians – by National Institute of Nutrition (NIN), 2nd revised edition, 2024. Publisher – Indian Council of Medical Research, Hyderabad.
14. Eat Right India: Handbook for Healthy and Sustainable Diets – by Food Safety and Standards Authority of India (FSSAI), 2023. Publisher – FSSAI, New Delhi.
15. The Circadian Code – by Satchin Panda, 1st edition, 2018. Publisher – Rodale Books, New York.
16. Integrative Medicine – by David Rakel, 5th edition, 2021. Publisher – Elsevier.
17. Nutrition Through the Life Cycle – by Judith E. Brown, 7th edition, 2023. Publisher – Cengage Learning.
18. Essentials of Medical Physiology – by K. Sembulingam and Prema Sembulingam, 8th edition, 2022. Publisher – Jaypee Brothers Medical Publishers, New Delhi.
19. Robbins and Cotran Pathologic Basis of Disease – by Vinay Kumar, Abul K. Abbas and Jon C. Aster, 11th edition, 2022. Publisher – Elsevier.
20. Digital Health: Understanding the Use of Digital Technologies in Health – by Christopher Dixon and Edward Maher, 1st edition, 2021. Publisher – Routledge.

Course Outcomes (COs):

Upon successful completion of this course the students would be able:

CO1: Identify major lifestyle diseases affecting modern populations.

CO2: Understand the relationship between metabolism, nutrition, stress, and chronic disease progression.

CO3: Evaluate current treatment modalities, including pharmacological and non-pharmacological interventions.

CO4: Analyse preventive healthcare strategies and health promotion models.

CO5: Develop practical knowledge regarding lifestyle counselling and therapeutic management.

Mapping with Programme Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10
CO 1	2	3	-	3	-	2	3	3	-	3
CO 2	3	3	-	3	-	1	2	3	-	3
CO 3	3	3	-	3	-	2	2	3	-	3
CO 4	3	2	-	3	-	-	-	3	-	3
CO 5	3	1	-	3	-	2	2	3	-	3

Correlation level: 1 – Low 2 – Moderate 3 - High

Year: II	CORE COURSE -3 CELL BIOLOGY	Semester: III
Code:	(Theory)	Credits: 4

COURSE OBJECTIVES:

- To understand the basics and fundamentals of cell biology and biogenesis of cell organelles.
- To study the cellular processes and mechanisms that lead to physiological functions in normal as well as in pathological state.
- Introduce the principles and applications of cell biology techniques such as centrifugation, microscopy and staining methods.
- Familiarize students with recent advances in cell biology, including gene editing technologies, advanced imaging techniques and their applications in understanding diseases like cancer.
- Explain the structure, organization and functions of cellular organelles in prokaryotic and eukaryotic cells.

UNIT I: BASICS OF CELL BIOLOGY

Historical Background, Chemical Components of Cell. Structure of prokaryotic and eukaryotic cell and its differences, Comparison between Plant and animal cells.

UNIT II: CELL ORGANELLES

Cellular Organelles-Plasma membrane, Cell wall, Vacuoles, plastids, Chloroplast, Nucleus, Intracellular compartments-I: Mitochondria, Ribosomes and its types, Golgi apparatus and endoplasmic reticulum; Intracellular compartments-II: Lysosomes, peroxisomes - their structural organization; Cytoskeleton: Microtubules, intermediate filaments and microfilaments.

UNIT III: CELL MEMBRANE

Cell Membrane: Composition, structure, models, and its functions - Transport across cell membrane: Major types of membrane transport, Active transport, Co-transport, Symports, Antiports, Ion channels and Osmosis. Specialized structures – Cell Junctions – Occulating, Anchoring and Gap, Ion channels.

UNIT IV: CELL CYCLE AND CELL DIVISION

Cell cycle: Molecular models and events. Regulators and checkpoints in cell cycle; Molecular mechanisms of cell division – Mitosis – Prophase, Metaphase, Anaphase, Telophase and Meiosis. Brief overview of apoptosis and necrosis; Aging and Senescence.

UNIT V: TOOLS OF CELL BIOLOGY

Cell Visualization techniques: Principles and applications of microscopy. Light microscopy: bright-field, phase-contrast and fluorescence microscopy. Electron microscopy: TEM and

SEM. Cell culture techniques and maintenance of cell lines. Staining techniques – dye and fluorescent based techniques.

UNIT VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Discussion on recent advancements like Crispr-Cas 9, recently developed cell imaging techniques, freeze fracturing technique, advanced microscopy techniques and recent noble prize awards in the field of medicine and physiology. Cellular abnormalities in various disorders like cancer.

REFERENCES:

1. Cooper, G.M. and Hausman, RE. 2009. The Cell .A Molecular Approach. (5" ed) Sunderland
2. Krebs.JE, Kilpatrick.S.T and Goldstein. E.S, 2013, Lewin GENES XI, JONES & Bartlett Learning, Burlington, Massachusetts.
3. Lodish.H,.A , Berk.C.A, Kaiser.M, Krieger.MP, Scott.ABretscher.H, Ploegh and p. Matsudaira, 2007, Molecular Cell Biology, 6th Edition, WH. Freeman Publishers, New York, USA.
4. PS Verma and VK Agarwal 2004 Cell Biology, Genetics, Molecular Biology Evolution and Ecology (14" ed), S.Chand and Company Ltd.
5. Watson. JD, TA.Basker and Sp.Bell, 2008, Molecular Biology of the Gene, 5th Edition. Dorling Kindersley Pvt., Ltd., New Delhi.
6. Bruce Alberts and Dennis Bray 2013, Essential Cell Biology.(4" ed).Garland Science, New ork.
7. De Robertis, EDP, and De Robertis, EM.F. 2010, Cell and Molecular Biology (8thed). Lippincott Williams and Wilkins, Philadelphia.
8. Geoffrey M. Cooper and Robert. E. Hausman, 2009 .The Cell: A Molecular Approach, Sinauer Associates, 5thEd, USA.
9. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiment (6th ed) John Wiley & Sons, Inc, United Kingdom.
10. Wayne M. Baker, 2008, The World of the Cell. (7th ed). Pearson Benjamin Cummings Publishing, San Francisco.
11. https://www.pdfdrive.com/biochemistry-books.html
12. https://drive.google.com/file/d/1tghNWPyuqPiqKlrlllZzUrFwcoMiuoMa/
13. https://www.freebookcentre.net/biology-books-download/Basisofmolecular-cell-biology-(PDF-36P).html.
14. https://agrilif.org/gold/files/2012/09/Lecture-26.pdf

COURSE OUTCOMES (COs):

Upon successful completion of this course the students would be able:

CO1: Understand the cell theory and basic cell structure.
CO2: Acquire knowledge on cell fractionation and cell visualization techniques.
CO3: Illustrate the structure and function of various cell organelles in a cell.
CO4: Describe the structure, function and composition of cell membrane.
CO5: Understand the mechanism of cell division and cell death.

Mapping with Programme Outcomes

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	1	1	-	-	-	-	1
CO2	3	2	2	1	1	-	-	-	-	1
CO3	3	3	2	2	2	-	-	-	-	1
CO4	3	3	3	2	1	1	1	-	-	1
CO5	3	2	2	3	3	-	1	2	1	2

Correlation level: 1 – Low 2 – Moderate 3 - High

Year: II | **CORE PRACTICAL -3 CELL BIOLOGY (Practical)** | **Semester: III**

Code: | **Credits: 4**

COURSE OBJECTIVES:

- To know the handling of microscope.
- To study practically the plant and animal cells, the cell organelles and components with the help of microscope.
- To study the different stages of mitosis and meiosis and staining methods.
- To understand the structural organization and functional significance of cellular organelles in prokaryotic and eukaryotic cells.
- To develop practical skills in cell observation, specimen preparation, staining techniques, and microscopic analysis for biological research.

Experiments:

1. Handling of Microscope.
2. Observe the characteristics of prokaryotic and eukaryotic cells by cytochemical staining method.
3. Preparation of blood smear and to observe different cell types in blood.
4. Isolation of plant cellular DNA and RNA.
5. Estimate the amount of chlorophyll present in the leaf tissue by paper/Thin Layer chromatography
6. To study the different stages of mitosis by temporary preparation in onion root tip.
7. To study the different stages of meiosis by temporary preparation in onion flower buds.

REFERENCES:

1. Bruce Alberts and Dennis Bray. 2013, Essential Cell Biology. (4”Ed). Garland Science.
2. Cooper, G.M. and Housman, R.E. 2009. The Cell. A Molecular Approach. (5” ed) Sunderland.
3. Ganesh M.K. and Shivashankara A.R. 2012. Laboratory Manual for Practical Biochemistry Jaypee publications, 2ndEdn.
4. LodishH.A,Berk C.A, Kaiser M, Krieger M.P, Scott A, Bretscher H, Ploegh and Matsudaira. 2007. Molecular Cell Biology, 6th Edition, WH. Freeman Publishers, New York, USA.
5. Watson J.D, Basker T.A. and Bell S.P. 2008. Molecular Biology of the Gene, 5th Edition. Dorling Kindersley Pvt., Ltd., New Delhi.
6. Bruce Alberts, 2008, Molecular Biology of the cell: Garland Publishing, 5th Ed.
7. Cooper, G.M. and Hausman, RE. 2009. The Cell .A Molecular Approach. (5” ed) Sunderland
8. Geoffrey M. Cooper and Robert. E. Hausman, 2009. The Cell: A Molecular Approach:,Sinauer Associates, 5thEd, USA.

9. Lodish.H,.A , Berk.C.A, Kaiser.M, Krieger.MP, Scott.Abretscher.H, Ploegh and p. Matsudaira, 2007. Molecular Cell Biology, 6th Edition, WH. Freeman Publishers, New York, USA.
10. Watson. JD, TA.Basker and Sp.Bell, 2008, Molecular Biology of the Gene, 5th Edition. Dorling Kindersley Pvt., Ltd., New Delhi.
11. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1
12. https://www.microscopemaster.com/organelles.html
13. https://www.pdfdrive.com/biochemistry-books.html

COURSE OUTCOMES (COs):

Upon successful completion of this course the students would be able to:

CO1: Gain the knowledge about handling of microscope.

CO2: Identify the microscopic examination of cell organelles.

CO3: Obtain hands on training in basic separation techniques in Cell biology.

CO4: Differentiate the stages of mitosis and meiosis.

CO5: Evaluate the cellular biomolecules by staining techniques.

Mapping with Programme Outcomes

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	1	1	1	1	1	1	1	2
CO2	2	3	1	1	2	1	1	1	1	2
CO3	1	2	2	2	3	2	2	2	2	2
CO4	1	2	3	3	3	2	3	2	2	2
CO5	2	2	3	3	3	3	3	3	3	3

Correlation level: 1 – Low 2 – Moderate 3 - High

Year: I	INTERDISCIPLINARY COURSE 3 NUTRITIONAL BIOCHEMISTRY	Semester: III
Code:	(Theory)	Credit: 2

COURSE OBJECTIVES:

- To understand the concept of balanced diet, nutritional assessment, and dietary planning.
- To impart knowledge on functional foods, nutraceuticals, and their role in health promotion.
- To develop awareness on nutritional needs across different physiological conditions and lifestyles.
- To understand the digestion, absorption, metabolism, and physiological functions of major nutrients in the human body.
- To evaluate the role of nutrition in the prevention and management of metabolic disorders and lifestyle-related diseases.

UNIT 1: BASIC CONCEPTS OF NUTRITION

Definition - Human nutrition, balanced diet, its composition, energy - units and measurements. Energy requirements for different categories of people, body mass index (BMI) and Basal metabolic rate (BMR): determination. Factors affecting BMR, SDA, RQ. Biological value and Net protein Utilization Regulation of body temperature, Balanced diet formulation and its Assessment.

UNIT II: FUNCTIONAL FOODS

Functional foods of plant and animal origin, Probiotics, prebiotics and synbiotics. Nutraceuticals- herbal nutraceuticals; Phytochemicals, phytosterols and other bioactive compounds. Physico-chemical, functional and nutritional characteristics of carbohydrates, proteins and fats and their interactions (emulsions, gelation, browning etc.).

UNIT III: MACRONUTRIENTS

Dietary sources, Classification and functions of carbohydrates, fats,proteins, dietary fibre and Vitamins. Caloric value and recommended daily allowances (RDA). Malnutrition: deficiencies and over-consumption.

UNIT IV: MICRONUTRIENTS

Minerals - Classification, Distribution, dietary sources, RDA, Functions, deficiency and toxicity of calcium, iron and phosphorus. iodine, fluoride, magnesium, copper, zinc, selenium and manganese.

UNIT V: DIFFERENT DIMENSIONS FOR FITNESS

Balanced diet - Different criteria for health and well-being: physical, intellectual, emotional, social, spiritual, environmental and occupational. Special nutritional concerns: pregnancy,

lactation and aging. Special nutritional requirements of working women, female athletes and post-pregnancy weight management.

UNIT: VI CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Role of genomics, metabolomics and microbiome in designing individualized diets. Case studies in personalized dietary interventions.

TEXT BOOKS:

1. Mary, K. Schmidl and Theodore, P. Labuza, Essentials of Functional Foods, Culinary and hospitality industry publication services, 2000.
2. Israel Goldberg, Functional foods, pharma foods, Nutraceuticals, Culinary and hospitality industry publication services, 2001
3. Robert easy Wildman, Handbook of Nutraceuticals and functional foods, Culinary and hospitality industry publication services, Third Edition, Wallace, 2002.

REFERENCE BOOKS:

1. Wildman, Robert. Nutraceuticals and Functional Foods, second edition. Taylor and Francis Group, 2007.
2. Gibson GR & William CM. Functional Foods - Concept to Product, 2000.
3. Goldberg I. Functional Foods: Designer Foods, Pharma Foods, 2010.
4. Brigelius-Flohé, J &Joost HG. Nutritional Genomics: Impact on Health and Disease. Wiley VCH, 2006.
5. Cupp J & Tracy TS. Dietary Supplements: Toxicology and Clinical Pharmacology. Humana Press, 2003.
6. Watson Ronald Ross, 'Functional Foods and Nutraceuticals in Cancer Prevention' Iowa State Press, Blackwell Pub Co, Iowa, 2003
7. Aluko, Rotimi, Functional Foods and Nutraceuticals, Springer-Verlag New York Inc., 2012.
8. Satinder Kaur Brar,Surinder Kaur and Gurpreet Singh Dhillon, Nutraceuticals Functional Foods, 2014.

E RESOURCES:

1. https://krishi.icar.gov.in/jspui/bitstream/123456789/71744/1/FINAL-231- 250.pdf
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3257668/
3. https://www.fda.gov.tw/upload/189/content/20140128170435362 59.pdf
4. https://gavsispanel.gelisim.edu.tr/Document/bgcol/20190220115348732_dc fb1798-bc12-4788-a50f-ec72d7f69ef4.pdf
5. https://www.youtube.com/watch?v=QxORI49hcI4
6. https://onlinecourses.swayam2.ac.in/cec23_ag02/preview
7. https://youtu.be/9G1wWUjkyz8?si=0XDM9lh7T6f1IGEY

COURSE OUTCOMES (COs):

Upon successful completion of this course the students would be able to:

CO1: Explain the basic concepts of nutrition, energy requirements and metabolism.
CO2: Describe the role of functional foods, probiotics and nutraceuticals in maintaining health.
CO3: Analyze and evaluate the importance of macro and micronutrients including their deficiencies and excess conditions.
CO4: Assess and apply the knowledge of nutrition to plan balanced diets and promote overall well-being.
CO5: Evaluate the role of nutrition in the prevention and management of metabolic disorders, lifestyle diseases, and other health conditions.

Mapping with Programme Outcomes

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	2	1	1	–	2	–	–	–	1
CO2	3	2	2	1	–	2	1	–	–	1
CO3	3	3	2	2	–	3	–	–	–	1
CO4	3	3	2	2	–	3	–	–	–	1
CO5	2	3	3	2	–	3	1	1	1	2

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: II	CORE COURSE 4 ENZYMOLOGY	Semester: IV
Code:	(Theory)	Credit: 4

Course Objective

- To examine the systematic classification, nomenclature and unique specificity of enzymes.
- To study the action of enzyme mechanisms and key activity factors.
- To investigate and apply quantitative kinetics to analyze enzyme behaviour.
- To understand and execute enzyme production and purification strategies.
- To study and evaluate immobilized enzyme systems.

Unit I: **Introduction to Enzymes**

Definition, properties and significance of enzymes - Nomenclature and classification (IUBMB system) - Enzyme structure and function - Active site, coenzymes, cofactors, prosthetic groups - Isoenzymes and multienzyme complexes - Metallo enzymes and metal activated enzymes - Non protein enzymes - ribozymes and abzymes.

Unit II: **Mechanism of Enzyme Action**

Mechanism of substrate binding, Lock-and-key model (Emil Fischer), Induced fit model (Daniel Koshland). Enzyme Specificity, Factors affecting enzyme activity (pH, temperature, substrate concentration). Mechanism of enzyme catalysis (acid-base catalysis, covalent catalysis).

Unit III: **Enzyme Kinetics**

Enzyme Kinetics: Michaelis-Menten kinetics and Lineweaver-Burk plot and its Significance. Enzyme Inhibition - competitive, non-competitive, uncompetitive. Allosteric enzymes and Regulation. Mechanism of Concerted and Sequential model and Feed Back inhibition.

Unit IV: **Enzyme isolation and Purification**

Microbial, plant and animal sources of enzymes, Fermentation technology for enzyme production (submerged and solid-state), Downstream processing - extraction, purification techniques (precipitation, dialysis, chromatography), Enzyme assay methods and units of activity - Enzyme characterization (specific activity, purity, stability).

Unit V: **Enzyme Immobilization and Engineering**

Methods of immobilization: Adsorption, covalent bonding, entrapment, encapsulation, Advantages and limitations of immobilized enzymes, Industrial applications of immobilized enzymes, Basics of enzyme engineering and protein design. Applications of Enzymes food industry and Therapeutics.

Unit VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only)

Artificial and Nano-Enzymes -Nanozymes: metal oxides, noble metals, carbon-based nanozymes, Applications of nanoenzymes.

Text Books

1. U.Sathyanarayana&U.Chakrapani, 2013, Biochemistry, 4th edition, Elsevier India Pvt. Ltd., Books & Allied Pvt. Ltd.
2. Dr. G.R Agarwal, Dr. Kiran Agarwal & O.P. Agarwal, 2015, Textbook of Biochemistry (Physiological chemistry),18th edition, Goel Publishing House,
3. T.Devasena, 2010, Enzymology,1st edition, Oxford university Press.

Reference Books

1. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2nd edition,2008 Trevor Palmer and Philip Bonner
2. Principles of Biochemistry, 1993. A.L. Lehninger, Nelson &Cox (CBS, India) and new edition.
3. Biochemistry, 2004, Donald Voet and Judith Voet, John Wiley and sons. ISBN - 047119350
4. Biochemistry, 5th edition, by LubertStryer, New York: W H Freeman; 2002, ISBN-10: 0-7167-3051-0.
5. TextBook of Biochemistry with clinical correlations, 4th edition – Thomas M.Devlin.
6. Text of Biochemistry, 1908 – West &Todd, MacMillian Publications
7. Principles of Biochemistry, by G. L. Zubay, 1995, Wm. C. Brown
8. Biochemistry 2nd edition Christopher K.Mathews and K.E.VanHoldge (1995) (Benjamin and cumming).
9. Enzymes. Dixon and Webb 3rded. Longmans, 1979.
10. Enzymes in Food Technology. CRC Press, 2001. Whitehurst RJ.
11. Industrial Enzymes and their applications. Uhlig H. John Wiley, 1998.
12. Fundamentals of enzymology 2nd edition,1989 by Nicholas C. Price and Lewis Stevens.

Web Resources:

1. nptel.ac.in/courses/102103097
2. Enzymes and Bioenergetics Syllabus
3. Enzymes: Structure, Types, Mechanism, Functions

Course Outcomes (COs):

Upon successful completion of this course the students would be able to:

CO1 – Recall and describe enzyme properties, classification, catalytic mechanisms, kinetics, inhibition, production, purification, immobilization and industrial/therapeutic uses.

CO2 – Interpret structure-function relationships, compare substrate binding models, explain Michaelis-Menten kinetics and Lineweaver-Burk plots, classify inhibition types with examples and outline downstream processing for enzyme purification.

CO3 – Calculate Km and Vmax, determine inhibition types from kinetic data, select suitable enzyme sources and fermentation methods, choose immobilization techniques by application.

CO4 – Compare catalytic mechanisms of ribozymes, abzymes and nanozymes, analyze pH/temperature effects graphically; distinguish concerted vs. sequential allosteric models, evaluate purification data.

CO5 – Justify immobilization methods based on stability and industrial constraints; compare nanozymes vs. natural enzymes.

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	1	1	2	1	2	2	1	2
CO2	2	3	2	2	2	1	2	2	1	1
CO3	1	2	2	3	2	1	2	3	2	1
CO4	1	3	3	2	3	2	3	2	2	2
CO5	2	2	3	2	3	2	3	2	3	2

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: II | **CORE PRACTICAL 4 ENZYMOLOGY (Practical)** | **Semester: IV**

Code: | **Credit: 4**

Course Objective:

- To determine the optimal pH and temperature for salivary amylase activity
- To assay the activity of liver enzymes SGPT (ALT) and SGOT (AST)
- To estimate the concentration of biomolecules (pyruvate and tryptophan)
- To compare the kinetic properties of acid phosphatase and alkaline phosphatase
- To investigate the effect of substrate concentration and enzyme concentration on reaction velocity

Experiments

1. Determination of optimum pH of salivary amylase.
2. Determination of optimum temperature of salivary amylase.
3. Assay of SGPT
4. Assay of activity of SGOT.
5. Assay of Acid phosphatase
6. Assay of Alkaline phosphatase
7. Effect of substrate and Enzyme concentration on the activity of salivary amylase and Alkaline phosphatase.

Text Books

1. Somkuti, S. J. Enzyme Technology. CBS Publishers & Distributors, New Delhi, Latest Edition 2021.
2. Jayaraman, J. Laboratory Manual in Biochemistry, 2nd Edition, New Age International Publishers, New Delhi, 2020.
3. Chawla, Ranjna. Practical Clinical Biochemistry: Methods and Interpretations, 6th Edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2025.

Reference Books

1. Price and Stevens 1989, Fundamentals of Enzymology, Oxford Bioscience publications 2nd Ed, New york.
2. D. Voet, and JG. Voet. 1990. Biochemistry, 4th edition, John Wiley &SonsInc, Publishers, New York
   A. White, 1959. Principles of Biochemistry, 3rd edition, McGraw Hill Book Co., Publishers, New York.
3. Lehninger Principles of Biochemistry: D.L. Nelson, Michael M. Cox, International Edition, CBS Publishers, 4th Ed, 2004.

Web Resources

1. https://www.pdfdrive.com/biochemistry-books.html
2. http://amrita.olabs.edu.in/?sub=73&brch=8&sim=133&cnt=2
3. 3.https://courses.lumenlearning.com/biolabs1/chapter/enzymes/
4. https://practicalbiology.org/bio-molecules/factors-affecting enzymeactivity/investigating-the-effect-of-ph-on-amylase-activity

Course Outcomes

Upon successful completion of this course the students would be able to:

CO1: Recall the principles, reagents, and reaction conditions forEnzyme assays.

CO2: Explain the effects of pH, temperature, substrate concentration, and enzyme concentration on enzyme activity

CO3: Apply spectrophotometric and colorimetric methods to determine the various activities of Enzymes.

CO4: Evaluate the reliability of enzyme assay data by comparing experimental optimum conditions

CO5: Design a simple experiment to verify the effect of an inhibitor (or activator) on salivary amylase or alkaline phosphatase.

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	1	1	2	1	1	1	1	2
CO2	2	3	2	2	3	1	2	2	1	1
CO3	2	2	2	2	3	2	2	3	2	1
CO4	1	2	3	3	3	2	3	3	2	2
CO5	2	2	3	2	3	3	3	3	3	2

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: II **INTERDISCIPLINARY COURSE 4** **Semester: IV**

FIRST AID MANAGEMENT

Code: **(Theory)** **Credit: 2**

Course Objectives

- Assess emergency scenes safely using the DR-ABC (Danger, Response, Airway, Breathing, and Circulation) protocol and activate emergency medical services appropriately
- Demonstrate competency in core first aid interventions: CPR/AED use, bleeding control, shock management, fracture immobilization and burn care per current AHA/Red Cross guidelines
- Apply psychological first aid (PFA) principles to support victims and bystanders during acute stress or crisis situations
- Manage common medical emergencies (choking, seizures, diabetic crises, allergic reactions, heat/cold injuries) using evidence-based, stepwise protocols.
- Evaluate legal, ethical and cultural considerations in first aid provision, including consent, documentation, Good Samaritan laws and scope of practice.

Unit I: Foundations of First Aid & Emergency Response

Definition, scope and historical evolution of first aid, Legal framework: Good Samaritan laws, consent, negligence, documentation, Scene safety, personal protective equipment (PPE), infection control (BSI), Emergency action principles: DR-ABC, calling for help, EMS activation, Introduction to psychological first aid: principles of Look-Listen-Link,Communication skills: calm instruction, cultural sensitivity, working with interpreters.

Unit II: Life-Threatening Emergencies & Basic Life Support

Cardiac Emergencies: Recognition of heart attack, stroke (FAST assessment), AED operation, CPR Techniques: Adult, child, infant protocols; compression-ventilation ratios; team dynamics, Airway Management: Choking relief (Heimlich maneuver), recovery position, foreign body, Severe Bleeding & Shock: Direct pressure, tourniquets, hemostatic agents, shock recognition and positioning, AED Training: Pad placement, rhythm analysis, safety protocols, pediatric considerations.

Unit III: Trauma & Environmental Emergencies

Wound Care: Abrasions, lacerations, punctures, avulsions; cleaning, dressing, infection prevention, Musculoskeletal Injuries: Sprains, strains, fractures, dislocations; RICE protocol, splinting techniques, Head, Neck & Spinal Injuries: Mechanism assessment, immobilization, log-roll maneuver, Burns & Thermal Injuries: Classification, cooling, covering, referral criteria; electrical/chemical burn specifics, Environmental Emergencies: Heat, exhaustion/stroke, hypothermia, frostbite, drowning, lightning strikes.

Unit IV: Medical Emergencies & Special Populations

Respiratory Emergencies: Asthma, COPD exacerbation, anaphylaxis (epinephrine auto-injector use), Metabolic Emergencies: Hypoglycemia/hyperglycemia, diabetic ketoacidosis

recognition, Neurological Events: Seizure first aid, post-ictal care, stroke identification (BE-FAST), Poisoning & Overdose: Ingestion, inhalation, dermal exposure; activated charcoal indications, naloxone administration, Special Populations: Pediatric, geriatric, pregnant individuals, persons with disabilities; adapting care approaches.

Unit V: Advanced Preparedness, Documentation & Community Response
Mass Casualty Incidents (MCI): Triage systems (START/JumpSTART), resource allocation, incident command basics, Disaster First Aid: Earthquake, flood, fire response; shelter-in-place vs. evacuation protocols, Documentation & Handover: SOAP notes, SBAR communication, transferring care to EMS, Mental Health & Critical Incident Stress: Recognizing acute stress reactions, self-care for responders, referral pathways, Community First Responder Programs: Training volunteers, public education, building resilient communities.

UNITVI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):
Simulation-based learning, e-learning and virtual training modules, use of mobile apps for emergency guidance, integration with public health awareness.

Textbooks:

1. American Red Cross (2024). First Aid/CPR/AED Carepayer's Manual. (Standard Edition).
2. St. John Ambulance / British Red Cross (2024). First Aid Manual. Dorling Kindersley. (11th Revised Edition).
3. Thygerson, A. L. (2022). First Aid, CPR, and AED Standard. Jones & Bartlett Learning. (8th Edition).

Reference Books:

1. American Heart Association (2025). Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care.
2. Auerbach, P. S. (2023). Medicine for the Outdoors: The Essential Guide to First Aid and Medical Emergencies. Elsevier.
3. WHO (2023). Community-based First Aid and Resilience Manual.

E-Sources:

1. IFRC (International Federation of Red Cross): ifrc.org (Global first aid standards).
2. AHA eLearning: elearning.heart.org (Interactive BLS and ACLS modules).
3. Mayo Clinic First Aid Guide: mayoclinic.org (Quick reference for medical emergencies).
4. Stop The Bleed: stopthebleed.org (Specialized resources for hemorrhage control).

Course Outcomes (COs):

Upon successful completion of this course the students would be able to:

CO1: Explain the principles, scope, legal framework, ethical responsibilities, communication strategies, and emergency action procedures essential for first aid and pre-hospital care.

CO2: Demonstrate proficiency in life-saving techniques including CPR, AED operation, airway management, choking relief, and management of severe bleeding and shock.

CO3: Apply first aid interventions for trauma, burns, musculoskeletal injuries, spinal injuries, and environmental emergencies using proper infection control and safety protocols.

CO4: Assess and provide appropriate care for medical emergencies such as respiratory, metabolic, neurological, poisoning, and overdose cases, including adaptations for special populations

CO5: Analyze and respond to disaster, mass casualty, and community emergency situations using triage, documentation, stress management, and preparedness strategies to enhance community resilience.

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	2	1	1	1
CO2	1	3	3	3	3	1	1	1	1	1
CO3	1	3	3	3	3	2	2	2	1	3
CO4	1	3	3	3	3	2	2	2	1	3
CO5	1	3	3	3	3	2	2	2	1	3

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: III **CORE COURSE 5** **Semester:V**

HUMAN PHYSIOLOGY

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To understand the sensory physiology.
- To explain the role of body fluids and blood in maintaining homeostasis.
- To describe cardiovascular and respiratory physiology.
- To understand digestion and nutrient metabolism.
- To integrate physiological concepts with biochemical pathways.

UNIT I: SENSORY PHYSIOLOGY

Physiology of vision: structure of the eye, image formation, phototransduction, accommodation, visual pathway and common refractive errors. Physiology of hearing: structure of the ear, mechanism of hearing, auditory pathway, and hearing defects. Physiology of taste and smell: taste buds, olfactory receptors and sensory transduction mechanisms.

UNIT II: BLOOD AND CARDIOVASCULAR SYSTEM

Blood composition and functions. Hemoglobin and oxygen transport. Blood groups and coagulation. Heart structure and cardiac cycle. Functions of Heart. Blood pressure regulation. Electrocardiogram.

UNIT III: RESPIRATORY AND DIGESTIVE SYSTEM

Anatomy of Lungs. Mechanics of breathing and gas exchange. Regulation of respiration. Role of Lung in acid – base balance. Digestive system organization, Digestion and absorption of carbohydrates, Lipids and Proteins.

UNIT IV: EXCRETORY SYSTEM

Kidney structure and function. Structure of nephron and urine composition and formation. Renal regulation of acid – base balance.

UNIT V: NERVOUS AND MUSCULOSKELETAL SYSTEM

Neuron structure and impulse transmission. Synapse and reflexes. Neurotransmitters. Types of muscles, Mechanism of Muscle contraction. Bone structure and calcium metabolism

UNIT VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Clinical correlations: diabetes, hypertension. Emerging infectious diseases : Nipah, Zika virus infections. Covid 19, Parkinson’s disease – Causes, diagnosis and recent treatment developments.

TEXTBOOKS

1. Hall, J.E. (2025). *Guyton and Hall Textbook of Medical Physiology*, 15th Edition. Elsevier.
2. Koeppen, B.M., Stanton, B.A. (2024). *Berne and Levy Physiology,* 8th Edition. Elsevier.
3. Barrett, K.E. (2023). *Ganong's Review of Medical Physiology,* 26th Edition. McGraw Hill.
4. Khurana, I. (2024). *Textbook of Medical Physiology*, 4th Edition. Elsevier India.
5. Fox, S.I. (2025). *Human Physiology*, Latest Edition. McGraw Hill.

REFERENCE BOOKS

1. Pal, G.K. (2022). *Comprehensive Textbook of Medical Physiology*. Jaypee Brothers.
2. Jain, A.K. (2021). *Textbook of Physiology*. Avichal Publishing.
3. Sembulingam, K. (2022). *Essentials of Medical Physiology.*Jaypee Brothers.
4. Best & Taylor (2021). *Physiological Basis of Medical Practice*. Wolters Kluwe

WEB RESOURCES

1. National Center for Biotechnology Information (NCBI) (2023–2025) – https://www.ncbi.nlm.nih.gov
2. PubMed Database (2023–2025) – https://pubmed.ncbi.nlm.nih.gov
3. Khan Academy Medicine (2023) – https://www.khanacademy.org
4. NPTEL Physiology Courses (2024) – https://nptel.ac.in
5. OpenStax Human Physiology (2023) – https://openstax.org

Course Outcomes (COs)
Upon successful completion of this course the students would be able to:

CO1: Recall the structure, functions, and physiological principles governing sensory organs, blood, cardiovascular, respiratory, digestive, excretory, nervous, and musculoskeletal systems.
CO2: Explain the mechanisms involved in sensory perception, circulation, respiration, digestion, excretion, neural communication, muscle contraction, and maintenance of physiological homeostasis.

CO3: Apply physiological principles to interpret normal functioning and basic physiological measurements related to sensory, cardiovascular, respiratory, digestive, renal, nervous, and musculoskeletal systems.

CO4: Analyze the interrelationship among organ systems and evaluate physiological responses involved in oxygen transport, nutrient absorption, acid–base balance, neural transmission, and locomotion.

CO5: Evaluate and formulate scientific explanations for physiological disorders and homeostatic imbalances by integrating knowledge of sensory, cardiovascular, respiratory, digestive, renal, nervous, and musculoskeletal functions.

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	1	1	2	1	1	1	–	1
CO2	2	3	2	2	2	1	1	2	–	1
CO3	2	3	2	3	3	2	2	3	1	2
CO4	2	3	3	3	3	2	2	3	2	2
CO5	3	3	3	3	3	2	3	3	3	3

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: III **CORE COURSE 6** **Semester: V**

INTERMEDIARY METABOLISM

Code: **(Theory)** **Credit: 4**

Course Objectives

- To understand the biochemical metabolic pathways of carbohydrates and their energetics.
- To enhance the knowledge about the key biochemical pathways in amino acids metabolism and their regulations.
- To attain and update the knowledge about Lipid metabolism.
- To study the importances of purine and pyrimidine metabolism.
- To acquire the concept of anabolism, catabolism and role of high energy compounds in the cell.

Unit I: Carbohydrate Metabolism

Glycolysis – aerobic and anaerobic glycolysis, Regulatory enzymes of glycolysis, energetics of glycolysis, Gluconeogenesis, Glycogenesis and Glycogenolysis, Hexose Monophosphate pathway and its biological significance.

Unit II: Amino Acid Metabolism

Biosynthesis and degradation of essential amino acids, Biosynthesis and degradation of non-essential amino acids, Glucogenic and ketogenic amino acids metabolism, Urea cycle and its regulation, energetics of urea cycle, Transamination, Oxidative Deamination, Decarboxylation.

Unit III: Lipid Metabolism

Biosynthesis of fatty acids, oxidation of fatty acids (alpha and beta), Biosynthesis of TAG, Phospholipids, Prostaglandins, Biosynthesis of cholesterol, Degradation of Cholesterol, Ketone bodies synthesis, Metabolism of lipoproteins.

Unit IV: Metabolism of Nucleic acids

Biosynthesis of Purines - Adenine and Guanine (de novo and salvage pathways) Catabolism of Purines, Biosynthesis of Pyrimidines - Cytosine, Thymine and Uracil, Catabolism of Pyrimidines, Porphyrin metabolism.

Unit V: Bioenergetics

High-energy Phosphate Compounds, ATP, GTP, CTP and UTP, Structure of ATP, ATP synthetases, Electron Transport Chain, Chemiosmotic theory, TCA cycle, oxidation of Pyruvate, Pyruvate dehydrogenase enzyme complex, biological oxidation, oxidative Phosphorylation, uncouplers and ionophores.

Unit VI: Current contours – (Self-directed learning activities for Continuous Internal Assessments Only):

Biosynthesis of Steroid hormones, sphingolipids, and cerebrosides, Biosynthesis of Epinephrine, Norepinephrine, dopamine, melanin.

Recommended Books:

1. Principles of Biochemistry – 7th edition, Lehninger, Nelson & Cox, Macmillan worth Publishers, (2013).
2. Stryer, "Biochemistry", 5th edition, Freeman, (2002).
3. Murray et al., "Harper's Biochemistry", 29th edition, Mc. GrawHill, (2012).
4. Primer for the Exercise and Nutrition Sciences: Thermodynamics, Bioenergetics,Metabolism, Christopher B. Scott. (2010).
5. Bioenergetics (Biochemistry Research Trends), Jeffrey W. Berkin, (2011).
6. Bioenergetics: Energy Conservation and Conversion (Results and Problems in Cell Differentiation), Günter Schäfer, (2008).
7. Donald Voet, J.G. Voet, John Wiley," Biochemistry", 4th edition, 2006.
8. Davidson &Sittman, "Biochemistry NM., 3rd edition", Lippincott. Willams and Wilkins, (2005).
9. Champe P.C and Richard A Harvey, Lippincotts Biochemistry, Williams & Wilkins Publishers, (2004).
10. https://www.kobo.com/us/en/ebook/metabolic-regulation

Course Outcomes (COs)

Upon successful completion of this course the students would be able to:

CO1: The student will be able to recognize the energetics, regulation of carbohydrate metabolism and explain metabolic pathways of carbohydrates.
CO2: The student will able to review and appreciate the pathways (metabolic and regulatory) of aminoacids.
CO3: The student will be able to identify and understand the metabolic fate of lipid molecules.
CO4: The student will able to review and appreciate the pathways (metabolic and regulatory) of nucleotides and nucleic acid.
CO5: The student will be able to recall and understand free energy relationships/interaction of biochemical metabolism and will be able to understand energy balance/change

Mapping with Program Outcomes:

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10
CO 1	3	2	3	2	1	2	3	3	2	3
CO 2	2	-	3	3	2	1	3	3	2	2
CO 3	3	3	3	3	2	3	3	3	2	2
CO 4	2	-	2	2	3	1	3	3	3	3
CO 5	2	3	3	1	1	3	3	1	3	3

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: III	CORE COURSE 7 MOLECULAR BIOLOGY	Semester: V
Code:	(Theory)	Credit: 4

COURSE OBJECTIVES:

- To enable students to understand the structure, organization and functional dynamics of nucleic acids (DNA/RNA) and their role in genetic information flow.
- To develop competence in comprehending molecular mechanisms of DNA replication, transcription, translation and gene regulation in prokaryotes and eukaryotes.
- To equip learners with knowledge of recombinant DNA technology, molecular cloning techniques and their applications in biotechnology and medicine.
- To foster analytical skills in interpreting molecular biology experimental data, including PCR, sequencing, blotting techniques and bioinformatics tools.
- To cultivate awareness of ethical, societal and emerging implications of molecular biology research including CRISPR, gene therapy and personalized medicine

UNIT I: Molecular Basis of Genetic Information

Chemical nature of DNA and RNA: Structure, conformations (A, B, Z-DNA), denaturation/renaturation, hyperchromicity, Genome organization: Prokaryotic vs. eukaryotic genomes, C-value paradox, repetitive DNA, chromatin structure, nucleosomes, histone modifications, DNA topology: Supercoiling, topoisomerases, DNA packaging in chromosomes, RNA types and functions: mRNA, tRNA, rRNA, snRNA, miRNA, siRNA, lncRNA.

UNIT II: DNA Replication, Repair & Recombination

Mechanism of DNA replication: Semi-conservative model, replication fork, leading/lagging strand synthesis, Replication machinery: DNA polymerases (I, II, III), primase, helicase, SSB proteins, ligase, sliding clamp, Replication in prokaryotes (E. coli) vs. eukaryotes: Origins, licensing factors, telomeres, telomerase, DNA damage and repair pathways: Direct reversal, BER, NER, MMR, SOS response, Homologous and site-specific recombination: RecA, Holliday junction, transposons, CRISPR-Cas systems.

UNIT III: Transcription & RNA Processing

Transcription fundamentals: RNA polymerases (bacterial & eukaryotic), promoter elements, transcription factors, Transcription cycle: Initiation, elongation, termination; rho-dependent/independent termination, post-transcriptional modifications: 5' capping, 3' polyadenylation, splicing (spliceosome mechanism), RNA editing, Regulation of gene expression: Operon model (lac, trp), enhancers, silencers, epigenetic regulation (DNA methylation, histone acetylation).

UNIT IV: Translation & Protein Targeting

Genetic code: Properties, wobble hypothesis, codon usage bias, Translation machinery: Ribosome structure (70S/80S), tRNA charging, initiation/elongation/termination factors, Mechanism of protein synthesis: Initiation complex formation, peptide bond formation, translocation, energy requirements, Post-translational modifications: Folding (chaperones), cleavage, glycosylation, phosphorylation, Protein targeting: Signal hypothesis, ER/Golgi trafficking, nuclear localization signals, mitochondrial import.

Unit V: Regulation of Gene Expression & Molecular Techniques

Prokaryotic Regulation: Operon concept; Inducible (Lac operon) and Repressible (Trp operon) systems.Eukaryotic Regulation: Levels of control (Epigenetic, transcriptional, and translational); RNA interference (siRNA and miRNA).Introduction to Molecular Techniques: Principle of PCR; Gel electrophoresis; Basic DNA cloning workflow.

UNIT VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

De Novo Molecular Design, Spatial Transcriptomics and Proteomics, CRISPR, Multi-Omics Integration, Cellular Digital Twins, Xenobiology, Cell-Free Protein Synthesis (CFPS).

Textbooks:

1. Watson, J.D., Baker, T.A., Bell, S.P., et al. (2024). Molecular Biology of the Gene (8th ed.). Affiliated East-West Press. ISBN: 9788176711340
2. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. (2023 reprint). Lewin's GENES XII. Jones & Bartlett Learning. ISBN: 9781284104493
3. Allison, L.A. (2021). Fundamental Molecular Biology (3rd ed.). Wiley-Blackwell. ISBN: 9781119538541
4. Elliott, W.H. & Elliott, D.C. (2022). Biochemistry and Molecular Biology (7th ed.). Oxford University Press. ISBN: 9780198834748
5. Lieberman, M.A. &Schoch, E.C. (2025). BRS Biochemistry, Molecular Biology, and Genetics (8th ed.). Wolters Kluwer. ISBN: 9781975219871

Reference Books:

1. Alberts, B., et al. (2022). Molecular Biology of the Cell (7th ed.). Garland Science.
2. Lodish, H., et al. (2021). Molecular Cell Biology (9th ed.). W.H. Freeman.
3. Weaver, R.F. (2020). Molecular Biology (6th ed.). McGraw-Hill Education
4. Das, L. (2023). Basic Techniques in Biochemistry and Molecular Biology. Springer.
5. Katoch, R. (2022). Analytical Techniques in Biochemistry and Molecular Biology. Springer biochemistry.uok.edu.in.
6. Pecorino, L. (2026). Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics, (6th ed.). Oxford University Press.

E-Sources & Digital Learning Resources

1. Biochemistry Free For All – Open textbook aligned with ASBMB foundational concepts open.oregonstate.education
2. OpenStax Biology 2e – Comprehensive molecular biology chapters with interactive contentlibguides.niu.edu
3. NCBI Bookshelf – Free access to Molecular Biology of the Cell excerpts and tutorialsguides.library.manoa.hawaii.edu
4. LibreTexts Biology – Peer-reviewed molecular biology modules with animations.

Course Outcomes (COs):

Upon successful completion of the course the students would be able to:

CO1: Explain the molecular architecture of nucleic acids and correlate structural features with biological function

CO2: Analyze and illustrate the molecular mechanisms of replication, transcription and translation with regulatory checkpoints

CO3: Design basic experimental protocols using recombinant DNA techniques for gene cloning and expression

CO4: Interpret molecular biology data from techniques like PCR, electrophoresis and sequencing to draw evidence-based conclusions

CO5: Critically assess ethical dimensions and societal impacts of molecular biology advances in healthcare and agriculture

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	2	2	3	3	3	3	3	2	2
CO2	1	3	3	3	3	3	3	2	2	1
CO3	1	3	3	3	3	3	3	3	3	3
CO4	1	3	3	3	3	3	3	3	3	3
CO5	1	3	3	3	3	3	3	3	3	3

Correlation level: 1 – Low 2 – Moderate 3 – High

III Year **CORE COURSE 8** **Semester V**

CLINICAL BIOCHEMISTRY

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES

- To introduce students to various clinical specimens and body fluids, along with proper collection, handling and storage techniques.
- To develop basic understanding of clinical laboratory organization, safety practices.
- To provide foundational knowledge of liver and kidney functions, their disorders and basic diagnostic tests.
- To familiarize students with protein metabolism disorders, amino acid disorders and nucleic acid-related conditions.
- To introduce concepts of lipid metabolism, dyslipidemia and cardiovascular risk factors with clinical relevance.

UNIT I: Clinical Specimens, Body Fluids and Basic Laboratory Concepts

Types of clinical specimens – blood, serum, plasma, urine, feces, CSF, amniotic fluid, tissues and cells. Basic principles of blood and urine collection and handling. Introduction to clinical laboratory – safety, common instruments and basic quality concepts (accuracy, precision). Body fluid homeostasis – water and electrolyte balance.Blood disorders – Anemias, thalassemia and Haemophilias.Porphyrias and Porphyrinurias.

UNIT II: Liver and Kidney Disorders

Bilirubin metabolism and types of jaundice – hemolytic, hepatic, obstructive. Liver diseases – hepatitis, cirrhosis, fatty liver. Liver function tests. Renal disorders – nephritis, renal failure, kidney stones. Renal function tests – urea, creatinine. Urinalysis – normal and abnormal constituents.

UNIT III: Carbohydrate Metabolism and Diabetes

Normal blood glucose levels and regulation. Hyperglycemia, hypoglycemia, glycosuria, renal threshold. Diabetes mellitus – types, causes, symptoms, complications. Diagnosis – glucose tolerance test (GTT), introduction to HbA1c. Basic management principles. Inherited disorders – glycogen storage diseases, galactosemia, fructosuria.

UNIT IV: Protein and Nucleic Acid Metabolism Disorders

Plasma proteins and their variations in disease. Nitrogen balance and proteinuria.Basic concept of multiple myeloma. Amino acid disorders – phenylketonuria, alkaptonuria, albinism, tyrosinemia. Simple overview of nucleic acid disorders – gout and hyperuricemia.

UNIT V: Lipid Metabolism and Cardiovascular Disorders

Plasma lipids – cholesterol, triglycerides, lipoproteins. Dyslipidemia – hyperlipidemia and hypolipoproteinemia. Fatty liver and obesity. Atherosclerosis – risk factors and pathogenesis.
.
Introduction to lipid profile and basic cardiovascular risk markers.

UNITVI: Current Contours (Self-directed learning activities for Continuous Internal Assessments Only):

Recent developments in diabetes and cardiovascular diseases – Diagnosis and treatment. Student seminars and case discussions.

REFERENCES:

Text Books

1. MN Chatterjea, Ranashinde – (2012). Textbook of Medical Biochemistry, 8th edition, JAYPEE Brothers Medical Publisher(P) Ltd, NewDelhi.
2. DM. Vasudevan, Sreekumari S, Kannan Vaidyanathan - Textbook of Medical Biochemistry for medical students, 11th edition, (2026), JAYPEE BROTHERS
3. Indumati V, Sowbhagya Lakshmi – (2021). Integrated Textbook of Biochemistry, Paras Medical Publisher, New Delhi.

Reference Books

1. Thomas M Devlin- (2022). Textbook of Biochemistry with Clinical Correlations (7^{th}ed), Wiley Publications.
2. Murray RK, Granner DK, Rodwell VW and Mayes PA (2000) Harper's Biochemistry, 25thEidtion, Applaton and Lange Publications, California, USA.
3. Nelson DL and Cox MM (2001) Lehninger Principles of Biochemistry, 3rd Edition, MacMillon Worth Publishers, New Delhi.
4. Rawn JD (1990) Biochemistry, 2nd Edition, Harpers and Row Publications, New York.
5. Voet D and Voet JG (2001) Biochemistry, 3rd Edition, John Wiley & Sons, New York.
6. Zubey G (1998) Biochemistry, 4th Edition, WMC Brown Publishers, USA.

7. https://iembase.org/iem-resources.asp
8. https://www.ncbi.nlm.nih.gov/books/NBK560891/

Course outcome (COs):

Upon successful completion of the course the students will be able to:
CO1: Recall the principles of clinical specimen handling, body fluid homeostasis, laboratory concepts and the biochemical basis of disorders related to blood, liver, kidney, carbohydrate, protein, nucleic acid and lipid metabolism.

CO2: Explain the biochemical mechanisms, clinical manifestations, diagnostic markers and laboratory investigations associated with hematological, hepatic, renal, metabolic, genetic and cardiovascular disorders.

CO3: Apply biochemical knowledge and laboratory parameters to interpret clinical findings related to body fluids, liver and kidney function, diabetes mellitus, amino acid disorders, dyslipidemia and cardiovascular risk assessment.

CO4: Analyze biochemical alterations and diagnostic data to differentiate disorders of blood, liver, kidney, carbohydrate metabolism, protein and nucleic acid metabolism and lipid metabolism.

CO5: Evaluate and create appropriate biochemical interpretations and diagnostic approaches for metabolic, hematological, hepatic, renal, genetic and cardiovascular disorders using clinical and laboratory evidence.

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	1	1	2	1	1	1	-	1
CO2	2	3	2	2	2	1	1	2	-	1
CO3	2	3	2	3	3	2	2	3	1	2
CO4	2	3	3	3	3	2	2	3	2	2
CO5	3	3	3	3	3	2	3	3	3	3

Correlation level: 1 – Low 2 – Moderate 3 – High

III Year **CORE PRACTICAL 5** **Semester V**

MOLECULAR AND CLINICAL BIOCHEMISTRY

Code: **(Practical)** **Credit: 4**

COURSE OBJECTIVES

- To impart fundamental knowledge on collection, handling and preservation of clinical specimens.
- To train students in routine hematological investigations and their clinical interpretation.
- To develop practical skills in biochemical analysis of blood and urine.
- To understand the principles and applications of diagnostic enzymatic and colorimetric assays.
- To develop analytical, observational and reporting skills in a clinical laboratory setup.

Experiments:

1. Collection and preservation of blood (anticoagulants: EDTA, heparin, citrate).
2. Collection and preservation of urine samples (random, early morning, 24-hour collection).
3. ABO blood grouping and Rh typing.
4. Determination of RBC count, WBC Count, Differential WBC count.
5. Estimation of hemoglobin by Sahli's and cyanmethemoglobin methods.
6. Determination of Erythrocyte Sedimentation Rate (ESR) – Westergren method.
7. Packed Cell Volume (PCV) determination (microhematocrit method).
8. Biochemical Analysis of Blood (glucose, protein, cholesterol, urea, uric acid, creatinine, bilirubin, liver enzymes)
9. Urine Analysis(colour, odor, pH, specific gravity, qualitative and quantitative analysis of urine constituents).
10. Isolation of DNA from blood/tissue samples.
11. Quantitative estimation of DNA (diphenylamine method).
12. Estimation of RNA (orcinol method).
13. Introduction to electrophoresis (demonstration).

Textbooks

1. Jayaraman J. laboratory manual in Biochemistry, 3rded, New Age International Pvt Ltd Publishers, New Delhi, 2011.
2. Sadasivam S, Manickam A, Biochemical Methods, 3rded, New Age International Pvt Ltd Publishers, New Delhi,2009.
3. Sawhney SK, Randhir Singh. Introductory Practical Biochemistry, Narosa Publishing House, New Delhi, 2014.
4. Maneemegalai S. Biochemistry - A Practical handbook, Ryan Publishers, Tamilnadu, India, 2024.

5. Murphy MJ, Srivastava R, Deans KA. Clinical biochemistry: An illustrated colour text. 7th ed. Elsevier; 2024.
6. Marshall WJ, Lapsley M, Day AP, Shipman K. Clinical chemistry. 10th ed. Elsevier; 2025.

Reference Books

1. Gowenlock AH. Varley's practical clinical biochemistry. 6th ed. CBS Publishers; 2022.
2. Burtis CA, Ashwood ER, Bruns DE. Tietz fundamentals of clinical chemistry. 6th ed. Saunders/Elsevier; 2008.
3. Varley H. Practical clinical biochemistry. 6th ed. Heinemann Medical Books; 1988.
4. Marshall WJ, Lapsley M, Day AP, Ayling RM. Clinical biochemistry: Metabolic and clinical aspects. 3rd ed. Churchill Livingstone Elsevier; 2014.
5. Godkar PB, Godkar DP. Textbook of medical laboratory technology. 3rd ed. Bhalani Publishing House; 2020.

COURSE OUTCOMES

Upon completion of the course, students would be able to:

CO1: Recall the principles, reagents, instruments, specimen handling procedures, hematological tests, biochemical assays, urine analysis methods, blood grouping techniques and molecular biology procedures used in clinical laboratories.

CO2: Explain the scientific basis, methodology, clinical significance and applications of clinical specimen processing, hematological investigations, biochemical estimations, urine analysis, immunohematological techniques and nucleic acid analysis.

CO3: Apply standard laboratory protocols to perform specimen collection and preservation, hematological tests, biochemical estimations, urine examinations, blood grouping, DNA isolation and nucleic acid quantification using appropriate laboratory practices.

CO4: Analyze laboratory results obtained from hematological, biochemical, urinary and molecular investigations to identify normal and abnormal physiological conditions and assess the reliability of experimental data.

CO5: Evaluate and design appropriate diagnostic and experimental approaches by integrating clinical laboratory findings, hematological parameters, biochemical markers, urine analysis results, blood typing data and molecular techniques for problem-solving and research applications.

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	1	1	2	1	2	1	–	1
CO2	2	3	2	2	2	1	2	2	–	1
CO3	2	3	2	3	3	2	3	3	2	2
CO4	2	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	3	2	3	3	3	3

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: III | **SKILL ENHANCEMENT COURSE 4 BIOMEDICAL INSTRUMENTATION (Theory)** | **Semester V**

Code: | **Credit: 2**

COURSE OBJECTIVES:

- Provide fundamental knowledge of human anatomy, physiology and bioelectric phenomena relevant to biomedical instrumentation.
- Introduce the principles, construction and working of basic biomedical instruments and laboratory equipment used in healthcare and research.
- Develop understanding of physiological signal acquisition, measurement techniques, and interpretation of diagnostic data such as ECG, EEG, EMG and blood pressure.
- Enable students to acquire practical skills in handling biomedical devices and measuring physiological parameters.
- Expose students to recent advances in biomedical engineering, including applications of nanotechnology and notable scientific contributions.

UNIT I: INTRODUCTION TO PHYSIOLOGY AND ANATOMY:

Physiological system of the body – Anatomy and physiology of respiratory system-Cardio vascular system-Endocrine system-Central nervous system. Bio-Electric phenomenon: Basic Bio potentials-Bio electricity – Resting and action potentials-Sodium pump generation-Characteristics of electric signals from heart, brain and muscle.

UNIT II: BASIC INSTRUMENTS AND ELECTRODES:

Principles and applications of Autoclave – Hot air oven – Incubator, Laminar air flow chamber / Biosafety cabinets, BOD Incubator, Lyophilizer. Electrodes- Types: Surface electrodes and Needle electrodes - Made of Ag/AgCl (Silver/Silver Chloride).

UNIT III: DIAGNOSING INSTRUMENTS:

Cardiovascular System and Measurements: ECG, blood pressure and its measurement, respiration and pulse rate, characteristics and measurement of blood flow meter, cardiac output, plethysmography, pacemaker, defibrillators, heart sounds and its measurement, test and instrument for the mechanics of breathing, the somatic nervous system, EEG, EMG and GSR. Measurement and Recording of Non-invasive Diagnostic Instrumentation.

UNIT IV: PATIENT CARE AND ELECTRICAL SAFETY:

Principle of ultrasonic measurement, ultrasonic, thermography, elements of intensive care monitoring, X-ray, CT – Scan and MRI, tonometer, dialysis, diathermy, Shock hazards from electrical equipment.

UNIT V: LABORATORY WORK:

Study the variance in pulse rate of subject in a batch, use Spirometer on the subject, auditory system check-up using Audiometer, Measurement of Heart Rate using Stethoscope, Blood pressure using Sphygmomanometer, Pulse Rate and SpO2 using Pulse Oximeter, Skin

Conductance and Skin Potential using Galvanic Skin Response Module, Pulse Rate using Polyrite machine. Respiration Rate using Polyrite. Electromyogram test using EMG biofeedback Trainer.

UNIT VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Biomedical instrumentation; applications of nanotechnology in medical devices; recent innovations in biomedical engineering.

TEXT/ REFERENCE BOOKS:

1. Medicine and Clinical engineering – B. Jacobson and J.G. Webster – Prentice Hall of India ,Prentice-Hall, Englewood Cliffs, New Jersey, USA, 1977.
2. Biomedical Instrumentation - Arumugam, Anuratha Agencies Publishers, II Edn, 1994.
3. Principles of Electronics & Medical research – D.W. Hill –Butterworths – London – 1965.
4. Principles of Instrumental Analysis - W. B. Saunders Co., Philadelphia, USA. Skoog, A. and West, M. (1980).
5. Medical Instrumentation: Application and Design John G. Webster 4th Edition JohnWiley&Sons, 2009.
6. Guyton and Hall, Text Book of Medical Physiology, John E Hall, 13 th edition, Elsevier , 2015.

E – SOURCES:

1. https://books.google.com/books/about/Medicine_and_Clinical_Engineering.html?id=LmxrAAAAMAAJ
2. https://www.ncbi.nlm.nih.gov/nlmcatalog/7700942
3. https://www.freeengineeringbooks.com/BioMedical/BioMedical-Instrumentation.php
4. https://wizape.com/English/Biomedical-Sensors-and-Instrumentation
5. https://www.ktuqbank.com/2023/10/biomedical-instrumentation-eet312-study_43.html

COURSE OUTCOMES (COs):

On the successful completion of the course, the students will be able to:

CO1: Exhibit a knowledge base in basic anatomy and physiology of major human systems.
CO2: Understand and apply the working principles of basic laboratory instruments.
CO3: Analyse and interpret signals from diagnostic instruments such as ECG, EEG, EMG, blood pressure
CO4: Evaluate the functioning of patient care equipment and imaging techniques.

CO5: Demonstrate competency in handling, calibration, and quality assurance of biomedical equipment

Mapping with Programme Outcomes

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	2	2	1	1	-	-	-	-	1
CO2	3	2	2	2	3	-	1	-	-	1
CO3	3	3	3	2	3	-	1	-	1	1
CO4	3	2	2	2	2	1	3	-	1	1
CO5	3	3	2	3	3	1	2	2	2	2

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: III | **CORE COURSE 9 ENDOCRINOLOGY (Theory)** | **Semester: VI**

Code: | **Credits: 4**

COURSE OBJECTIVES:

- To understand how hormones are synthesized, how they travel through the blood, and the molecular mechanisms by which they "talk" to target cells via receptors.
- To analyze the Hypothalamic-Pituitary-Target Organ Axis, focusing on how feedback loops maintain the body's internal balance.
- To explore the biochemical basis of endocrine disorders like Diabetes, PCOS, and Thyroid imbalances.
- To detail the hormonal control of human life cycles, from puberty and the menstrual cycle to pregnancy and menopause.
- To evaluate the integration and coordination of endocrine signaling with metabolic, reproductive, and physiological processes in maintaining homeostasis.

UNIT I: Fundamentals of Endocrinology and Pituitary Hormones

Hormones – Classification, Biosynthesis, circulation in blood, modification and degradation. Mechanism of hormone action. Hormones of Hypothalamus and pituitary hormones – Hypothalamic releasing factors, synthesis, secretion and biological role. Anterior pituitary hormones – Physiological actions and feedback regulation of synthesis. Growth promoting, Lactogenic hormones. Glycoprotein hormones, the POMC family, Endorphins – Biological functions Posterior Pituitary hormones – Synthesis, secretion and physiological action of Vasopressin and oxytocin Hypothalamus Pituitary- Target organ axis and feedback regulation.

UNIT II: Pancreatic, Gastrointestinal and Pineal Hormones

Pancreatic hormones – cell types of the islets of Langerhans. Insulin – structure, Biosynthesis, regulation of secretion, Biological actions and mechanism of action. Glucagon, somatostatin and pancreatic polypeptide. Insulin like growth factors – structure, biological action. Gastrointestinal hormones – secretin, gastrin, cholecystokinin – biological action, regulation of secretion. Pineal gland.

UNIT III: Thyroid and Parathyroid Hormones in Metabolic Regulation

Biosynthesis, secretion, transport, biological action, metabolic fate of thyroid hormones. Role of thyroid hormones in metabolism, basal metabolic rate and functions of other organs. Biosynthesis, secretion, transport, biological action, metabolic fate of thyroid and parathyroid hormones. Role of parathyroid hormones in maintenance of calcium and phosphorus metabolism.

UNIT IV: Adrenal Hormones, Catecholamines and Prostaglandins

Adrenal hormones – Glucocorticoids, mineralocorticoids, synthesis, secretion, transport, metabolism and excretion. Biological effects. Mechanisms of action, adrenal androgens, metabolic effects and functions. Adrenal medulla – Catecholamines, biosynthesis, storage, metabolism, regulation of synthesis and biological effects. Chemical nature and biological action of prostaglandins.

UNIT V: Reproductive Endocrinology and Hormonal Regulation of Reproduction

Gonadal Hormones – Chemical Nature and Biosynthesis. Physiological action of hormone in the regulation of spermatogenesis and oogenesis. Ovarian cycle. Menarche and Menopause. Role of hormones in implantation, gestation, parturition and lactation, Biochemical changes in pregnancy. Polycystic ovarian syndrome and Endometriosis. Contraception – Male and Female contraceptive methods, Types- Barrier methods (IUDs), hormonal contraceptives and surgical methods. Infertility and treatment modalities.

UNIT – VI Current contours (Self-directed learning activities for Continuous Internal Assessments Only):

Recent techniques for assessing hormones in blood. Drugs for hypo and hyper secretion disorders.

Recommended Books

1. Williams Textbook of Endocrinology (15th Ed., 2024): The definitive global reference for clinical and experimental endocrinology (Melmed et al., 2024).
2. Hadley's Endocrinology (8th Ed., 2025): Excellent for understanding the molecular and cellular mechanisms of hormone action.
3. Guyton and Hall Textbook of Medical Physiology (15th Ed., 2026): Contains updated chapters on endocrine physiology and metabolic regulation.
4. Endocrine Society (Endo-Education): Provides the latest clinical guidelines and interactive modules for students (Endocrine Society, 2026).
5. UpToDate / Medscape: Essential for clinical applications, specifically for Units IV and V regarding PCOS and Adrenal disorders.
6. Journal of Clinical Endocrinology & Metabolism (JCEM): For the most recent research papers on hormone biosynthesis and degradation.
7. Ramamurthy and Durgadevi. Endocrinology, Akini publication New delhi, 2020
8. Murray et al., Harper’s Biochemistry –. 26th ed. McGraw Hill, 2003.
9. Endocrine Society. (2026). Endocrine library and patient resources. https://www.endocrine.org/patient-engagement
10. Melmed, S., Auchus, R. J., Goldfine, A. B., Koenig, R. J., & Rosen, C. J. (2024). Williams textbook of endocrinology (15th ed.). Elsevier.

11. National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). (2026). The endocrine system and its hormones. https://www.niddk.nih.gov/health-information/endocrine-diseases

Course Outcomes (COs):

Upon successful completion of the course the students would be able to

CO1: Explain the complex hormonal interplay required for successful gestation and lactation.

CO2: Predict the physiological consequences of hormonal hypersecretion or hyposecretion across glands, tissues, and cells.

CO3: Evaluate different contraceptive methods and fertility treatments based on their hormonal mechanisms.

CO4: Differentiate between various chemical classes of hormones (Peptides vs. Steroids) and their distinct signaling pathways.

CO5: Integrate knowledge of multiple endocrine glands to explain how the body responds to complex stimuli like starvation, stress, or dehydration.

Mapping with Programme Outcomes

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	3	3	3	2	3	1	3	2	3
CO 2	3	3	3	3	2	3	1	3	2	3
CO 3	3	3	3	3	2	3	2	3	2	3
CO 4	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3

Correlation level: 1 – Low 2 – Moderate 3 – High

III Year | **CORE COURSE 10** | **Semester VI**

BIOTECHNOLOGY AND PLANT BIOCHEMISTRY

Code: | **(Theory)** | **Credit: 4**

Course Objectives

- To understand the technological aspect applied in biological science.
- To learn the tools and various methods used in biotechnology.
- To acquire knowledge in the field of plant biochemistry.
- To understand the principles and applications of molecular biology, genetic engineering, and recombinant DNA technology in biotechnology.
- To develop skills in the application of biotechnological techniques for agriculture, healthcare, environmental management, and industrial processes.

Unit I: Fermentation Biotechnology

Fermentation Biotechnology –Biotechnology – scope and importance, Basic principles of microbial growth, Bioreactor- batch and continuous bioreactor, fermentation culture medium, downstream processing. Fermentation production of penicillin and vitamin B12.

Unit II: Molecular Biotechnology

Molecular Biotechnology - Basic principles of cloning, Introduction of foreign DNA in to host by particle bombardment gun, electroporation and microinjection. Basic Polymerase Chain Reaction (PCR), applications, Micro arrays, the human genome project.

Unit III: Environmental Biotechnology

Environmental Biotechnology – Biological fuel generation- ethanol and methane from biomass. Sewage treatment. Bioremediation: oil spill cleanup, bioleaching, IPR, Biosafety andhazards of environmental engineering.

Unit IV: Germination and Plant Breeding

Germination changes in composition and enzyme activities in seed, factors affecting germination. Structure and functions of plant hormones- Auxins, gibberellins and abscisic acid. Plant breeding- principles of plant breeding, important conventional methods of breeding.

Unit V: Photosynthesis

Photosynthesis: Chloroplast structure and function - CO_2 fixation by C3, C4 and CAM plants. Hill's reaction, Photorespiration, Photophosphorylation. Nitrogen metabolism, transport and storage of nitrogen. Trace elements in plant nutrition.

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Emerging Trends in Biotechnology and Plant Sciences – CRISPR-Cas genome editing, synthetic biology, AI and bioinformatics in biotechnology, development of biofertilizers and biopesticides, climate-resilient crop improvement, precision agriculture, and sustainable biotechnological approaches for food security and environmental conservation.

References

1. Molecular Biotechnology: Principles and Applications of Recombinant DNA- B.R. Glick & J.J. Pasteniak, ASM Press, Washington, D.C., 2010
2. Gene cloning and DNA analysis: an introduction / T.A. Brown. 6th ed. Brown, T.A. (Terence A.) Wiley-Blackwell. 2010.
3. Elements of Biotechnology- P. K. Gupta, Rastogi Publications, 2nd edition 3rd reprint, 2015-2016.
4. A text book of Biotechnology- R. C .Dubey, S. Chand Publications, 2014
5. Industrial Microbiology- A. H. Patel, Macmillan, India Ltd, 2012
6. Frank B. Salisbury Clean W. Ross, 2004, Plant Physiology, 4thedition, Thomson Wordsworth.
7. Arvind Kumar S.S Purohit, 2005, Plant Physiology Fundamental and
8. Applications, 2nd edition, Agrobios.
9. Michael J. Pelczar et. al. 2004, Microbiology, 5th edition, Tata Mc-Graw Hill.

Course Outcomes (COs):

At the end of the course, the student will be able to:

CO1: Explain the principles of fermentation biotechnology, microbial growth, bioreactor operations, downstream processing, and industrial production of antibiotics and vitamins.

CO2: Describe molecular biotechnology techniques including gene cloning, DNAtransfer methods, PCR, microarrays, and applications of the Human Genome Project.]

CO3: Analyze the role of biotechnology in environmental management throughbiofuel production, sewage treatment, bioremediation, bioleaching, biosafetyand IPR.

CO4: Explain seed germination processes, plant hormone functions, andconventional plant breeding methods for crop improvement.

CO5: Interpret the mechanisms of photosynthesis, carbon fixation pathways, nitrogen metabolism, and the importance of mineral nutrients in plant growth.

Mapping with Programme Outcomes

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	1	1	1	1
CO2	3	3	2	2	3	1	1	1	1	1
CO3	3	3	2	2	2	3	3	2	1	1
CO4	3	2	2	1	2	2	2	1	1	1
CO5	3	3	2	2	2	2	2	1	1	1

Correlation level: 1 – Low 2 – Moderate 3 – High

III Year	CORE COURSE 11 IMMUNOLOGY	Semester VI
Code:	(Theory)	Credit: 4

Course Objectives

- To understand the fundamental components of the immune system, including cells, organs and tissues.
- To differentiate between innate and adaptive immunity and their mechanisms of action.
- To explore the structure and function of antigens, antibodies and MHC molecules.
- To analyze the mechanisms of immune effector responses, including inflammation and hypersensitivity.
- To introduce modern immunological techniques and their applications in diagnostics and research.

Unit I: Foundations of Immunology

History: Contributions of Edward Jenner, Louis Pasteur and Paul Ehrlich. Immune System Overview: Innate vs. Adaptive immunity (General characteristics and components), Cells of the Immune System:Hematopoiesis, structure and functions of Lymphocytes (T, B, NK cells), Phagocytes (Monocytes, Macrophages, Neutrophils), Mast cells and Dendritic cells, Organs of the Immune System: Primary (Bone marrow, Thymus) and Secondary (Spleen, Lymph nodes, Peyer's patches) lymphoid organs.

Unit II: Antigens and Antibodies

Antigens: Characteristics (Foreignness, Molecular size, Complexity); Epitopes, Haptens and Adjuvants.Antibodies (Immunoglobulins): Structure, types (IgG, IgM, IgA, IgD, IgE), and biological functions.Antigen-Antibody Interactions: Affinity, Avidity and Cross-reactivity; Precipitation and Agglutination reactions, Monoclonal Antibodies: Production (Hybridoma technology) and clinical applications.

Unit III: MHC and Antigen Presentation

Major Histocompatibility Complex (MHC): Organization of MHC genes; Structure and distribution of MHC Class I and Class II molecules, Antigen Processing and Presentation: Endogenous and Exogenous pathways, T-Cell and B-Cell Biology: T-cell receptor (TCR) structure; B-cell receptor (BCR); Maturation, activation and differentiation of T and B cells.The Complement System: Classical, Alternative and Lectin pathways; Biological consequences of complement activation.

Unit IV: Immune Effector Mechanisms

Cytokines: Properties, functional categories and the cytokine storm.Hypersensitivity: Classification (Type I to Type IV) with clinical examples (e.g., Asthma, Rh-incompatibility), Tolerance and Autoimmunity: Mechanisms of self-tolerance; Brief overview of autoimmune

diseases (Rheumatoid Arthritis, SLE), Transplantation Immunology:GvHD (Graft vs. Host Disease) and mechanisms of graft rejection.

Unit V: Applied Immunology and Techniques

Vaccines: Principles of vaccination; Types of vaccines (Live-attenuated, Inactivated, Subunit, DNA, and mRNA vaccines).Immunodeficiencies:Primary (SCID) and Secondary (HIV/AIDS) deficiencies.Immunological Techniques: ELISA (Direct, Indirect, Sandwich), Immunofluorescence and Flow Cytometry, Western Blotting and RIA (Radioimmunoassay).

UNIT VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Bispecific &Multispecific Antibodies, Antibody-Drug Conjugates (ADCs), De novo AI Design of antibodies, CRISPR-Edited Immunotherapies, Single-Cell RNA-seq (scRNA-seq), Spatial Proteomics, Epitope Prediction, Antigen Engineering, Self-Amplifying RNA (saRNA).

TEXTBOOKS

1. Cellular and Molecular Immunology – Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai, 11th edition, Elsevier 2025.
2. Kuby Immunology – Judith A. Owen, Jenni Punt, SharonStranford, 9th edition, Macmillan Learning, 2023.
3. Janeway'sImmunobiology – Kenneth M. Murphy, Casey Weaver, Leslie Berg10th edition, W.W. Norton, 2022 .
4. Immunology – David Male, Victoria Male, R. Stokes Peebles, 10th edition, Elsevier, HealthSciences, 2025.
5. Paul's Fundamental Immunology – Martin Flajnik (Ed.), 8th edition, Wolters Kluwer, 2023.

REFERENCE BOOKS

1. Roitt's Essential Immunology – Ivan M. Roitt, Peter J. Delves, Seamus J. Martin, 14th Ed., Wiley-Blackwell, 2021
2. Basic Immunology: Functions and Disorders of the Immune System – Abul K. Abbas, Andrew H. Lichtman, 7th Ed., Elsevier, 2024
3. libguides.lib.cuhk.edu.hk
4. Immunology: A Short Course – Eli Benjamini, Geoffrey Sunshine, Sidney Leskowitz, 8th Ed., Wiley, 2022
5. Textbook of Microbiology & Immunology – Ananthanarayanan&Panikar, 11th Ed., Elsevier India, 2024
6. Clinical Immunology: Principles and Practice – Robert R. Rich et al., 6th Ed., Elsevier, 2023

E-Resources

1. NCBI Bookshelf:*Immunobiology* (Janeway) - Free Online Access
2. SWAYAM/NPTEL: Online courses on "Immunology" by IIT/IISc faculty.
3. The American Association of Immunologists (AAI): Educational resources and latest research updates.

Course outcomes (COs):

At the end of the course, the student will be able to:

CO1: Explain the principles of innate and adaptive immunity, the structure and function of immune cells, organs, and molecules, and the mechanisms of host defense against pathogens.

CO2: Analyze the molecular and cellular mechanisms underlying antigen recognition, signal transduction, cytokine networks, and the interactions between immune components in health and disease.

CO3: Apply immunological concepts to predict immune responses in infections, vaccination, hypersensitivity reactions, autoimmunity, and transplant rejection.

CO4: Evaluate experimental immunological techniques such as ELISA, flow cytometry, immunoblotting, and immunofluorescence, and design basic immunoassays for research or diagnostic purposes.

CO5: Critically analyze immunological disorders, therapeutic interventions, and vaccine strategies, and propose approaches to modulate immune responses for clinical or biotechnological applications.

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	2	2	2	2	2	2	1	1
CO2	1	3	3	2	2	2	2	2	1	1
CO3	1	3	3	3	3	3	3	3	2	2
CO4	1	3	3	3	3	3	3	3	2	2
CO5	1	3	3	3	3	3	3	3	3	3

Correlation level: 1 – Low 2 – Moderate 3 – High

III Year | **SKILL ENHANCEMENT COURSE 6 HERBS AND PHYTOTHERAPEUTICS (Theory)** | **Semester VI**

Code: | **Credit: 2**

Course Objectives

- To learn about herbal medicine scope, traditional systems, quality control, and GACP.
- To explain phytochemical groups, extraction methods (Soxhlet, TLC, HPLC), and their therapeutic roles.
- To describe five key herbs (turmeric, ashwagandha, ginkgo, echinacea, aloe) and their preparations.
- To understand the principles of standardization, safety evaluation, and regulatory guidelines governing herbal medicines and phytopharmaceuticals.
- To evaluate the therapeutic applications of medicinal plants in the prevention and management of various diseases based on scientific evidence.

Unit I: Fundamentals of Herbs and Phototherapeutics

Definition, scope and history of herbal medicine. Classification of medicinal plants (taxonomic, morphological, therapeutic). Overview of traditional medicine systems: Ayurveda, TCM, Unani, Siddha, African and Indigenous herbalism. Pharmacokinetics and pharmacodynamics of herbal drugs. Quality control parameters: organoleptic, microscopic, physicochemical, and microbial evaluation. Good Agricultural and Collection Practices (GACP) for herbs.

Unit II: Phytoconstituents and Their Therapeutic Roles

Primary vs. secondary metabolites, Detailed study of major phytochemical groups: Alkaloids (e.g., morphine, caffeine, berberine), Glycosides (cardiac glycosides, anthraquinones, saponins), Terpenoids and essential oils, Phenolics, flavonoids, tannins and coumarins. Extraction, isolation, and identification techniques (maceration, percolation, Soxhlet, TLC, HPLC). Correlation of phytoconstituents with pharmacological actions.

Unit III: Common Medicinal Herbs and Clinical Phytotherapy

Monographs of selected herbs: Curcuma longa (Turmeric) – anti-inflammatory, Withaniasomnifera (Ashwagandha) – adaptogen, Ginkgo biloba – cognitive enhancement, Echinacea spp. – immunomodulation,Aloe vera – wound healing, laxative. Herbal preparations: teas, tinctures, extracts, capsules, topical formulations.

Unit IV: Safety, Standardization, and Regulatory Aspects

Herb-drug interactions (mechanisms and clinically relevant examples)- Adverse effects, contraindications, and toxicity of herbs, Standardization: marker-based, bioactivity-linked, and metabolomic fingerprinting. Regulatory frameworks: WHO guidelines on herbal medicines- DSHEA (USA), EMA HMPC (Europe), AYUSH (India), TGA (Australia), Pharmacovigilance of herbal products- Ethical issues in herbal trade, biopiracy, and intellectual property rights (traditional knowledge).

Unit V: Formulation, Quality Assurance, and Marketed Herbal Products

Herbal drug formulation principles: solid, liquid, semisolid, and novel delivery systems- Stability testing of herbal products- Adulteration and contamination issues (heavy metals, pesticides, microbes). Case studies of quality failures (e.g., aristolochic acid nephropathy). Overview of leading herbal brands and nutraceuticals. Pharmacoeconomics and global market trends of herbal medicines.

Unit VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Nanophytotherapeutics: Phytosomes, liposomes, nanoemulsions, solid lipid nanoparticles for enhanced bioavailability.

TEXT BOOKS

1. Evans, William Charles. Trease and Evans' Pharmacognosy, 16th Edition, Saunders Elsevier, London, 2009.
2. Benzie, Iris F. F. and Wachtel-Galor, Sissi (Eds.). Herbal Medicine: Biomolecular and Clinical Aspects, 2nd Edition, CRC Press/Taylor & Francis, Boca Raton, 2011.
3. Capasso, Francesco, Grandolini, Giuliano and Izzo, Angelo A. Phytotherapy: A Quick Reference to Herbal Medicine, Springer-Verlag, Berlin Heidelberg, 2003.
4. Recent Advances in Phytopharmacology (Annual Review Volumes), Studium Press / Research Signpost Publications.

Reference books:

1. WHO monographs on selected medicinal plants
2. Journals: Journal of Ethnopharmacology, Phytomedicine, Phytotherapy Research, Frontiers in Pharmacology – Ethnopharmacology

Web Resources:

1. Phytotherapy: Herbal Medicine Today | PDF | Homeopathy | Dietary Supplements
2. Phytotherapy: Definition, Research& Principles

Course Outcomes

Upon successful completion of this course the students would be able to:

CO1: Recall the history and quality control parameters of Herbs and its Collection Practices.

CO2: Understand about Traditional Medicinal Systems, Secondary metabolites, Medicinal Herbs and its Preparations.

CO3: Apply knowledge about Pharmacokinetics and pharmacodynamics, extraction techniques, Herbal Preparations and Pharmacoeconomics.

CO4: Analyze quality control parameters, Phytoconstituents, medicinal herbs and its Phytotherapy.

CO5: Evaluate and correlate phytoconstituents with pharmacological actions and to determine the efficacy of Herbal preparations.

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	1	1	1	1	1	1	1	2
CO2	2	3	2	2	2	1	1	1	1	1
CO3	1	2	2	2	3	2	2	2	2	2
CO4	1	2	3	3	2	2	2	2	2	2
CO5	2	3	3	3	3	2	3	3	3	3

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: III | **SKILL ENHANCEMENT COURSE BASICS OF BIOINFORMATICS (Theory)** | **Semester: II**

Code: | **Credit: 2**

Course Objectives

- To provide comprehensive knowledge of fundamental concepts in bioinformatics, including biological databases, internet-based bioinformatics resources and computational tools used for biological data analysis.
- To develop analytical skills in biological sequence analysis, including pairwise and multiple sequence alignment, database searching using BLAST and FASTA and phylogenetic interpretation of molecular sequences.
- To enable understanding of genomics, proteomics and biomolecular structure, including genome databases, protein architecture, DNA/RNA structural organisation and their biological significance.
- To train students in the application of protein structure visualisation, classification and analysis tools for structural bioinformatics studies.
- To introduce students to contemporary applications of bioinformatics in drug discovery, systems biology, precision medicine and computational biology research for solving modern biological and healthcare challenges.

UNIT I: Introduction

Definition, scope and history of bioinformatics. Branches and applications of bioinformatics. Role of bioinformatics in genomics, proteomics, transcriptomics and metabolomics. Biological data generation and management. Overview of computational biology and systems biology. Introduction to computer fundamentals in bioinformatics.

UNIT II: Biological Sequence Analysis

Pairwise sequence comparison. Sequence queries against biological databases, such as BLAST and FASTA. Multiple sequence alignments. phylogenetic alignment. Primary, secondary and composite databases. Nucleotide databases: GenBank, EMBL, DDBJ. Protein databases: UniProt, Swiss-Prot, PIR. Structural databases: PDB, SCOP, CATH. Specialised databases: OMIM, KEGG, PubChem. Data mining and biological data integration. Database search and retrieval systems. Sequence submission and annotation basics

UNIT III: Genome Sequences

Genomics and next-generation sequencing (NGS). Functional genomics and transcriptomics. Proteomics and metabolomics overview. Bioinformatics in precision medicine. AI and machine learning in biological research. Computational drug discovery and vaccine design.

UNIT IV: Protein Information Resources

Proteins – Amino acids – Peptide bond — Levels of protein structure - -helix, β-sheet and βturns – Ramachandran Map - Super secondary structures – Domains - quaternary structure -

DNA and RNA structure - Watson and Crick model - A, B and Z forms of DNA - RNA secondary structure.

UNIT V: Protein Structure and Visualisation Tools

Protein structure visualisation tools –Swiss PDB Viewer, RasMol, PyMOL, Chimaera - Structure – Classification, alignment and analysis – SCOP, CATH, FSSP. Ethical issues, data privacy and bioinformatics regulations. Prospects of bioinformatics.

UNIT VI: Current Contours (Self-directed learning activities for Continuous Internal Assessments Only):

Emerging trends in bioinformatics and computational biology. Big data analytics in biological sciences. Cloud computing and bioinformatics resources. Single-cell genomics and multi-omics integration. CRISPR and genome editing informatics. Microbiome analysis and metagenomics. Artificial intelligence and deep learning applications in biological data analysis

References:

1. Bioinformatics: A Practical Guide to Next Generation Sequencing Data Analysis – by Hamid D. Ismail, 1st edition, 2023. Publisher – CRC Press, Boca Raton.
2. Bioinformatics and Functional Genomics – by Jonathan Pevsner, 4th edition, 2024. Publisher – Wiley-Blackwell.
3. Introduction to Bioinformatics – by Arthur M. Lesk, 6th edition, 2023. Publisher – Oxford University Press, New Delhi.
4. Bioinformatics: Sequence and Genome Analysis – by David W. Mount, 2nd edition, 2004. Publisher – Cold Spring Harbor Laboratory Press.
5. Essential Bioinformatics – by JinXiong, 1st edition, 2006. Publisher – Cambridge University Press.
6. Introduction to Computational Biology and Bioinformatics – by C. K. Mathews, K. E. van Holde and David R. Appling, 1st edition, 2018. Publisher – Pearson Education.
7. Bioinformatics: The Machine Learning Approach – by Pierre Baldi and SørenBrunak, 2nd edition, 2001. Publisher – MIT Press.
8. Biological Sequence Analysis – by Richard Durbin, Sean R. Eddy, Anders Krogh and Graeme Mitchison, 1st edition, 1998. Publisher – Cambridge University Press.
9. Principles of Genome Analysis and Genomics – by Sandy B. Primrose and Richard Twyman, 8th edition, 2023. Publisher – Wiley-Blackwell.
10. Genomes – by T. A. Brown, 5th edition, 2023. Publisher – Garland Science, Taylor & Francis.
11. Structural Bioinformatics – by Philip E. Bourne and Helge Weissig, 2nd edition, 2009. Publisher – Wiley-Blackwell.
12. Protein Structure and Function – by Gregory A. Petsko and Dagmar Ringe, 2nd edition, 2023. Publisher – Oxford University Press.
13. Molecular Biology of the Cell – by Bruce Alberts, Rebecca Heald, Alexander Johnson, David Morgan, Martin Raff, Keith Roberts and Peter Walter, 7th edition, 2022. Publisher – Garland Science.

14. Lehninger Principles of Biochemistry – by David L. Nelson and Michael M. Cox, 9th edition, 2025. Publisher – W.H. Freeman and Company.
15. Bioinformatics: Sequence, Structure and Databanks – by Des Higgins and Willie Taylor (Eds.), 1st edition, 2000. Publisher – Oxford University Press, New Delhi.
16. Introduction to Bioinformatics – by T. K. Attwood and D. J. Parry-Smith, 1st edition, 2004. Publisher – Pearson Education Ltd., New Delhi.
17. Instant Notes in Bioinformatics – by David R. Westhead, J. Howard Parish and Richard M. Twyman, 2nd edition, 2003. Publisher – Viva Books Private Ltd., New Delhi.
18. Next Generation Sequencing and Data Analysis – by Xinkun Wang, 1st edition, 2021. Publisher – CRC Press, Boca Raton.
19. Artificial Intelligence in Bioinformatics and Drug Discovery – by Kunal Roy, SupratikKar and Rudra Narayan Mukherjee, 1st edition, 2023. Publisher – Academic Press, Elsevier.
20. Computational Drug Discovery and Design – by Riccardo Baron (Ed.), 1st edition, 2012. Publisher – Humana Press, Springer.
21. Bioinformatics Algorithms: An Active Learning Approach – by Phillip Compeau and Pavel Pevzner, 3rd edition, 2024. Publisher – Active Learning Publishers.
22. Genomics, Proteomics and Bioinformatics – by Campbell A. M. and Laurie J. Heyer, 2nd edition, 2006. Publisher – Benjamin Cummings.
23. Ethical Issues in Bioinformatics and Computational Biology – by David B. Resnik, 1st edition, 2012. Publisher – Springer Nature.

Course Outcomes (COs):

Upon successful completion of this course the students would be able to:

CO1: Demonstrate comprehensive knowledge of bioinformatics concepts, biological databases, internet resources and computational tools used in modern biological research.

CO2: Sequence analysis methods, including BLAST, FASTA, multiple sequence alignment and phylogenetic analysis, to interpret biological sequence data and solve research-oriented problems.

CO3: Analyse genomic and proteomic information using genome databases and bioinformatics resources to understand biological organisation and molecular function.

CO4: Evaluate the structural organisation of proteins, DNA and RNA, including secondary, tertiary and quaternary structures, and interpret their biological significance.

CO5: Utilise protein structure visualisation, classification and analysis tools such as PyMOL, Chimaera, SCOP, and CATH for independent learning, structural analysis and research applications.

Mapping with Programme Outcomes

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	1	1	-	-	-	-	1
CO2	3	2	2	1	1	-	-	-	-	1
CO3	3	3	2	2	2	-	-	-	-	1
CO4	3	3	3	2	1	1	1	-	-	1
CO5	3	2	2	3	3	-	1	2	1	2

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: **SKILL ENHANCEMENT COURSE** **Semester:**

BIOSTATISTICS

Code: **(Theory)** **Credit: 2**

Course Objectives

- To equip biochemistry students with statistical tools for data analysis.
- To validate experimental design and interpretation of biological data, including exposure to modern computational and high-dimensional data methods.
- To understand and apply descriptive and inferential statistical methods in biological and biomedical research.
- To develop skills in hypothesis testing, correlation, regression, and analysis of variance for scientific investigations.
- To interpret and communicate statistical findings effectively using appropriate graphical, tabular, and computational tools.

Unit I: Introduction to Biostatistics

Biostatistics - Introduction, fundamental scope, data classification into qualitative and quantitative types, sampling techniques, and methods for presenting data through tables, charts, histograms, box plots, and scatter plots. Measures of central tendency: Mean, median, mode – applications for normal and skewed data. Measures of dispersion: Range, variance, standard deviation, coefficient of variation (CV) – use in assay precision.

Unit II: Probability Distributions and Estimation

Basic probability rules. Probability distributions, Binomial distribution (e.g., mutation presence/absence),Poisson distribution (e.g., rare events, colony counts), Normal distribution (Gaussian curve, Z-scores), Sampling distribution and standard error of the mean. Estimation: Point estimation, confidence intervals for mean and proportion.

Unit III: Hypothesis Testing and Parametric Tests

Null and alternative hypotheses, Type I and Type II errors, significance level (α) and p-value. One-sample tests: Z-test and t-test (comparing sample mean to population mean). Two-sample comparisons: Independent and paired t-tests. One-way Analysis of Variance (ANOVA): Comparing >2 group means (e.g., dose-response experiments). Assumptions of parametric tests (normality, homogeneity of variance).

Unit IV: Non-Parametric Tests and Correlation

Common non-parametric tests: Mann-Whitney U test (instead of independent t-test), Wilcoxon signed-rank test (instead of paired t-test), Kruskal-Wallis test (instead of one-way ANOVA), Chi-square test (goodness-of-fit, test of independence –Correlation analysis-Pearson’s correlation coefficient, Spearman’s rank correlation, Partial correlation.

Unit V: Regression and Experimental Design

Simple linear regression: Equation, interpretation of slope and intercept.Multiple linear regression: Concept and use in adjusting for confounders. Experimental design principles: Randomization, replication, blocking, completely randomized design (CRD), Randomized block design (RBD),Factorial designs.

Unit VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

High-dimensional data analysis: Introduction to multiple testing corrections (Bonferroni, FDR) – for genomics, proteomics, metabolomics.

Text Books

1. Wayne W. Daniel & Chad L. Cross (2018). Biostatistics: A Foundation for Analysis in the Health Sciences. Wiley, 11th Edition.
2. Bernard Rosner (2015). Fundamentals of Biostatistics. Cengage Learning, 8th Edition.
3. Harvey Motulsky (2018). Intuitive Biostatistics: A Nonmathematical Guide to Statistical Thinking. Oxford University Press, 4th Edition.
4. Holmes, S. & Huber, W. (2019). Modern Statistics for Modern Biology. Cambridge (free online).
5. Field, A., Miles, J., & Field, Z. (2012). Discovering Statistics Using R. Sage.

Reference Books:

1. Michael J. Campbell (2021). Statistics at Square One. BMJ Books/Wiley, 12th Edition.
2. John H. McDonald (2014). Handbook of Biological Statistics. Sparky House Publishing, 3rd Edition.
3. Susan Holmes & Wolfgang Huber (2019). Modern Statistics for Modern Biology. Cambridge University Press.
4. Andy Field, Jeremy Miles & Zoe Field (2012). Discovering Statistics Using R. Sage Publications.

Web Resources:

1. MSCBOT-606.pdf
2. Sampling Methods | Types, Techniques & Examples
3. Hypothesis Testing - GeeksforGeeks

Course Outcomes (COs):

Upon successful completion of this course the students would be able to:

CO1: Recall data types, sampling, data presentation, central tendency & dispersion, probability rules, hypothesis testing and non-parametric tests.

CO2: Explain data types, sampling, probability distributions, standard error, hypothesis testing, non-parametric tests and correlation.

CO3: Apply appropriate statistical methods including measures of central tendency and dispersion, probability distributions, confidence intervals, parametric, non-parametric tests, correlation analysis, and linear regression to solve biostatistical problems.

CO4: Analyze statistical data by selecting appropriate data classification, probability distributions, confidence intervals, parametric tests, non-parametric tests, correlation coefficients, regression models, and experimental designs to interpret results and draw valid conclusions

CO5: Evaluate the appropriateness of statistical methods including t-tests, ANOVA, Mann-Whitney, Wilcoxon, Kruskal-Wallis, chi-square and experimental designs to justify the best analytical approach for given biostatistical problems.

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	1	1	1	1	1	2	1	2
CO2	2	3	2	2	2	1	1	2	1	1
CO3	1	2	2	2	3	1	2	3	2	2
CO4	1	2	3	3	3	2	3	3	2	2
CO5	2	2	3	3	3	2	3	3	3	2

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: **SKILL ENHANCEMENT COURSE** **Semester:**

MEDICAL LABORATORY TECHNOLOGY

Code: **(Theory)** **Credit: 2**

Course Objectives:

- Understand the principles of laboratory organisation, biosafety, specimen collection, and pre-analytical variables that affect diagnostic accuracy.
- Describe haematological investigations including complete blood count, differential leucocyte count, coagulation tests, and interpret results in the context of common blood disorders.
- Apply clinical biochemistry principles to analyse carbohydrate, lipid, protein, enzyme, and electrolyte parameters in serum/plasma, and correlate findings with disease states.
- Explain routine and special urine analysis, faecal analysis, and body fluid examination, and use these findings in the diagnosis of renal, hepatic, and metabolic disorders.
- Describe the principles and procedures of serology, immunohaematology, blood banking, and laboratory quality management systems including quality control charts and accreditation standards.

Unit I: Introduction to Medical Laboratory & Safety Management

History & organization of clinical laboratories, Code of conduct & medical ethics, Laboratory hazards (biological, chemical, radiological, physical), First aid & fire safety, Specimen collection, labeling, transport, and rejection criteria.

Unit II: Hematology& Clinical Pathology

Hemoglobinometry, total RBC/WBC/platelet counts, Differential leukocyte count (DLC), Anemia&leukemia screening, Reticulocyte count & osmotic fragility, Urine dipstick, sediment analysis, and 24-hour urine collection.

Unit III: Clinical Biochemistry & Instrumentation

Photometry, colorimetry, flame photometry, electrophoresis, Enzymes (AST, ALT, ALP, GGT, Amylase, Lipase), Electrolytes (Na^+, K^+, Cl^-, HCO_3^-), calcium, magnesium, Point-of-care testing (POCT) and biosensors, Reference ranges and clinical interpretation.

Unit IV: Diagnostic Microbiology & Immunology

Sterilization & disinfection (autoclave, hot air oven, filters), Culture media (simple, differential, selective, enriched), Biochemical tests (catalase, coagulase, oxidase, IMViC),

Virology (specimen handling, cell culture basics), Parasitology (stool ova & cyst examination, malaria parasite (MP) smear).

Unit V: Immunohematology (Blood Banking) & Advanced Diagnostics

Donor selection, phlebotomy, and storage requirements, Hemolytic disease of the newborn (HDN) – antenatal testing, Quality assurance in blood bank (NABL, AABB standards), Automation in molecular diagnostics (GeneXpert, sequencing basics), Laboratory information system (LIS) & medical record keeping.

Unit VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Next-generation sequencing (NGS) for oncology, inherited disorders, and infectious diseases.

Textbooks

1. Cheesbrough, M. (2006). District Laboratory Practice in Tropical Countries, Parts 1 & 2 (2nd ed.). Cambridge University Press, Cambridge, UK.
2. Harsh Mohan (2018). Textbook of Pathology (8th ed.). Jaypee Brothers Medical Publishers, New Delhi.
3. Dacie, J. V., & Lewis, S. M. (2017). Practical Haematology (12th ed.). Churchill Livingstone / Elsevier, Edinburgh.
4. Tietz, N. W. (Ed.) (2012). Fundamentals of Clinical Chemistry and Molecular Diagnostics (7th ed.). W. B. Saunders / Elsevier, Philadelphia.
5. Strasinger, S. K., & Di Lorenzo, M. S. (2022). Urinalysis and Body Fluids (7th ed.). F. A. Davis Company, Philadelphia.

Reference Books

1. Burtis, C. A., Ashwood, E. R., &Bruns, D. E. (2015). Tietz Textbook of Clinical Chemistry and Molecular Diagnostics (6th ed.).Elsevier Saunders, Philadelphia.
2. McPherson, R. A., &Pincus, M. R. (2021). Henry's Clinical Diagnosis and Management by Laboratory Methods (24th ed.). Elsevier, Philadelphia.
3. Harmening, D. M. (2018). Modern Blood Banking and Transfusion Practices (7th ed.). F. A. Davis Company, Philadelphia.
4. McKenzie, S. B., & Williams, J. L. (2021). Clinical Laboratory Hematology (4th ed.). Pearson Education, New Jersey.
5. Wallach, J. (2007). Interpretation of Diagnostic Tests (8th ed.).Lippincott Williams & Wilkins, Philadelphia.

Web Resources:

1. HEMOGLOBINOMETRY | PDF
2. Microsoft Word - sterilization.doc

Course Outcomes (COs):

Upon successful completion of this course the students would be able to:

CO1: list and identify the types of laboratory hazards, describe urine dipstick analysis and to recall the reference ranges.

CO2: classify and distinguish among laboratory hazards, describe the methods for total RBC, WBC and platelet counts and to explain the principles of sterilization and disinfection.

CO3: Apply safety protocols to manage laboratory hazards, Apply the principles of hemoglobinometry, to interpret clinical laboratory results.

CO4: compare and contrast first aid protocols, analyzehemoglobinometry results and to identify patterns of acid-base and fluid balance disturbances.

CO5: justify the importance of pre-analytical quality control, Evaluate the diagnostic utility of hemoglobinometry, assess the diagnostic value of enzyme markers.

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	1	1	1	1	1	1	1	2
CO2	2	3	2	2	2	1	1	1	1	1
CO3	2	2	3	2	3	2	2	3	2	2
CO4	1	2	3	3	3	2	3	3	2	2
CO5	2	3	3	3	3	2	3	3	3	3

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: **SKILL ENHANCEMENT COURSE** **Semester:**

PHARMACOVIGILANCE

Code: **(Theory)** **Credit: 2**

Course Objectives

- To understand the principles and practices of drug safety monitoring, including history and development regulations.
- To know the methods for detecting, assessing and preventing adverse drug reactions.
- To delve into specific areas like adverse drug reaction (ADR).
- To know about classifications, reporting systems and risk management strategies.
- To know about Differences in Indian and global pharmacovigilance requirements.

Unit I: History of Pharmacovigilance

Introduction to Pharmacovigilance: History and development of Pharmacovigilance, Importance of safety monitoring of Medicine, WHO international drug monitoring programme, Pharmacovigilance Program of India (PvPI): Adverse drug reactions - Definition, classification of ADRs, Detection and reporting, Methods in Causality assessment, Severity and seriousness assessment, Predictability and preventability assessment: Management of adverse drug reactions Basic terminologies used in pharmacovigilance 165: Terminologies of adverse medication related events. Regulatory terminologies.

Unit II: Drugs

Drug and disease classification: Anatomical, therapeutic and chemical classification of drugs: International classification of diseases, Daily defined doses, International Nonproprietary Names for drugs. Drug dictionaries and coding in pharmacovigilance, WHO adverse reaction terminologies, MedDRA and Standardised MedDRA queries, WHO drug dictionary, Eudravigilance medicinal product dictionary Information resources in pharmacovigilance, Basic drug information resources, Specialised resources for ADRs Establishing pharmacovigilance programme, Establishing in a hospital, Establishment & operation of drug safety department in industry, Contract Research Organisations (CROs), Establishing a national programme.

Unit III: Vaccines

Vaccine safety surveillance, Vaccine Pharmacovigilance, Vaccination failure, Adverse events following immunization: Pharmacovigilance methods, Passive surveillance – Spontaneous reports and case series, Stimulated reporting, Active surveillance – Sentinel sites, drug event monitoring and registries, Comparative observational studies – Cross sectional study, case control study and cohort study, Targeted clinical investigations: Communication in pharmacovigilance, Effective communication in Pharmacovigilance, Communication in Drug Safety Crisis management, Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media.

Unit IV: Planning of Pharmacovigilance

Safety data generation, Pre clinical phase, Clinical phase, Post approval phase (PMS) ICH Guidelines for Pharmacovigilance, Organization and objectives of ICH, Expedited reporting, Individual case safety reports, Periodic safety update reports, Post approval expedited reporting, Pharmacovigilance planning, Good clinical practice in pharmacovigilance studies.

Unit V: Pharmacogenomics

Pharmacogenomics of adverse drug reactions, Genetics related ADR - example focusing PK parameters: Drug safety evaluation in special population, Paediatrics, Pregnancy and lactation, Geriatrics CIOMS, CIOMS Working Groups, CIOMS Form CDSCO (India) and Pharmacovigilance, D&C Act and Schedule Y, Differences in Indian and global pharmacovigilance requirements.

Unit VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Digital Pharmacovigilance & eHealth Tools, Advanced Signal Detection & Causality Methods and Pharmacovigilance for Advanced Therapies.

TEXT BOOKS

1. Strom, Brian L., Kimmel, Stephen E., and Hennessy, Sean (Eds.). Textbook of Pharmacoepidemiology, 3rd Edition, Wiley-Blackwell Publishers, 2019.
2. Parthasarathi, G., Hansen, Karin Nyfort, and Nahata, Milap C. A Textbook of Clinical Pharmacy Practice: Essential Concepts and Skills, 2nd Edition, Universities Press (India) Pvt. Ltd., Hyderabad, 2012.
3. Munjal, Yash Pal (Ed.). API Textbook of Medicine, 11th Edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2019.

REFERENCE BOOKS

1. Gupta, S. K. Textbook of Pharmacovigilance, 2nd Edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2011.
2. Cobert, Barton and Biron, Pierre. Practical Drug Safety from A to Z, Jones & Bartlett Publishers, Massachusetts, 2002.
3. Andrews, Elizabeth B. and Moore, Nicholas. Mann's Pharmacovigilance, 3rd Edition, Wiley-Blackwell Publishers, 2014.
4. Talbot, John and Waller, Patrick. Stephens' Detection of New Adverse Drug Reactions, 6th Edition, Wiley-Blackwell Publishers, 2011.
5. Waller, Patrick. An Introduction to Pharmacovigilance, 2nd Edition, Wiley-Blackwell Publishers, 2017.
6. Cobert, Barton. Cobert's Manual of Drug Safety and Pharmacovigilance, 2nd Edition, Jones & Bartlett Learning Publishers, 2012.
7. National Formulary of India, Indian Pharmacopoeia Commission, Ministry of Health and Family Welfare, Government of India.

Web Resources:

1. https://cioms.ch/publications/product/cioms-cumulatihttps://who-umc.org/vigibase/ve-pharmacovigilance-glossary/
2. https://who-umc.org/vigibase/

Course Outcomes (COs):

Upon successful completion of this course the students would be able to:

CO1: Recall and describe Pharmacovigilance, Adverse drug reactions and Regulatory terminologies, disease Classification, Vaccines and Pharmacogenomics.

CO2: Understand about WHO, Basic drug information resources, Vaccine safety surveillance and Good Clinical Practice.

CO3: Apply methods of casualty assessment, ATC Classification, Stimulated reporting and Post-marketing surveillance.

CO4: Analyse Causality assessment discrepancies,MedDRA hierarchy, Vaccination failure analysis and to Analyze differences in Schedule Y (India) vs. ICH requirements.

CO5: Design underreporting solutions, MedDRA vs WHO-ART, Synthesize multiple surveillance methods.

Mapping with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	1	1	1	1	1	1	1	2
CO2	2	3	1	1	2	1	1	1	1	2
CO3	1	2	2	2	3	2	2	2	2	2
CO4	1	2	3	3	3	2	3	2	2	2
CO5	2	2	3	3	3	3	3	3	3	3

Correlation level: 1 – Low 2 – Moderate 3 – High

Year: Third | **SKILL ENHANCEMENT COURSE FORENSIC SCIENCE** | **Semester: VI**

Code: | **(Theory)** | **Credits: 2**

COURSE OBJECTIVES:

- Provide fundamental knowledge about the principles, scope, and applications of forensic science in the criminal justice system.
- Equip students with skills to analyse biological fluids using preliminary and confirmatory tests.
- Introduce modern techniques like DNA fingerprinting for individual identification.
- Promote awareness of ethical issues and professional standards in forensic science practice.
- To develop the ability to collect, preserve, and interpret forensic evidence for scientific investigation and legal proceedings.

UNIT I: INTRODUCTION TO FORENSIC SCIENCE:

Definition & Scope of Forensic Science, History and Evolution, Branches & Divisions. Role of Forensic Science in Criminal Justice System, Relationship between Forensic Sciences, Investigation & Law, Ethical issues in Forensic Science Practice.

UNIT II: BIOCHEMICAL ANALYSIS OF BODY FLUIDS:

Biochemical analysis of trace evidence - Examination of Fiber, Soil, Hair and Pollen. Biochemical analysis of biological fluids as forensic evidence. Blood group and blood protein analysis for identification of an individual. Blood splatter analysis. Stability and degradation of biological samples, Presumptive vs confirmatory tests – comparison, Limitations and sources of error in biological analysis.

UNIT III: DNA FINGERPRINTING:

Extraction of DNA from biological samples (Blood/Semen/Saliva/Hair).
DNA fingerprinting based on micro/mini satellite markers (PCR and Agarose gel electrophoresis).Contaminationcontrol and quality assurance in DNA labs, Interpretation of DNA profiles and statistical analysis.

UNIT IV: FORENSIC ANTHROPOLOGY:

Determination of sex, age and ethnicity through skeletal remains, Forensic odontology to determine age and identity of remains. Use of imaging techniques (X-ray, CT scan) Forensic archaeology basics (excavation of remains).

UNIT V: FIELD TRIP & CASE STUDY

(Teaching Methodology/Activities in the Classroom Content presentations, virtual labs/videos, hands-on sessions and case study discussions). Preparation of forensic laboratory reports, Documentation and presentation of forensic findings.

UNIT VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Forensic response during pandemics (e.g., COVID-19), Role of AI in pattern recognition and crime prediction, Facial recognition and biometric analysis.

TEXT BOOKS:

1. Forensic Science: An Introduction to Scientific and Investigative Techniques, Stuart H. James & Jon J. Nordby, 4th Edition, 2014, CRC Press / Taylor & Francis.
2. Fundamentals of Forensic Science, Max M. Houck & Jay A. Siegel, 2nd Edition, 2015, Academic Press (Elsevier).
3. Forensic Biology, Richard Li, 2nd Edition, 2015, CRC Press.

REFERENCE BOOKS:

1. Principles and Techniques of Biochemistry and Molecular Biology Keith Wilson & John Walker, 7th Edition, 2010, Cambridge University Press.
2. An Introduction to Forensic GeneticsWilliam Goodwin, Adrian Linacre &SibteHadi, 2nd Edition, 2011, Wiley-Blackwell.
3. Forensic DNA Typing, John M. Butler, 2nd Edition, 2005, Elsevier Academic Press.
4. MedicalJurisprudence and Toxicology, K.S. Narayan Reddy & O.P. Murty, 33rd Edition, 2014, Jaypee Brothers Medical Publishers.
5. Forensic Anthropology Contemporary Theory and Practice Debra A. Komar& Jane E. Buikstra, 1st Edition, 2008, Oxford University Press.
6. Textbook of Forensic Science, Pankaj Shrivastava et al., 2023, Springer Nature.

E – SOURCES:

1. https://archive.org/details/fundamentals-of-forensic-science
2. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Forensic_Chemistry
3. https://www.ncbi.nlm.nih.gov/books/
4. https://open.umn.edu/opentextbooks/textbooks
5. https://www.ncbi.nlm.nih.gov

COURSE OUTCOME (COs):

After successful completion of the course, students will be able to:

CO1: Explain the concept, scope and importance of forensic science and its role in investigations.
CO2: Identify and analyze trace evidence such as fibers, hair, soil and pollen using biochemical techniques.
CO3: Perform and interpret tests for biological fluids including blood, semen and saliva.
CO4: Apply knowledge of DNA fingerprinting techniques for identification and forensic analysis.

CO5: Interpret forensic data and present findings through case studies and reports.

Mapping with Programme Outcomes

COs\ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	1	1	-	3	1	–	2
CO2	3	3	2	2	2	-	1	–	–	1
CO3	3	3	3	3	3	-	1	1	–	1
CO4	3	3	2	2	2	-	1	–	–	1
CO5	2	2	2	3	3	1	2	2	2	3

Correlation level: 1 – Low 2 – Moderate 3 – High