

PERIYAR UNIVERSITY

SALEM – 636011



DEGREE OF BACHELOR OF SCIENCE

(CHOICE BASED CREDIT SYSTEM)

B.Sc. CLINICAL LABORATORY TECHNOLOGY

OBE REGULATIONS AND SYLLABUS

SEMESTER PATTERN

(For Candidates admitted in the Colleges affiliated to

Periyar University from 2026-2027 onwards)

REGULATIONS

1. PREAMBLE AND OBJECTIVES OF THE COURSE

The B.Sc. Clinical Laboratory Technology program is designed to provide students with a comprehensive foundation in the principles and practices of modern laboratory medicine. It emphasizes the integration of theoretical knowledge with practical skills in biochemistry, pathology, hematology, microbiology, and clinical diagnostics. The course prepares graduates to play a vital role in healthcare delivery by ensuring accurate laboratory investigations, supporting clinical decision-making, and contributing to research and innovation in medical sciences. Ethical practice, safety standards, and quality assurance are central to the training, enabling students to become competent professionals in diverse healthcare and laboratory settings. The major objectives of B.Sc., Clinical Laboratory Technology course are

The major objectives of the B.Sc. Clinical Laboratory Technology course are:

- To strengthen advanced knowledge and understanding of biochemistry, pathology, hematology, microbiology, and clinical diagnostics.
- To develop technical competence in handling laboratory instruments, performing diagnostic tests, and ensuring accuracy and precision in clinical investigations.
- To integrate theoretical concepts with practical applications in clinical laboratory settings for effective healthcare delivery.
- To enhance analytical, interpretative, and problem-solving skills in evaluating laboratory data for clinical decision-making.
- To promote professional ethics, safety practices, and quality assurance standards in laboratory work.
- To prepare graduates for careers in healthcare, diagnostics, research, teaching, and laboratory management.
- To encourage lifelong learning and adaptability to emerging technologies in laboratory medicine.

2. PROGRAMME OUTCOME AND KNOWLEDGE LEVEL

PO No	PROGRAMME OUTCOME	Knowledge Level
PO1	Disciplinary knowledge: Ability to understand fundamental concepts of CLT; Ability to apply basic principles of chemistry to Biological Systems and Molecular Biology; Ability to relate various interrelated physiological and metabolic events; A general awareness of current developments at the forefront in CLT and Allied subjects; Ability to critically evaluate a problem and resolve to challenge blindly accepted concepts; Zeal and ability to work safely and effectively in a laboratory; Good experimental and quantitative skills encompassing preparation of laboratory reagents, conducting experiments, satisfactory analyses of data and interpretation of results; Awareness of resources, and their conservation; Ability to think laterally and in an integrating manner and develop interdisciplinary approach; Overall knowledge of the avenues for research and higher academic achievements in the field of CLT and allied subjects.	K3
PO2	Communication Skills: Ability to speak and write clearly in English; Ability to listen to and follow scientific viewpoints and engage with them.	K2
PO3	Problem solving: ability to closely observe the situation, and apply lateral thinking and analytical skills.	K4
PO4	Analytical reasoning: Ability to evaluate the strengths and weaknesses in scholarly texts spotting flaws in their arguments; Ability to use critics and theorists to create a framework and to substantiate one's argument in one's reading of scientific texts.	K4
PO5	Team work /Time Management: Ability to participate constructively in class room discussions; Ability to contribute to group work; Ability to meet a deadline.	K6
PO6	Scientific reasoning: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. Ability to formulate logical and convincing arguments.	K4
PO7	Self-directed learning: Ability to work independently in terms of organizing laboratory, and critically analyzing research literature; Ability to postulate hypothesis, questions and search for answers.	K6
PO8	Digital literacy: Ability to use digital sources, and apply various platforms to convey and explain concepts of CLT	K3
PO9	Moral and ethical awareness/reasoning: Ability to interrogate one's own ethical values and to be aware of ethical and environmental issues; Ability to read values	K3

	inherited in society and criticism vis a vis, the environment, religion and spirituality as also structures of power	
PO10	Leadership readiness: Ability to lead group discussions, to formulate questions related to scientific and social issues.	K6

K1 – Remember; K2-Understand; K3-Apply; K4-Analyse; K5-Evaluate; K6-Create
(Ref: UGC Document on LOCF – UG – 2019)

3. ELIGIBILITY FOR ADMISSION

Candidate for admission to the first year of B.Sc., Degree Course in Biochemistry shall be required to have passed the Higher Secondary Examination **with Chemistry and Biology / Chemistry, Botany and Zoology / Biochemistry / Vocational group (Agri and Nursing).**

4. DURATION OF THE COURSE

The duration of the course is three academic years comprising six semesters.

5. COURSE OF STUDY

The B.Sc. CLT course comprises the following subjects in the syllabus,

- Foundation Courses : Languages - I, II, III, IV and English – I, II, III, IV
- Core Theory : Core I to Core XI
- Core Practical : Core Practical I to IV
- Allied I : Biochemistry
- Allied Practical I : Biochemistry
- Allied II : Microbiology
- Allied Practical II : Microbiology
- Elective : I, II, III
- Skill Enhancement Course (SEC) : I, II, III
- Non - Major Elective Course (NME) : I, II

(NME may be chosen by the respective colleges and the same must be communicated to the University).

- Summer Internship / Industrial Training: 15 days (at the end of Second year)

(Attendance should be submitted to the department (Attendance & Mini report mandatory))

- Common Papers for all UG Programmes :
 - Value Education
 - Disaster Management
 - Health and Wellness
 - Environmental Studies
 - NMSDC and
 - Extension Activity

6. EXAMINATIONS

There shall be six semester examinations for three years – two semester examination per year. Candidates failing in any subject / subjects will be permitted to reappear for failed subject / subjects in subsequent examinations. The syllabus has been divided into six semesters. The odd semester examinations (I, III and V) will be held in November/ December and even semester examinations (II, IV and VI) will be held in April / May. The practical examination I will be held at the end of I year (II-semester). II will be held at the end of II year (IV-semester). III and IV will be held at the end semester of III year (VI-semester).

7. PASSING MINIMUM

A candidate shall be declared to be passed the examination if he /she secure not less than 40% of the marks in each paper and practical. The candidates who do not secure the required minimum marks for pass in a paper and practical shall be required to reappear to pass the same at a subsequent appearance. For the practical the minimum pass includes the record mark too. There is no passing minimum for the record. However, submission of a record notebook is a must.

8. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Candidates who secured not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First Class. Candidates secured above 50% less than 60% shall be declared to have passed in Second Class.

Candidates who obtain 75% and above in the aggregate shall be declared to have passed the examination in First Class with Distinction provided they pass all the examination in prescribed period at first appearance.

9. RANKING

Candidates who pass all the examinations for the prescribed course in the first attempt/appearance and within a period of three academic years from the year of admission to the course only are eligible for University Ranking.

10. MAXIMUM DURATION FOR THE COMPLETION OF THE UG PROGRAMME:

The maximum duration for completion of the UG Programme shall not exceed twelve semesters.

11. COMMENCEMENT OF THIS REGULATION

These regulations shall be effect from the academic year 2026-27 onwards for candidates admitted during the academic year 2026-27 and thereafter.

12. TRANSITORY PROVISION

Candidates who were admitted to the UG course of study before 2023-2024 shall be permitted to appear for the examinations under those regulations for a period of three years i.e. up to April / May 2028 examination. Thereafter, they will be permitted to appear for the examination only under the regulations therein force.

13. LIST OF ELECTIVE PAPERS (Colleges can choose any one of the paper as Elective)

Elective – I

- A) Analytical Techniques
- B) Biomedical Instrumentation

Elective – II

- A) Pharmacology and Toxicology
- B) Immunology

Elective – III

- A) Health and Hygiene
- B) Healthcare management

14. COURSES GIVEN BY THE BOARD AS NON – MAJOR ELECTIVE COURSE (NME)

Semester - I

- NME – I – Lifestyle Diseases – Page No: 85

Semester - II

- NME – II – Communicable Diseases – Page No: 88

15. A) ** NAAN MUDHALVAN – Courses external 25 marks will be assessed by Industry and Internal will be offered by respective course teacher.

B) ** Alternate SKILL Papers for Naan Mudhalvan reappear students:

- | | | |
|----------------|---|--|
| • Semester II | - | Diet and Nutrition – Page No: 13 |
| • Semester III | - | Diet Therapy– Page No: 28 |
| • Semester IV | - | Good Laboratory Practices — Page No: 45 |
| • Semester V | - | Communicable and Non-Communicable Diseases– Page No: 66 |
| • Semester VI | - | Diagnostic Approaches to Clinical Disorders– Page No: 82 |

16. COURSE OF THE STUDY AND SCHEME OF EXAMINATIONS

S.No	Semeste	Paper Code	Part	Course Group	Paper Type	Subject Title	Hours / Week	Exam Hours	Internal Marks	External Marks	Total Marks	Credit	Page No.
1	I		I	Foundation	Theory	Language - I	6	3	25	75	100	3	
2			II	Foundation	Theory	English - I	6	3	25	75	100	3	
3			III	Core I	Theory	Cell Biology	5	3	25	75	100	5	1
4			III	Core II	Theory	Human Anatomy	5	3	25	75	100	5	4
5			III	Allied – I	Theory	Biochemistry	5	3	25	75	100	4	
6			IV	NMEC	Theory	Choose any one paper offered by other departments	2	3	25	75	100	2	
7			IV	Value Added	Theory	Value Education	1	3	25	75	100	1	
8	II		I	Foundation	Theory	Language - II	6	3	25	75	100	3	
9			II	Foundation	Theory	English – II	6	3	25	75	100	3	
10			III	Core – III	Theory	Human Physiology	5	3	25	75	100	5	7
11			III	Core Practical - I	Practical	Practical – I – Human Anatomy and Physiology	4	6	40	60	100	5	10
12			III	Allied Practical – I	Practical	Allied Biochemistry practical I	3	3	40	60	100	4	
13			IV	NMEC	Theory	Choose any one paper offered by other departments	2	3	25	75	100	2	
14			IV	Common Paper	Theory	Disaster Management	2	3	25	75	100	1	
15	II I		IV	NMSDC	NMSD		2					2	
16			I	Foundation	Theory	Language - III	6	3	25	75	100	3	
17			II	Foundation	Theory	English - III	6	3	25	75	100	3	
18			III	Core – IV	Theory	Enzymes	5	3	25	75	100	5	16
19			III	Allied – II	Theory	Microbiology	4	3	25	75	100	4	
20			III	Elective - I	Theory	A) Analytical Techniques/ B) Biomedical Instruments Note: Choose any ONE Elective paper	3	3	25	75	100	3	19 / 22
21			IV	Skill Enhancement Course (SEC)	Theory	First Aid	2	3	25	75	100	2	25
22			IV	Common Paper	Theory	Health and Wellness	2	3	25	75	100	1	
23				NMSDC	NMSD		2	3	25	75	100	2	
24			I	Foundation	Theory	Language - IV	6	3	25	75	100	3	
25			II	Foundation	Theory	English – IV	6	3	25	75	100	3	

44			III	Core – Practical IV	Practical	Practical – IV – Biochemical Tests in Clinical Laboratory	5	6	40	60	100	5	80
45			IV	Common	-	Extension Activity	-	-	-	-	-	1	-
46				NMSDC	NMSD		2	-	-	-	-	-	2

17. TOTAL PAPERS-46 (41+5 NM)

Part - I	Total Papers	Part – II	Total Papers	Part - III	Total Papers - 22		Part - IV	Total Papers
Language	4	English	4	Core	15	11 (Theory) 4 (Practical)	NME	2
				Allied	4	2 (Theory) 2 (Practical)	SEC	3
				Elective	3	Theory	VE	1
							DM	1
							HW	1
							Extn	1
							Internship	1
							NM	5
							EVS	1

Language Part - I – Total Papers - 4

Language Part - II – Total Papers - 4

Part - III – Core – Total Papers – 15 [11 (Theory) & 4 (Practical)]

Part - III – Allied – Total Papers – 4 [2 (Theory) & 2 (Practical)]

Part - III – Elective – 3

Part - IV – SEC – Total Papers – 3

Part - IV – Value Education – 1

Part - IV – Disaster Management – 1

Part - IV – Health and Wellness – 1

Part - IV – NMSDC – 5

Part - IV – NME – Total Papers – 2

Part - IV – EVS – 1

Part - IV – Extension – 1

Part - IV – Internship – 1

18. CREDIT DISTRIBUTION

Part	Title of the Course	Total No.of Papers	Credits	Total credits
Part I	Language	4	12 (Each 3 credits)	24 credits
Part II	English	4	12 (Each 3 credits)	
Part III	Core Courses	15 [11 Theory + 4 Practical]	75 (Each 5 credits)	100 credits
Part III	Allied Courses	4 [2 Theory + 2 Practical]	16 (Each 4 credits)	
Part III	Elective	3 [Theory]	9 (Each 3 credits)	
Part IV	Non Major Elective	2 [Theory]	4 (Each 2 credits)	18 credits
Part IV	Skill Enhancement Course	3 [Theory]	6 (Each 2 credits)	
Part IV	Value Education	1 [Theory]	1 credit	
Part IV	Disaster Management	1 [Theory]	1 credit	
Part IV	Health and Wellness	1 [Report]	1 credit	
Part IV	EVS	1 [Theory]	2 credits	
Part IV	Extension Activity	-	1 credit	
Part IV	Internship	Training Report – Commended/Highly Commended	2 credits	
Part IV	Naan Mudhalvan	5 [Exam Online] Theory (Offline)	10 (Each 2 credits)	10 credits
Total credits for UG Programmes				142+10=152

19. QUESTION PAPER PATTERN (For Core, Allied, Elective, SEC and NME)

Maximum marks– 75

Duration – 3 hours

Section –A (15 x 1 = 15 marks)

Answer all the questions

Multiple-choice questions

(3 questions from each unit)

Section –B (2 x 5 = 10 marks)

(One question from each unit)

Answer any TWO questions out of FIVE

Section –C (5 x 10 = 50 marks)

Answer ALL questions

(Internal choice from the same unit)

20. INTERNAL MARKS AND EXTERNAL MARKS

Study component	Internal Marks	External Marks
Theory	25	75
Practical	40	60
Internship / Health and Wellness	Commended / Highly Commended	

B. Sc., CLINICAL LABORATORY TECHNOLOGY
FIRST YEAR - SEMESTER – I
CORE – I - CELL BIOLOGY

Objectives

- To introduce the basic concepts of cells, their types, and differences between plant, animal, prokaryotic, and eukaryotic cells.
- To explain the structure and functions of cell membranes, cell walls, and important organelles.
- To describe how chromosomes are organized and highlight special types of chromosomes.
- To outline the stages of the cell cycle and explain the processes of mitosis and meiosis.
- To understand the role of the extracellular matrix and cell interactions in maintaining tissue structure and communication.

Course Outcome

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Recall the fundamental concepts of cell biology, including cell theory, types of cells, and basic structures of prokaryotic and eukaryotic cells.	K1 – Remember
CO2	Explain the structure and functions of cell organelles, membranes, and cell walls, and differentiate between plant and animal cells.	K2 – Understand
CO3	Apply knowledge of chromosome organization and cell division to interpret cellular processes such as growth, reproduction, and genetic variation.	K3 – Apply
CO4	Analyze the differences between mitosis and meiosis, and evaluate the role of chromatin organization and special chromosomes in gene regulation.	K4 – Analyze
CO5	Evaluate the significance of extracellular matrix components and cell–cell/ECM interactions in tissue organization.	K5 – Evaluate
CO6	Design conceptual models to illustrate extracellular matrix composition and cell–cell/ECM interactions, integrating knowledge of proteins and junctional complexes.	K6 – Create

UNIT I

Cell: Introduction, cell theory, types of cell - Prokaryotic cell and eukaryotic cell structure, difference between plant cell and animal cell. Structure, composition, functions of the cell membrane, bacterial cell wall and plant cell wall.

UNIT II

Cell Organelles: Structure and functions of Nucleus, Mitochondria, Chloroplast, Endoplasmic Reticulum, Golgi bodies, Ribosomes, Lysosomes, Peroxisomes and Cytoskeleton.

UNIT III

Chromosome Organization: Structure of chromatin, types of euchromatin and heterochromatin, structure of chromosome, special types of chromosome – Lamp Brush Chromosomes and Polytene Chromosomes.

UNIT IV

Cell Cycle: Stages of cell cycle, cell division - various stages and significance of Mitosis and Meiosis, Differences between Mitosis and Meiosis.

UNIT V

Extracellular Matrix and Cell Interactions: ECM: - Collagen, Elastin, Fibronectin, Laminins, Cell – ECM interactions: - Integrins, Focal adhesions, Hemidesmosomes. Cell – cell interactions: - Cadherins, IgSF, Selectins, Intracellular junctions: Gap junctions, tight junctions, adherens junctions, and desmosomes.

Reference Books

- Cell Biology – T. Devasena; 1st Edition; Oxford University Press; 2012.
- Cytology (Cell Biology and Molecular Biology) – V.K. Agarwal, P.S. Varma; 4th Edition; S. Chand & Company, New Delhi; 2000.
- Cell and Molecular Biology – Prakash S. Lohar; 1st Edition; MJP Publishers; 2007.
- The Cell: A Molecular Approach – Geoffrey M. Cooper, Robert E. Hausman; 9th Edition; Oxford University Press; 2022 (*latest edition, updated from 5th in 2009*).
- Cell and Molecular Biology – Gerald Karp; 9th Edition; John Wiley & Sons; 2021 (*latest edition, updated from 3rd in 2002*).

Web Resources

- **Easy Biology Class** – Free tutorials, notes, and diagrams for cell biology concepts.
<https://www.easybiologyclass.com>

- **NCBI Bookshelf** – Open-access reference materials on molecular and cell biology.
<https://www.ncbi.nlm.nih.gov/books> ([ncbi.nlm.nih.gov](https://www.ncbi.nlm.nih.gov/books) in Bing)
- **Khan Academy – Cell Biology** – Interactive lessons on cell structure, organelles, and the cell cycle.
<https://www.khanacademy.org/science/biology/cell-biology> ([khanacademy.org](https://www.khanacademy.org/science/biology/cell-biology) in Bing)

Mapping with Programme Outcomes

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	M	L	L	M	L
CO2	S	M	S	M	L	M	L	M	M	L
CO3	S	S	M	M	M	M	L	M	M	L
CO4	S	S	S	M	M	M	L	M	M	M
CO5	S	M	S	M	L	M	M	M	S	M

S - Strong

M - Medium

L - Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
FIRST YEAR - SEMESTER – I
CORE – II – HUMAN ANATOMY

Objectives

- To understand the structural organization of the human body.
- To learn gross anatomy of major organ systems.
- To relate anatomical structures to physiological functions.
- To develop skills in identifying organs and tissues.
- To apply anatomical knowledge in clinical and diagnostic contexts.

Course Outcome

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Recall anatomical terms, planes, and subdivisions	K1 – Remember
CO2	Explain digestive system structure and functions	K2 – Understand
CO3	Demonstrate knowledge of respiratory organs and positions	K3 – Apply
CO4	Analyze circulatory and nervous system structures	K4 – Analyze
CO5	Evaluate excretory and reproductive anatomy	K5 – Evaluate, K6 – Create

UNIT I

General Anatomy: Definitions and scope of anatomy, Subdivisions of anatomy, Anatomical terms of location and position, Fundamental planes of the body, Vertebrate structural plane of humans, Organization of the body: cells and tissues.

UNIT II

Digestive System: Gross anatomy of the digestive system, Components: mouth, tongue, teeth, salivary glands. Stomach, Intestine, Liver, biliary apparatus, pancreas – position and brief functions.

UNIT III

Respiratory System: Organs of the respiratory system. Respiratory portion: pleurae and lungs, Brief knowledge of parts, structure, and positions.

UNIT IV

Circulatory & Nervous Systems: Circulatory System: Heart – size, location, coverings, chambers, Blood supply and nerve supply, Major arteries and veins. Nervous System: Central nervous system – spinal cord anatomy and functions, Reflex arc and meninges.

UNIT V

Excretory & Reproductive Systems: Excretory System: kidneys, ureters, urinary bladder, Urethra. Reproductive System: Male reproductive system – testis, duct system, Female reproductive system – ovaries, duct system, accessory glands.

Reference Books

- Chaurasia, B.D. – *Human Anatomy* (Volume I–III), 8th Edition, CBS Publishers, 2020
- Snell, R.S. – *Clinical Anatomy by Regions*, 10th Edition, Wolters Kluwer, 2018
- Gray, H. – *Gray's Anatomy: The Anatomical Basis of Clinical Practice*, 42nd Edition, Elsevier, 2020
- Moore, K.L., Dalley, A.F., Agur, A.M.R. – *Clinically Oriented Anatomy*, 8th Edition, Wolters Kluwer, 2018
- Romanes, G.J. – *Cunningham's Manual of Practical Anatomy*, 16th Edition, Oxford University Press, 2017

🌐 Web Resources

- **American Association of Anatomists** – <https://www.anatomy.org>
- **MedlinePlus – Anatomy** – <https://medlineplus.gov/anatomy.html> (medlineplus.gov in Bing)
- **Khan Academy – Human Anatomy** – <https://www.khanacademy.org/science/health-and-medicine/human-anatomy> ([khanacademy.org](https://www.khanacademy.org) in Bing)

- **NCBI – Anatomy Resources** – <https://www.ncbi.nlm.nih.gov/guide/anatomy> (ncbi.nlm.nih.gov in Bing)
- **Visible Body – Anatomy Learning Tools** – <https://www.visiblebody.com>

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	L	L	L	L	L	M	L
CO2	S	M	M	M	L	L	L	M	M	L
CO3	S	S	M	M	M	M	L	M	M	L
CO4	S	M	S	S	M	L	M	M	M	L
CO5	S	S	S	S	M	M	M	M	S	M

S - Strong

M - Medium

L - Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
FIRST YEAR - SEMESTER – II
CORE – III – HUMAN PHYSIOLOGY

Objectives

- To understand the physiological basis of digestion, respiration, circulation, excretion, reproduction, and nervous control.
- To learn mechanisms of regulation and homeostasis in organ systems.
- To explore muscle physiology, cardiovascular functions, and skeletal system roles.
- To relate physiological processes to clinical and diagnostic applications.
- To develop analytical skills to interpret physiological data and integrate knowledge across systems.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Recall digestive physiology and absorption processes	K1 – Remember
CO2	Explain respiratory physiology and gas exchange	K2 – Understand
CO3	Apply knowledge of muscle contraction, cardiac cycle, and skeletal functions	K3 – Apply
CO4	Analyze renal physiology and reproductive processes	K4 – Analyze
CO5	Evaluate nervous system and sensory physiology; integrate knowledge	K5 – Evaluate, K6 – Evaluate

UNIT I

Digestive System: Overview of the digestive system, secretions of digestive tract, digestive hormones, process of digestion, absorption, assimilation of carbohydrates, proteins, fats, nucleic acids. Absorption of vitamins, minerals and water.

UNIT II

Respiratory System: Overview of the respiratory system, pulmonary ventilation, Alveolar ventilation, composition and partial pressure of inspired air, alveolar air and expired air, exchange and transport of respiratory gases.

UNIT III

Muscle physiology and Cardiovascular System: overview of muscle tissue, contraction and relaxation of skeletal muscle, cardiac muscle tissue and cardiac conduction system, cardiac cycle, cardiac output, blood pressure and E.C.G.

Skeletal System: Introduction to human skeletal system, skeletal divisions and functions of skeleton.

UNIT IV

Excretory System: Overview of renal system, Renal physiology: - glomerular filtration, tubular reabsorption and secretion, production of dilute and concentrated urine.

Reproductive System: Overview of male and female reproductive system, spermatogenesis, oogenesis and follicular development, menstrual cycle, physiology of pregnancy, parturition and lactation.

UNIT V

Nervous System: Overview of nervous system, classification of nervous system, signal transmission at synapse, neurotransmitters.

Special Senses: Physiology of Olfaction, Gustation, Vision, Hearing and equilibrium.

Reference Books

- Guyton & Hall's *Textbook of Medical Physiology* is published by Elsevier in its 15th edition (2025).
- Ganong's *Review of Medical Physiology* is available from McGraw Hill/Lange Medical Books in the 27th edition (2025).
- Sherwood's *Human Physiology: From Cells to Systems* was published by Cengage Learning (Brooks/Cole) in the 9th edition (2015).
- Sembulingam & Sembulingam's *Essentials of Medical Physiology* is published by Jaypee Brothers Medical Publishers in the 10th edition (2025).

- Berne & Levy's *Physiology*, authored by Bruce M. Koeppen and Bruce A. Stanton, is published by Elsevier in the 8th edition (2023).

Web Resources

- **American Physiological Society (APS)** – <https://www.physiology.org>
- **MedlinePlus – Human Physiology** – <https://medlineplus.gov/physiology.html> (medlineplus.gov in Bing) (bing.com in Bing)
- **Khan Academy – Human Physiology Tutorials** – <https://www.khanacademy.org/science/biology/human-biology> (khanacademy.org in Bing) (bing.com in Bing)
- **PhysiologyWeb** – <http://www.physiologyweb.com>
- **NCBI – National Center for Biotechnology Information** – <https://www.ncbi.nlm.nih.gov/> (ncbi.nlm.nih.gov in Bing) (bing.com in Bing)

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	M	L	L	M	L
CO2	S	M	S	M	M	M	L	M	M	M
CO3	S	S	S	S	M	M	L	M	M	S
CO4	S	S	S	M	M	M	L	M	M	S
CO5	S	S	S	S	S	S	M	M	S	S

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
FIRST YEAR - SEMESTER – II
CORE PRACTICAL – I – HUMAN ANATOMY AND PHYSIOLOGY

Objectives

- To develop practical skills in microscopy, staining, and cell identification.
- To understand structural organization of major human organs through models and slides.
- To acquire knowledge of physiological measurements and their clinical significance.
- To correlate theoretical concepts with experimental demonstrations.
- To prepare students for advanced biomedical and research applications.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Perform smear preparation, staining, and identification of prokaryotic/eukaryotic cells and organelles.	K3 – Application
CO2	Demonstrate mitotic stages using onion root tip squash preparation.	K2 – Understanding
CO3	Identify and explain major human organs using models and permanent slides.	K2 – Understanding
CO4	Measure body temperature, pulse, blood pressure, respiratory volumes, and interpret ECG recordings.	K3 – Application
CO5	Correlate anatomical and physiological data with theoretical knowledge for biomedical relevance.	K4 – Analysis

I. CELL BIOLOGY

1. Preparation of smear and identification of Prokaryotic and Eukaryotic cells.
2. Staining and visualization of mitochondria by Janus green stain.
3. Staining and visualization of the nuclear fraction by the Acetocarmine stain.
4. Squash preparation of onion root tips to observe mitotic stages.

II. HUMAN ANATOMY

Demonstration of Major organs through Models and Permanent Slides

1. Respiratory System
2. Cardiovascular System
3. Digestive System
4. Urogenital System
5. Nervous System
6. Skeletal and Muscular System
7. Structure of Eye and Ear

III. HUMAN PHYSIOLOGY

1. Measurement of Human Body Temperature Using Different Methods
2. Measurement of radial pulse under resting and exercise conditions
3. Measurement of Blood Pressure using sphygmomanometer and stethoscope, interpretation of systolic and diastolic values
4. Demonstration of heart electrical activity and basic interpretation using Electrocardiogram (ECG) Recordings.
5. Measurement of Respiratory Volumes and Capacities using Spirometry.

Reference Books

- Cell Biology by Alberts et al. – Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter; 6th Edition; Garland Science; 2015.
- Practical Physiology by C.L. Ghai – C.L. Ghai; 9th Edition; Jaypee Brothers Medical Publishers; 2013.
- Human Anatomy & Physiology Laboratory Manual by Elaine N. Marieb – Elaine N. Marieb & Lori A. Smith; 12th Edition; Pearson; 2018.
- Textbook of Medical Physiology by Guyton & Hall – Arthur C. Guyton & John E. Hall; 13th Edition; Elsevier; 2016.
- Principles of Anatomy and Physiology by Tortora & Derrickson – Gerard J. Tortora & Bryan H. Derrickson; 15th Edition; Wiley; 2017.

🌐 Web Resources

- **Easy Biology Class – Cell Biology** – Free tutorials, notes, and diagrams.
<https://www.easybiologyclass.com>
- **NCBI Bio**

- **kshelf – Cell & Molecular Biology** – Open-access reference materials.
<https://www.ncbi.nlm.nih.gov/books> ([ncbi.nlm.nih.gov](#) in Bing)
- **Khan Academy – Cell Biology** – Interactive lessons on cell structure, organelles, and cell cycle.
<https://www.khanacademy.org/science/biology/cell-biology> ([khanacademy.org](#) in Bing)
- **Visible Body – Anatomy Learning Tools** – 3D anatomy visualization platform.
<https://www.visiblebody.com>
- **American Physiological Society (APS)** – Professional physiology resources.
<https://www.physiology.org>
- **PhysiologyWeb** – Concise explanations of physiological principles.
<http://www.physiologyweb.com>

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	L	M	M	L	M	L
CO2	S	M	S	M	L	M	M	L	M	L
CO3	S	S	M	M	M	M	S	M	M	L
CO4	S	S	S	S	M	S	S	M	S	M
CO5	S	S	S	S	S	S	S	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SEMESTER – II
SKILL ENHANCEMENT COURSE (SEC) – DIET AND NUTRITION

(Only for NMSDC Reappear Students)

Objectives

- To introduce the fundamentals of nutrition and dietary guidelines.
- To classify food groups and explain their nutritional functions.
- To understand nutritional requirements across different life stages.
- To analyze diet in relation to diseases and deficiencies.
- To apply food safety and regulatory standards in practice.

Course Outcome

On successful completion of this course, students should be proficient to

CO No	Course Outcome	Knowledge Level
CO1	Explain the basic concepts of nutrition and RDA	K2 – Understanding
CO2	Identify food groups and evaluate their nutritional value	K3 – Applying
CO3	Assess nutritional needs across life stages	K4 – Analyzing
CO4	Relate diet to malnutrition and lifestyle diseases	K5 – Evaluating
CO5	Apply food safety and regulatory measures	K3 – Applying

UNIT I

Basics of Nutrition: Definition and scope of nutrition, Nutrients: carbohydrates, proteins, fats, vitamins, minerals, water, Balanced diet and dietary guidelines, Recommended Dietary Allowances (RDA).

UNIT II

Food Groups and Functions: Classification of foods: cereals, pulses, fruits, vegetables, milk, meat, fish, eggs, Nutritional value and role in health, Energy content of foods, Functional foods and nutraceuticals.

UNIT III

Nutrition in Life Stages: Nutritional needs of infants, children, adolescents, Nutrition during pregnancy and lactation, Nutrition for elderly, Nutrition for athletes and special groups.

UNIT IV

Diet and Disease: Malnutrition: undernutrition and overnutrition, Protein energy malnutrition (PEM), Micronutrient deficiencies (iron, iodine, vitamin A, vitamin D), Diet in lifestyle diseases: diabetes, hypertension, obesity, cardiovascular diseases.

UNIT V

Food Safety and Regulations: Food hygiene and sanitation, Food adulteration and safety standards, National and international food regulations (FSSAI, Codex Alimentarius), Food preservation methods.

Reference Books

- Swaminathan, M. *Essentials of Food and Nutrition*, 2nd Edition, 2012, Bangalore Printing & Publishing Co.
- Gopalan, C., Rama Sastri, B.V., & Balasubramanian, S.C. *Nutritive Value of Indian Foods*, Revised Edition, 2011, National Institute of Nutrition (ICMR).
- Bamji, M.S., Krishnaswamy, K., & Brahmam, G.N.V. *Textbook of Human Nutrition*, 4th Edition, 2019, Oxford & IBH Publishing.
- Whitney, E. & Rolfes, S.R. *Understanding Nutrition*, 15th Edition, 2018, Cengage Learning.
- Gibney, M.J., Lanham-New, S.A., Cassidy, A., & Vorster, H.H. *Introduction to Human Nutrition*, 3rd Edition, 2013, Wiley-Blackwell.

Web Resources

- **WHO Nutrition Guidance** – <https://www.who.int/health-topics/nutrition> ([who.int](https://www.who.int/health-topics/nutrition) in Bing)

- **FAO Nutrition Portal** – <https://www.fao.org/nutrition/en/>
- **ICMR-NIN Resources** – <https://www.nin.res.in/>
- **CDC Nutrition Basics** – <https://www.cdc.gov/nutrition/index.html>
- **Harvard Nutrition Source** – <https://www.hsph.harvard.edu/nutritionsource/>
([hsph.harvard.edu](https://www.hsph.harvard.edu/nutritionsource/) in Bing)

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	L	L	M	L	L	M	L
CO2	M	S	M	L	L	M	L	L	M	L
CO3	M	S	S	M	M	M	L	M	S	M
CO4	S	M	S	S	M	S	M	M	S	M
CO5	M	M	S	S	M	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SECOND YEAR - SEMESTER – III
CORE – IV – ENZYMES

Objectives

- To introduce the history, classification, and basic concepts of enzymes.
- To explain enzyme active sites, catalytic mechanisms, and theories of enzyme–substrate interaction.
- To understand enzyme kinetics, factors affecting activity, and types of inhibition and regulation.
- To describe coenzymes, isoenzymes, allosteric enzymes, and multienzyme complexes with examples.
- To provide knowledge of immobilized enzymes, isolation/purification methods, and industrial/medical applications.

Course Outcome

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Recall enzyme history, terminology, classification, and basic concepts such as holoenzymes and ribozymes.	K1 – Remember
CO2	Explain enzyme active sites, catalytic mechanisms, and theories of enzyme–substrate interaction.	K2 – Understand
CO3	Apply enzyme kinetics equations (Michaelis–Menten, Lineweaver–Burk, etc.) to calculate parameters like V_{max} and K_m .	K3 – Apply
CO4	Analyze the effects of pH, temperature, inhibitors, and activators on enzyme activity and regulation.	K4 – Analyze
CO5	Evaluate the role of coenzymes, isoenzymes, and allosteric enzymes in biochemical reactions and clinical contexts.	K5 – Evaluate
CO6	Design experimental approaches using immobilized enzymes and purification methods, and propose industrial/medical applications.	K6 – Create

UNIT I

Introduction to Enzymes: History and terminology, nomenclature and IUB classification of enzymes. Holoenzymes, Apoenzymes, metalloenzymes, metal activated enzymes, monomeric enzymes, oligomeric enzymes, and ribozymes. Enzyme specificity, specific activity, units of enzyme activity – IU and Katal. Enzyme turn over.

UNIT II

Active Site: Structure of active site and its characteristics, theories of ES complex - Lock and key, induced fit and substrate strain theory. **Nature of Enzyme Catalysis:** Acid - base catalysis, covalent catalysis, Metal ion catalysis, Electrostatic catalysis. **Mechanism of Action of Specific Enzyme:** - lysozyme.

UNIT III

Enzyme Kinetics: Michaelis-Menten Equation: - Initial velocity and steady state approach, V_{max} , K_m and their significance, Linear transformation of Michaelis-Menten Equation; - Lineweaver-Burk Plot, Eadie-Hofstee Plot, Hanes Plot.

Factors Affecting Enzyme Activity: - Effect of pH, temperature, enzyme concentration, substrate concentration, and the presence of inhibitors and activators.

Enzyme Inhibition: - Types of inhibition - Reversible inhibition - Competitive, Non-competitive and Uncompetitive inhibition. Irreversible inhibition, Feedback inhibition.

Regulation of Enzyme Activity: Allosteric inhibition, covalent modification.

UNIT IV

Coenzymes: The structure and function of following coenzymes in enzyme catalyzed reactions – Thiamine pyrophosphate, nicotinamide nucleotides, Flavin nucleotides, Coenzyme A, Lipoate, Folate and biotin.

Isoenzymes: Definition, features and clinical significance with examples – Lactate dehydrogenase (LDH) and creatine kinase (CK).

Allosteric Enzymes: Definition, structure and properties with example - Aspartate transcarbamoylase.

Multienzymes Complex – Pyruvate dehydrogenase complex (PDH complex)

UNIT V

Immobilized Enzymes: Principles, methods and applications of immobilized enzymes.

Isolation and Purification of Enzymes: Methods of isolation and purification of enzymes from microbial, plant and animal sources, determination of purity of isolated enzymes.

Applications of enzymes- in food, textile and leather industries and role of enzymes in medicine.

Reference Books

- Enzymes – Dixon, E.C. Webb, CJR Thorne, K.F. Tipton, Longmans, London.
- Fundamentals of Enzymology – Nicholas C. Price & Lewis Stevens, Oxford University Press (2nd Edition, 1998).
- Understand Enzymes – Trevor Palmer, Ellis Horwood Limited (3rd Edition, 1991).
- Protein Biotechnology – Gary Walsh & Denis Headon, John Wiley and Sons (1994).
- Protein Biochemistry and Biotechnology – Gary Walsh, John Wiley and Sons Ltd. (2002).

Web Resources

- University of Wisconsin Biochemistry Symposium (Steenbock Abstracts)**
https://biochem.wisc.edu/sites/default/files/symposia/steenbock/36th/36th_Steenbock_Abstract_Book_web.pdf ([biochem.wisc.edu](#) in Bing)
- NCBI Bookshelf – Enzyme Function and Kinetics**
<https://www.ncbi.nlm.nih.gov/books> ([ncbi.nlm.nih.gov](#) in Bing)
- Khan Academy – Enzyme Structure and Function**
<https://www.khanacademy.org/science/biology>
- Easy Biology Class – Enzymology Notes** <https://www.easybiologyclass.com>
- NPTEL (IIT Online Lectures) – Enzyme Technology** <https://nptel.ac.in>

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	M	L	L	M	L
CO2	S	M	S	M	L	M	L	M	M	L
CO3	S	S	S	M	M	M	L	M	M	L
CO4	S	S	S	M	M	M	L	M	M	M
CO5	S	M	S	M	M	S	M	M	S	M
CO6	S	S	S	S	S	M	M	M	S	M

S - Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SECOND YEAR - SEMESTER – III
ELECTIVE – I – A) ANALYTICAL TECHNIQUES

Objectives

- To introduce the principles and applications of chromatography techniques.
- To explain the fundamentals of centrifugation and its types.
- To describe electrophoresis methods and their uses in biomolecule separation.
- To understand the principles and applications of spectroscopy in biochemical analysis.
- To provide knowledge of radioisotope techniques, detection methods, and safety aspects.

Course Outcome

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Recall the principles and procedures of chromatography, centrifugation, electrophoresis, spectroscopy, and radioisotope techniques.	K1 – Remember
CO2	Explain the working principles, instrumentation, and applications of biochemical techniques.	K2 – Understand
CO3	Apply knowledge of separation and detection methods to analyze biomolecules in laboratory experiments.	K3 – Apply
CO4	Analyze the differences among various techniques (chromatography types, centrifugation methods, electrophoresis systems) and evaluate their suitability for specific applications.	K4 – Analyze
CO5	Evaluate the advantages, limitations, and safety aspects of spectroscopy and radioisotope techniques in biochemical research.	K5 – Evaluate
CO6	Design experimental approaches using combinations of biochemical techniques to solve research problems.	K6 – Create

UNIT I

Chromatography: Principles, procedure and applications of Paper chromatography, Thin layer chromatography, column chromatography - Ion exchange chromatography, gel filtration chromatography, affinity chromatography. Gas Liquid Chromatography, High performance Liquid Chromatography.

UNIT II

Centrifugation: Basic principles of sedimentation, Svedberg's constant, sedimentation velocity and sedimentation equilibrium. Types of centrifuges – desk top, high speed and ultracentrifuges. Types of Rotors - swinging bucket, fixed angle, vertical tube and zonal rotor. Types of centrifugation: Preparative centrifugation - differential and density gradient centrifugation with applications, Analytical centrifugation – molecular weight determination.

UNIT III

Electrophoresis: Principles, techniques and applications of paper electrophoresis, gel electrophoresis - agarose, SDS- PAGE, Capillary electrophoresis, isoelectric focusing, Factors affecting electrophoresis.

UNIT IV

Spectroscopy: Laws of absorption -Beer - Lambert's law and its limitations. Principles, instrumentations and applications of colorimeter, spectrophotometer, spectrofluorimeter and flame photometer.

UNIT V

Radioisotope Techniques: Radioactivity, stable and radioactive isotopes, Radioactive decay - rate of radioactive decay and $t_{1/2}$ of radioactivity. Methods of detection of radioisotopes: - GM counter, Scintillation counter. Autoradiography and its applications. Advantages, disadvantages and safety aspects of radio isotopic techniques.

Reference Books

- Principles and Techniques of Biochemistry and Molecular Biology – Keith Wilson & John Walker; 7th Edition; Cambridge University Press; 2010.
- Biophysical Chemistry – Charles R. Cantor & Paul R. Schimmel; Part I–III; W.H. Freeman; 1980.
- Biochemistry Laboratory: Modern Theory and Techniques – Rodney Boyer; 2nd Edition; Pearson; 2011.
- Practical Biochemistry – Harold Varley; 4th Edition; CBS Publishers; 1988.
- Biochemical Techniques: Theory and Practice – John F. Robyt & Bernard J. White; Waveland Press; 1987.
- Biochemistry – Debajyoti Das; 19th Edition; Academic Publishers, India; 2019.
- Biochemistry – U. Satyanarayana & U. Chakrapani; 5th Edition; Books & Allied Pvt. Ltd.; 2017.

Web Resources

- **NCBI Bookshelf – Biochemistry Methods** <https://www.ncbi.nlm.nih.gov/books/ncbi.nlm.nih.gov.in/Bing/>
- **Khan Academy – Biochemistry & Lab Techniques** <https://www.khanacademy.org/science/biology>
- **Easy Biology Class – Biochemical Techniques Notes** <https://www.easybiologyclass.com>
- **Springer – Principles and Techniques of Biochemistry and Molecular Biology** <https://link.springer.com>
- **Coursera – Biochemistry Courses & Lab Methods** <https://www.coursera.org>
- **NPTEL (IIT Online Lectures) – Biochemistry & Biotechnology** <https://nptel.ac.in>

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	M	L	L	M	L
CO2	S	M	S	M	M	M	L	M	M	L
CO3	S	S	S	M	M	M	L	M	M	L
CO4	S	S	S	M	M	M	L	M	M	M
CO5	S	M	S	M	M	S	M	M	S	M
CO6	S	S	S	S	S	M	M	M	S	M

S- Strong

M- Medium

L-Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SECOND YEAR - SEMESTER – III
ELECTIVE – I – B) BIOMEDICAL INSTRUMENTATION

Objectives

- To understand biomedical monitoring principles for cardiovascular, neurophysiology, and respiratory systems.
- To learn diagnostic imaging techniques including X-ray, CT, MRI, PET, and ultrasound.
- To gain knowledge of life-support equipment such as pacemakers, defibrillators, ventilators, and infusion pumps.
- To explore therapeutic and rehabilitation devices including diathermy, dialysis, prosthetics, and physiotherapy tools.
- To develop practical skills in handling, calibration, and safety of biomedical instruments.

Course Outcome

On successful completion of this course, students should be proficient to

CO No.	Course outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Explain principles of cardiovascular & neurophysiology monitoring	K2 – Understanding
CO2	Demonstrate respiratory monitoring and support systems	K3 – Applying
CO3	Analyze medical imaging modalities and diagnostic tools	K4 – Analyzing
CO4	Evaluate assisting & life-support equipment	K5 – Evaluating
CO5	Apply therapeutic & rehabilitation equipment in clinical practice	K3 – Applying
CO6	Integrate safety, calibration, and ethical use of biomedical devices	K6 – Creating

UNIT I

Cardiovascular & Neurophysiology Monitoring: Measurement of blood pressure – sphygmomanometer, Cardiac output and cardiac rate, Heart sounds – stethoscope, Electrodiagnostic techniques: ECG, EEG, EMG, ERG, Pulse oximetry, Phonocardiography, Blood flow measurement techniques.

UNIT II

Respiratory Monitoring & Support Systems: Monitoring of inspired/expired anesthetic gases, Capnography, Inhalators, nebulizers, aspirators, Infant respirator, Plethysmography, Spirometry, Oxygen concentrators, CPAP/BiPAP devices.

UNIT III

Medical Imaging & Diagnostic Tools: X-ray machine – radiographic and fluoroscopic techniques, Computed tomography (CT), Magnetic resonance imaging (MRI), Positron emission tomography (PET), Ultrasonography, Endoscopy, Thermography, Digital radiography, Nuclear medicine imaging (SPECT), Optical coherence tomography (OCT).

UNIT IV

Assisting & Life-Support Equipment: Pacemakers, Defibrillators, Ventilators, Infusion pumps, Syringe pumps, Automated external defibrillators (AEDs), Patient monitoring systems

UNIT V

Therapeutic & Rehabilitation Equipment: Nerve and muscle stimulators, Diathermy (shortwave, microwave, ultrasonic), Heart–lung machine, Audiometers, Dialyzers, Physiotherapy equipment (TENS UNIT s, ultrasound therapy), Laser therapy devices, Cochlear implants, Prosthetic and orthotic devices.

Reference Books

- Principles of Medical Instrumentation – John G. Webster, Wiley, 4th Edition, 2009.
- Medical Instrumentation: Application and Design – John G. Webster, Wiley, 5th Edition, 2014.
- Biomedical Instrumentation and Measurements – Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Prentice Hall, 2nd Edition, 1980.
- Handbook of Biomedical Instrumentation – R.S. Khandpur, McGraw Hill, 3rd Edition, 2014.
- Introduction to Biomedical Engineering – John Enderle, Joseph Bronzino, Academic Press, 3rd Edition, 2011.

Web Resources

- NIH Biomedical Imaging – National Institutes of Health**
<https://www.nibib.nih.gov/science-education/science-topics/biomedical-imaging>
 (nibib.nih.gov in Bing)
- WHO Medical Devices – World Health Organization** <https://www.who.int/health-topics/medical-devices> (who.int in Bing)
- PubMed Biomedical Engineering – Research articles & journals**
<https://pubmed.ncbi.nlm.nih.gov/?term=biomedical+engineering>
 (pubmed.ncbi.nlm.nih.gov in Bing)
- IEEE Xplore Biomedical Instrumentation – Technical papers**
<https://ieeexplore.ieee.org/Xplore/home.jsp>
- FDA Medical Devices – Regulatory guidelines** <https://www.fda.gov/medical-devices>
 (fda.gov in Bing)

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	M	M	L	L	M	L	M
CO2	S	S	M	M	S	M	L	M	M	M
CO3	S	S	S	S	S	M	M	M	M	S
CO4	S	M	S	M	S	M	M	S	M	M
CO5	M	M	S	M	S	M	M	M	S	S
CO6	S	S	S	S	S	S	M	S	S	S

S- Strong

M- Medium

L-Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SECOND YEAR - SEMESTER – III
SKILL ENHANCEMENT COURSE – I – FIRST AID

Objectives

- To understand the fundamental principles, aims, and legal aspects of first aid.
- To learn essential emergency response techniques for various situations.
- To acquire practical skills in CPR, airway management, and life support.
- To develop competence in handling injuries, trauma, and medical emergencies.
- To gain awareness of environmental hazards, poisoning, and disaster evacuation methods.

Course Outcome

On successful completion of this course, students should be proficient to

CO No.	Learning Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Explain the aims, principles, and legal aspects of first aid; identify contents of a first aid kit	K1 - Remember & K2 Understand
CO2	Demonstrate CPR, AED use, Heimlich maneuver, and management of breathing emergencies	K3 - Application
CO3	Apply first aid techniques for trauma, fractures, burns, and shock	K3 - Application & K4 - Analysis
CO4	Recognize and respond to medical emergencies like stroke, seizures, heart attack, and diabetic crises	K4 - Analysis & K5 - Evaluation
CO5	Provide first aid for poisoning, bites, environmental hazards, and electrical injuries	K3 - Application & K5 -Evaluation

UNIT I

Fundamentals of First Aid & Emergency Response: Aims, principles, and legal aspects of first aid, dealing with emergency, types and content of a first aid kit. First aid techniques – Dressing and bandaging techniques, Safe lifting, moving, and transportation of victims, Evacuation during disasters (fire, earthquake basics). 6 Hrs

UNIT II

Airway, Breathing & Life Support: Basics of respiration and oxygen supply, CPR (Cardiopulmonary Resuscitation) – adult, child, infant, Use of AED (Automated External Defibrillator), First aid for Choking (Heimlich maneuver) , Drowning , Asthma attacks (use of inhalers), Allergic reactions (anaphylaxis awareness), Smoke inhalation and gas poisoning, Strangulation and hanging cases, Managing breathing difficulty in crowded/public places. 6 Hrs

UNIT III

Injuries & Trauma Management: First aid for Cuts, wounds, and bleeding control, Head, chest, and abdominal injuries, Burns, Fractures, sprains, and dislocations, Amputations, Shock management, Road accident response basics. 6 Hrs

UNIT IV

Medical Emergencies: First aid related to unconsciousness, Stroke recognition (FAST method), Seizures and epilepsy care, Fainting and dizziness, Heart attack, Diabetic emergencies (low/high blood sugar), Panic attacks and basic mental health first aid, Heat stroke and hypothermia. 6 Hrs

UNIT V

Poisoning, Bites & Environmental Emergencies: First aid for Snake bites and insect stings, Animal bites (rabies awareness), Food poisoning, Chemical poisoning (acids, alkalis, household cleaners), Drug and alcohol poisoning, Handling contamination and use of disinfectants. First aid for environmental emergencies:- Electric shock, Lightning injuries, Water-related accidents. 6 Hrs

Reference Books

- American Red Cross. *First Aid/CPR/AED Participant's Manual*. Revision 2025. American Red Cross, 2025.
- St. John Ambulance, St. Andrew's First Aid, British Red Cross. *First Aid Manual*. 10th Edition. Dorling Kindersley (DK), 2014.
- Tintinalli, J. E. *Emergency Medicine: A Comprehensive Study Guide*. 9th Edition. McGraw-Hill Education, 2019.
- Limmer, D., O'Keefe, M. F., Dickinson, E. T. *Emergency Care (Brady Series)*. 14th Edition. Pearson, 2020.

Web Resources

- **World Health Organization – Emergency Preparedness**
<https://www.who.int/emergencies> ([who.int](#) in Bing)
- **American Heart Association – CPR & First Aid** <https://cpr.heart.org>
- **Red Cross First Aid Resources** <https://www.redcross.org/firstaid>
- **National Safety Council – First Aid & CPR** <https://www.nsc.org/first-aid>

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	M	L	M	M
CO2	S	M	S	S	M	M	L	M	M	M
CO3	S	S	S	S	M	M	L	M	M	S
CO4	S	S	S	M	M	M	M	M	M	S
CO5	S	M	S	M	M	S	M	M	S	S

S – Strong

M - Medium

L - Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SEMESTER – III
SKILL ENHANCEMENT COURSE (SEC) – DIET THERAPY

(Only for NMSDC Reappear Students)

Objectives

- To introduce the principles of diet therapy and scope of nutrition care.
- To understand therapeutic diets and their applications.
- To analyze energy balance and weight management strategies.
- To apply nutrition therapy in gastrointestinal, cardiovascular, metabolic, and renal disorders.
- To gain practical skills in planning and preparing therapeutic diets for special conditions.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No	Course Outcome	Knowledge Level
CO1	Explain principles of diet therapy and nutrition care process	K2 – Understanding
CO2	Apply therapeutic diets in energy and weight management	K3 – Applying
CO3	Analyze dietary modifications for gastrointestinal and cardiovascular disorders	K4 – Analyzing
CO4	Evaluate nutrition therapy for metabolic and renal disorders	K5 – Evaluating
CO5	Demonstrate practical skills in planning therapeutic diets for special conditions	K6 – Creating

UNIT I

Principles of Diet Therapy & Nutrition Care: Definitions and scope of diet therapy, Types of therapeutic diets: Clear liquid, soft diet, High/low protein, Calorie-restricted diets, Nutrition Care Process (NCP): Assessment, Diagnosis, and Intervention.

UNIT II

Energy & Weight Management: Energy modifications in diet, Diet and management of: Obesity, Overweight, Underweight, Eating disorders: Anorexia nervosa, Bulimia nervosa.

UNIT III

Gastrointestinal & Cardiovascular Disorders: Dietary management for: Constipation, Diarrhea, Peptic ulcers, Ulcerative colitis, Cardiovascular system diets: Hypertension, Atherosclerosis, Congestive heart failure.

UNIT IV

Metabolic & Renal Disorders: Nutrition therapy for: Diabetes Mellitus (Type I & II), Thyroid dysfunction, Inborn errors of metabolism, Renal diseases: Nephritis, Nephrotic syndrome, Acute & chronic renal failure - dialysis diets.

UNIT V

Special Conditions & Practical Applications: Febrile conditions & surgery: Diet for fevers, infections, HIV. Pre-operative & post-operative nutrition, Nutritional management for Anemia & blood disorders, Practical application: Planning and preparation of therapeutic diets (e.g., liquid diets, low-sodium diets)

Reference Books

- Krause, M.V. & Mahan, L.K. *Food & Nutrition Care Process*, 14th Edition, 2017, Elsevier.
- Bamji, M.S., Krishnaswamy, K., & Brahman, G.N.V. *Textbook of Human Nutrition*, 4th Edition, 2019, Oxford & IBH Publishing.
- Gopalan, C., Rama Sastri, B.V., & Balasubramanian, S.C. *Nutritive Value of Indian Foods*, Revised Edition, 2011, National Institute of Nutrition (ICMR).
- Whitney, E. & Rolfes, S.R. *Understanding Nutrition*, 15th Edition, 2018, Cengage Learning.
- Escott-Stump, S. *Nutrition and Diagnosis-Related Care*, 8th Edition, 2015, Wolters Kluwer Health.

Web Resources

- **WHO Nutrition Guidance** – <https://www.who.int/health-topics/nutrition> ([who.int](https://www.who.int/) in Bing)
- **FAO Nutrition Portal** – <https://www.fao.org/nutrition/en/>
- **ICMR-NIN Resources** – <https://www.nin.res.in/>
- **CDC Nutrition Basics** – <https://www.cdc.gov/nutrition/index.html>
- **Harvard Nutrition Source** – <https://www.hsph.harvard.edu/nutritionsource/> ([hsph.harvard.edu](https://www.hsph.harvard.edu/) in Bing)

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	L	L	M	L	L	M	L
CO2	M	S	M	L	L	M	L	L	M	L
CO3	M	S	S	M	M	M	L	M	S	M
CO4	S	M	S	S	M	S	M	M	S	M
CO5	M	M	S	S	M	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SECOND YEAR - SEMESTER – IV
CORE – V – MEDICAL BIOCHEMISTRY

Objectives

- To understand carbohydrate metabolism disorders including diabetes mellitus and inborn errors.
- To classify lipid metabolism disorders and explain their clinical significance.
- To analyze amino acid, nucleotide, and bilirubin disorders with clinical correlation.
- To evaluate liver, renal, and enzyme function tests for diagnostic purposes.
- To apply gastric, pancreatic, and intestinal function tests in clinical biochemistry practice.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To describe carbohydrate metabolism disorders including diabetes and inborn errors	K2 – Understanding
CO2	To classify lipid metabolism disorders and explain their clinical significance	K3 – Application
CO3	To interpret amino acid, nucleotide, and bilirubin disorders	K4 – Analysis
CO4	To evaluate liver, renal, and enzyme function tests	K5 – Evaluation
CO5	To apply gastric, pancreatic, and intestinal function tests in diagnosis	K6 – Creation

UNIT I

Disorders of Carbohydrate Metabolism: Carbohydrate Metabolism: Diabetes mellitus: - Aetiology, classification, Clinical features, complications, laboratory investigations - GTT. Inborn errors of carbohydrate metabolism: - Galactosaemia, Fructosuria, Lactose intolerance, Pentosuria and Glycogen Storage Diseases.

UNIT II

Disorders of Lipid Metabolism: Hyperlipoproteinaemia – classifications, Hypercholesterolemia, ketosis and its significance, Cardiovascular disorders - Atherosclerosis – aetiology, clinical features and its complications. Lipid storage diseases – Niemann-pick disease, Fabry disease, Tay-Sachs disease and Gaucher's disease. Fatty liver – causes, types, symptoms and diagnosis.

UNIT III

Disorders of Amino Acid and Protein Metabolism: Inborn errors of amino acid metabolism: - Phenylketonuria, alkaptonuria, cystinuria, albinism and tyrosinemia.

Disorders of Nucleotide Metabolism: Gout, Lesh-Nyhan syndrome, xanthinuria, orotic aciduria.

Disorders of Bilirubin Metabolism: Jaundice: - classification, clinical features.

UNIT IV

Liver Function Tests: Liver Function Tests: Tests based on abnormalities of bile pigment metabolism, carbohydrate metabolism, lipid metabolism, amino acid metabolism, detoxification and excretory function of liver.

Renal Function Tests: Tests based on Glomerular filtration, renal plasma flow and tubular function.

Enzymology: Clinical significance of SGOT, SGPT, ALP, ACP, CPK and LDH.

UNIT V

Gastric Function Tests: Examination of resting contents in resting juice, Fractional gastric analysis using test meal and Examination of the contents after stimulation.

Pancreatic function Tests: Introduction, serum amylase and lipase; direct stimulation test, indirect stimulation test.

Intestinal function Test: Introduction, Test used in the diagnosis of malabsorption-determination of total faecal fat (fat balance test), test of monosaccharide absorption (xylose excretion test) and determination of total protein (Lowry's method).

Reference Books

- Tietz Textbook of Clinical Chemistry and Molecular Diagnostics – Burtis, Ashwood & Bruns, 2018, Elsevier, 6th Edition

- Clinical Biochemistry: Metabolic and Clinical Aspects – Marshall & Bangert, 2014, Churchill Livingstone, 3rd Edition
- Harper's Illustrated Biochemistry – Victor W. Rodwell et al., 2021, McGraw Hill, 31st Edition
- Lehninger Principles of Biochemistry – Nelson & Cox, 2021, W.H. Freeman, 8th Edition

Web Resources

- **MedlinePlus** – Clinical biochemistry and metabolic disorders
- **PubMed (pubmed.ncbi.nlm.nih.gov in Bing)** – Research articles on metabolic disorders
- **Lab Tests Online** – Explanation of diagnostic tests
- **WHO Health Topics (who.int in Bing)** – Global perspectives on metabolic diseases

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	M	L	L	M	L
CO2	S	M	S	M	L	M	L	M	M	L
CO3	S	S	M	M	M	M	L	M	M	L
CO4	S	S	S	M	M	M	L	M	M	M
CO5	S	M	S	M	L	M	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SECOND YEAR - SEMESTER – IV
ELECTIVE – II – A) PHARMACOLOGY AND TOXICOLOGY

Objectives

- To define general pharmacology including scope, sources, routes, dosage forms, and drug interactions.
- To explain pharmacokinetics and pharmacodynamics with emphasis on absorption, distribution, metabolism, excretion, and receptor theories.
- To analyze toxicological principles including ADRs, poisoning, drug dependence, tolerance, and intolerance.
- To evaluate systemic pharmacology with drugs acting on ANS, cardiovascular, respiratory, and gastrointestinal systems.
- To understand drug discovery and regulation including clinical trials, ethics, regulatory authorities, and pharmacovigilance.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To describe general pharmacology including sources, routes, dosage forms, and drug interactions	K2 – Understanding
CO2	To explain pharmacokinetics and pharmacodynamics and factors modifying drug action	K3 – Application
CO3	To analyze toxicology including ADRs, poisoning, dependence, tolerance, and intolerance	K4 – Analysis
CO4	To evaluate systemic pharmacology with drugs acting on ANS, CVS, RS, and GIT	K5 – Evaluation
CO5	To understand drug discovery and regulation including trials, ethics, and pharmacovigilance	K6 – Creation

UNIT I

General Pharmacology: Definitions, scope, and branches of pharmacology, Sources of drugs: natural, synthetic, biotechnological, Routes of drug administration, Dosage forms and calculations, Bioavailability and bioequivalence, Combined drug effects: synergism, antagonism, potentiation

UNIT II

Pharmacokinetics & Pharmacodynamics: Absorption, distribution, metabolism, and excretion of drugs, Pharmacokinetic parameters: half-life, C_{max}, T_{max}, Drug receptors and receptor theories, Mechanisms of drug action: receptor-mediated and non-receptor mediated, Factors modifying drug action.

UNIT III

Toxicology: Principles of toxicology, Types of adverse drug reactions (pharmacological, non-pharmacological, disease-related, multiple drug reactions), Acute and chronic poisoning – general principles and management, Drug dependence: psychological and physical, Drug tolerance and intolerance.

UNIT IV

Systemic Pharmacology: Drugs acting on the autonomic nervous system, Cardiovascular pharmacology: antihypertensives, antiarrhythmics, diuretics, Respiratory pharmacology: bronchodilators, anti-asthmatics, Gastrointestinal pharmacology: anti-ulcer drugs, laxatives, antiemetics,

UNIT V

Drug Discovery, Development & Regulation: Approaches to drug discovery: random, screening, molecular modification, rational drug design, Preclinical and clinical trials – phases and ethical considerations, Regulatory authorities: DCGI, CDSCO, FDA, WHO, Pharmacovigilance and post-marketing surveillance.

Reference Books

- **Goodman & Gilman's The Pharmacological Basis of Therapeutics** – Brunton, Hilal-Dandan, Knollmann, 2018, McGraw Hill, 13th Edition
- **Basic & Clinical Pharmacology** – Bertram G. Katzung, 2021, McGraw Hill, 15th Edition
- **Essentials of Medical Pharmacology** – K.D. Tripathi, 2019, Jaypee Brothers Medical Publishers, 8th Edition
- **Modern Pharmacology with Clinical Applications** – Craig & Stitzel, 2017, Lippincott Williams & Wilkins, 6th Edition

Web Resources

- **MedlinePlus** – Drug information and pharmacology basics
- **PubMed (pubmed.ncbi.nlm.nih.gov in Bing)** – Research articles on pharmacology and toxicology
- **FDA Drug Database** – Regulatory and approval information
- **WHO Essential Medicines (who.int in Bing)** – Global drug regulation and pharmacovigilance

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	M	L	L	M	L
CO2	S	S	S	M	M	M	L	M	M	L
CO3	S	S	M	M	M	S	M	M	M	L
CO4	S	S	S	S	M	M	M	M	M	M
CO5	S	M	S	M	M	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SECOND YEAR - SEMESTER – IV
ELECTIVE – II – B) IMMUNOLOGY

Objectives

- To explain types, mechanisms, and components of the immune system.
- To identify immunogens, epitopes, antibodies, and their properties.
- To use antigen-antibody interaction tests such as ELISA and immunofluorescence.
- To assess the role of vaccines, MHC molecules, hypersensitivity, and transplantation.
- To describe complement pathways, autoimmune diseases, immunodeficiency, and HIV infection.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Describe immUNIT y, hematopoiesis, immune cells/organs, and immune responses	K1 – Remember, K2 – Understand
CO2	Analyze immunogens, epitopes, antibodies, and monoclonal antibody applications	K4 – Analyze
CO3	Apply immunological assays to study antigen-antibody interactions	K3 – Apply
CO4	Evaluate vaccines, MHC roles, hypersensitivity, and transplantation immunology	K5 – Evaluate
CO5	Recognize immune disorders and synthesize HIV infection mechanisms	K1 – Remember, K6 – Evaluate

UNIT I

Introduction to Immunology: Immunity, types of immunity, mechanism of immunity, Hematopoiesis, cells and organs of the immune system. Humoral and cell mediated immune response, primary and secondary immune response.

UNIT II

Immunogens and Antigens: Immunogenicity, antigenicity, factors that influencing antigenicity, antigenic specificity, epitopes of an antigen, haptens, adjuvants. **Antibodies:** Structure, Classes, Subclasses, Properties of Immunoglobins, Antigenic determinants – isotypic, allotypic and idiotypic determinants. Production and applications of Monoclonal antibodies.

UNIT III

Antigen - Antibody Interactions: Antigen – antibody binding, strength of binding, Primary binding tests: - Radioimmunoassay, Immunofluorescence assays, Immunoenzyme assays- ELISA. Secondary binding tests: - Agglutination, Precipitation, Immunodiffusion, Immunoelectrophoresis. Complement fixation.

UNIT IV

Immunization: Vaccine and its types.

Major Histocompatibility Complex: Classification and role of MHC in immune response.

Hypersensitivity: Types – I to V. **Transplantation Immunology:** mechanism of graft acceptance and rejection,

UNIT V

Complement System: Classical and Alternative pathway, **Auto immunity:** - History and types of auto immune disorders. Immunodeficiency disorders: - Causes, symptoms, mechanism of HIV infection, HIV replication, transcription and diagnostic methods.

Reference Books

- Kuby Immunology – Jenni Punt, Sharon Stranford, Patricia Jones, Judy Owen; 8th Edition; W.H. Freeman / Macmillan Learning; 2018.
- Roitt's Essential Immunology – Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt; 13th Edition; Wiley-Blackwell; 2016.
- Janeway's Immunobiology – Kenneth M. Murphy, Casey Weaver, Leslie Berg; 10th Edition; W.W. Norton & Company; 2022.
- Cellular and Molecular Immunology – Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai, Sarah Henrickson; 11th Edition; Elsevier; 2025.
- Fundamental Immunology – William E. Paul (Editor); 7th Edition; Wolters Kluwer Health / Lippincott Williams & Wilkins; 2013.

Web Resources

- **NCBI Bookshelf – Immunology (ncbi.nlm.nih.gov in Bing)** – Free online textbooks and chapters on immunology.
- **Nature Immunology** – Peer-reviewed journal publishing cutting-edge immunology research.
- **Frontiers in Immunology** – Open-access journal covering all aspects of immunology.
- **WHO – Vaccines and Immunization (who.int in Bing)** – Global guidelines and resources on vaccines and immunization.
- **CDC – HIV Basics (cdc.gov in Bing)** – Authoritative information on HIV infection, replication, and prevention.

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	M	L	L	M	L
CO2	S	S	S	M	M	M	L	M	M	M
CO3	S	S	S	S	M	M	L	M	M	S
CO4	S	S	S	M	M	S	M	M	S	S
CO5	S	S	S	S	S	S	M	M	S	S

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SECOND YEAR - SEMESTER – IV
SKILL ENHANCEMENT COURSE – II – MEDICAL CODING

Objectives

- To understand the fundamentals of medical coding systems.
- To apply ICD-10-CM, CPT, and HCPCS codes accurately.
- To develop skills in medical billing and compliance documentation.
- To analyse coding practices for reimbursement and auditing.
- To explore advanced coding applications and emerging technologies

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Recall coding systems and ethical principles	K1 – Remember
CO2	Explain ICD-10-CM guidelines and apply them	K2 – Understand, K3 – Apply
CO3	Perform CPT/HCPCS coding with modifiers	K3 – Apply, K4 – Analyze
CO4	Evaluate billing processes and compliance standards	K5 – Evaluate
CO5	Design coding solutions using advanced tools	K6 – Evaluate

UNIT I

Introduction to Medical Coding: Basics of healthcare delivery systems, Role of medical coding in healthcare reimbursement, Overview of coding systems, Structure and format of ICD-10-CM codes, Medical terminology - specialization I and II, Ethical and legal aspects of medical coding.

UNIT II

ICD-10-CM Coding: Guidelines for diagnosis coding, Coding conventions and sequencing rules, Coding for infectious diseases, neoplasms, endocrine disorders, Coding for circulatory and respiratory system diseases, Case studies and practice exercises.

UNIT III

CPT & HCPCS Coding: Introduction to Current Procedural Terminology (CPT), CPT code structure: Evaluation & Management, Surgery, Radiology, Pathology, Medicine, HCPCS Level II codes: supplies, equipment, and services, Modifiers and their applications, Practical exercises in CPT/HCPCS coding.

UNIT IV

Medical Billing and Compliance: Revenue cycle management, Insurance claim process (CMS-1500 form), Coding for inpatient vs. outpatient services, Fraud, abuse, and compliance regulations (HIPAA, OIG guidelines), Documentation of medical record and auditing.

UNIT V

Advanced Topics and Applications: ICD-10-PCS for inpatient procedures, DRG (Diagnosis Related Groups) and reimbursement models, Electronic Health Records (EHR) integration with coding, Emerging trends: AI in medical coding, automation tools, Quality assurance and accuracy in coding.

Reference Books

- Medical Coding: ICD-10-CM, CPT, HCPCS – Carol J. Buck, 2020, Elsevier, 1st Edition
- Step-by-Step Medical Coding – Elsevier, 2021, Saunders, 9th Edition
- ICD-10-CM Official Guidelines for Coding and Reporting – CMS/CDC, 2025, Government Publication
- Principles of Healthcare Reimbursement – Anne Casto, 2019, AHIMA Press, 6th Edition

Web Resources

- **AAPC – American Academy of Professional Coders** – Certification and coding resources

- **AHIMA – American Health Information Management Association** – Coding and compliance guidelines
- **CMS – Centers for Medicare & Medicaid Services** – Official coding and billing regulations
- **WHO ICD Classification (who.int in Bing)** – International disease coding standards

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	M	L	M	L
CO2	S	S	S	M	M	M	L	M	M	M
CO3	S	S	S	S	M	M	L	M	M	S
CO4	S	S	S	M	M	S	M	M	S	S
CO5	S	S	S	S	S	M	M	M	S	S

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SECOND YEAR - SEMESTER – IV
CORE PRACTICAL – II – ENZYMES AND BIOCHEMICAL TECHNIQUES

Objectives

- To develop skills in enzyme isolation, assay, and immobilization.
- To understand the effect of physical and chemical factors on enzyme activity.
- To gain hands-on experience in chromatographic and electrophoretic separation techniques.
- To learn organelle isolation methods using centrifugation.
- To perform colorimetric estimations of biomolecules using classical methods.

Course Outcome

On successful completion of this course, students should be proficient to

CO No.	Course outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Isolate and determine enzyme activity	K2 – Understanding, K3 – Applying
CO2	Study specific activity, pH, temperature, substrate concentration	K3 – Applying, K4 – Analyzing
CO3	Entrap enzymes in sodium alginate gel	K4 – Analyzing, K5 – Evaluating
CO4	Separate biomolecules using paper, TLC, column chromatography	K3 – Applying, K4 – Analyzing
CO5	Separate proteins and organelles	K4 – Analyzing
CO6	Estimate biomolecules using colorimetric methods	K5 – Evaluating, K6 – Creating

I. Enzyme Assay

1. Isolation and Determination of the activity of the following enzymes
 - i. Acid phosphatase
 - ii. Alkaline phosphatase
 - iii. Urease
2. Determination of specific activity, effect of pH, temperature and substrate concentration of Salivary Amylase
3. Immobilization of enzymes by entrapment in sodium alginate gel.

II. Analytical Techniques

1. Separation of amino acids by paper chromatography.
2. Separation of lipids by thin-layer chromatography.
3. Separation of plant pigments by column chromatography
4. Separation of serum proteins by gel electrophoresis.

5. Isolation of cell organelles by differential centrifugation.

III. Colorimetric Analysis

1. Estimation of fructose by Seliwanoff's method.
2. Estimation of Amino Acids by Ninhydrin method.
3. Estimation of Phosphorus by Fiske Subbarow method.

Practical Reference Books

- Practical Biochemistry – D.T. Plummer; 3rd Edition; Tata McGraw-Hill; 1998.
- Laboratory Manual of Biochemistry – Ranjna Chaudhry; 2nd Edition; Jaypee Brothers Medical Publishers; 2014.
- Essentials of Practical Microbiology – R.C. Dubey, D.K. Maheshwari; 1st Edition; S. Chand; 2002.
- Practical Manual in Biochemistry – D.K. Jain; 1st Edition; Jaypee Brothers Medical Publishers; 2016.
- Biochemistry Laboratory Techniques – H.D. Kumar; 1st Edition; Vikas Publishing House; 2005.
-

🌐 Web Resources

- **NCBI Bookshelf** – Free access to biochemistry and lab manuals.
- **Khan Academy Biology** – Tutorials on enzyme kinetics and chromatography.
- **PubMed** – Research articles on enzyme assays and analytical techniques.
- **Biology Online** – Lab protocols and definitions.
- **ScienceDirect** – Peer-reviewed methods in biochemistry.

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	L	M	M	L
CO2	S	S	S	S	S	M	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SEMESTER – IV
SKILL ENHANCEMENT COURSE (SEC) – GOOD LABORATORY PRACTICES

(Only for NMSDC Reappear Students)

Objectives

- To introduce the principles of GLP and international guidelines (OECD, WHO).
- To familiarize students with laboratory infrastructure, equipment, and materials.
- To instill awareness of safety practices and hazard prevention.
- To provide knowledge on biosafety levels, risk assessment, and compliance.
- To develop skills in hazard identification, workplace inspection, and control measures.

Course Outcome

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Explain the fundamentals of GLP and international guidelines	K2 – Understanding
CO2	Identify laboratory facilities, glassware, chemicals, and equipment	K1 – Remembering
CO3	Apply general safety practices and interpret safety symbols	K3 – Applying
CO4	Analyze biosafety levels, risk assessment, and compliance measures	K4 – Analyzing
CO5	Evaluate hazards and propose appropriate control measures	K5 – Evaluating

UNIT I

Fundamentals of GLP, Overview of OECD - GLP principles and WHO GLP in brief.

UNIT II

General Science Laboratory facilities, glass wares, chemicals and common science lab equipments.

UNIT III

Safety practice in the laboratory - Laboratory safety rules – general good laboratory safety practices, personnel protection, chemical safety instructions, Do's and Don'ts in laboratory, Laboratory safety symbols.

UNIT IV

History of biosafety, Risk assessment, Biosafety levels, Personal protective equipment, Disinfection, decontamination, and sterilization, Regulatory compliance, Laboratory security and emergency response.

UNIT V

Collection of existing information and Inspection of the workplace for safety hazards, Identification of health hazards associated with emergency and non-routine situations, Characterization and control measures.

References

- ***Principles of Good Laboratory Practice***, 2nd Edition, 2021, OECD Publishing.
- **World Health Organization. *Handbook: Good Laboratory Practice (GLP)***, 1st Edition, 2010, WHO Press.
- **Carson, P.A. & Mumford, C.J. *Hazardous Laboratory Chemicals Disposal Guide***, 3rd Edition, 2012, Wiley-Interscience.
- **Fleming, D.O. & Hunt, D.L. *Biological Safety: Principles and Practices***, 5th Edition, 2014, ASM Press.
- **Collins, C.H. & Kennedy, D.A. *Laboratory-Acquired Infections and Biosafety***, 4th Edition, 1999, Butterworth-Heinemann.
- **Gad, S.C. *Safety Evaluation of Pharmaceuticals and Medical Devices***, 2nd Edition, 2016, Springer.
- **Sax, N.I. *Dangerous Properties of Industrial Materials***, 11th Edition, 2004, Wiley.

Web Resources

- OECD GLP Guidelines** – <https://www.oecd.org/chemicalsafety/testing/oecdprinciplesofgoodlaboratorypractice.htm> ([oecd.org](#) in Bing)
- WHO Laboratory Biosafety Manual** – <https://www.who.int/publications/i/item/9789240011311> ([who.int](#) in Bing)
- NIH Biosafety Resources** – <https://osp.od.nih.gov/biotechnology/biosafety/> ([osp.od.nih.gov](#) in Bing)
- CDC Laboratory Safety** – <https://www.cdc.gov/labsafety/index.html>
- OSHA Laboratory Safety Guidance** – <https://www.osha.gov/laboratory-safety> ([osha.gov](#) in Bing)
- FAO Biosafety Resources** – <https://www.fao.org/biosafety/en/>
- EPA Chemical Safety** – <https://www.epa.gov/chemical-research> ([epa.gov](#) in Bing)

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	M	L	L	M	L
CO2	M	S	M	L	L	M	L	L	M	L
CO3	M	S	S	M	M	M	L	M	S	M
CO4	S	M	S	S	M	S	M	M	S	M
CO5	M	M	S	S	M	S	M	M	S	M

S - Strong

M - Medium

L - Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
THIRD YEAR - SEMESTER – V
CORE – VI – CLINICAL HEMATOLOGY

Objectives

- To introduce fundamental principles of haematology and blood composition.
- To train haematological indices and basic laboratory tests.
- To provide knowledge of blood grouping and transfusion practices.
- To develop skills in clinical haematology investigations and diagnosis.
- To familiarize students with advanced techniques and modern applications.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Recall the basics of haematology and blood composition	K1 – Remember
CO2	Understand haematological indices and basic tests	K2 – Understand
CO3	Apply knowledge of blood grouping and transfusion	K3 – Apply
CO4	Analyze hematological findings in clinical conditions	K4 – Analyze
CO5	Evaluate advanced haematology techniques	K5 – Evaluate, K6 – Create

UNIT I

Introduction to Hematology: Definition, scope, and importance of hematology, Composition and functions of blood, Hematopoiesis – formation of blood cells, Collection and preservation of blood samples, Anticoagulants – types and uses, Laboratory safety and ethics in Hematology

UNIT II

Hematological Indices & Basic Tests: Hemoglobin estimation (Sahli's, Cyanmethemoglobin method), Hematocrit (Packed Cell Volume), Red cell indices: MCV, MCH, MCHC, ESR (Wintrobe/Westergren methods), Total RBC, WBC, and Platelet counts, Differential Leukocyte Count (DLC), Reticulocyte count.

UNIT III

Blood Grouping & Blood Banking: ABO and Rh blood grouping, Cross-matching techniques, Screening of donors and recipients, Hazards of blood transfusion, Coombs test (Direct and Indirect), Storage and preservation of blood and components, Hemolytic disease of the newborn.

UNIT IV

Clinical Hematology Investigations: Peripheral blood smear preparation and examination, Bone marrow aspiration – indications and procedure, Anemia: classification and laboratory diagnosis, Leukemias and lymphomas – hematological findings, Hemostatic disorders – bleeding time, clotting time, PT, Aptt, Quality control in hematology laboratories.

UNIT V

Advanced Hematology & Recent Techniques: Automated hematology analyzers, Flow cytometry in hematology, Immunohematology – principles and applications, Molecular techniques in hematology (PCR, FISH), Hematology in infectious diseases (malaria, filariasis, HIV-related changes), Recent advances in hematology diagnostics.

Reference Books

- Rodak B.F. – Hematology: Clinical Principles and Applications – 2020, Elsevier, 5th Edition
- Dacie & Lewis – Practical Haematology – 2017, Churchill Livingstone, 12th Edition
- Hoffbrand A.V. – Essential Haematology – 2019, Wiley-Blackwell, 7th Edition
- Turgeon M.L. – Clinical Hematology: Theory and Procedures – 2018, Wolters Kluwer, 6th Edition
- Williams Hematology – Kenneth Kaushansky et al. – 2021, McGraw Hill, 10th Edition

Web Resources

- **MedlinePlus – Hematology (medlineplus.gov in Bing)** – Overview of blood disorders and tests

- **American Society of Hematology** – Research, guidelines, and educational resources
- **Lab Tests Online** – Explanation of hematology laboratory tests
- **WHO Hematology Resources (who.int in Bing) (bing.com in Bing)** – Global standards and disease classification
- **PubMed Hematology Articles (pubmed.ncbi.nlm.nih.gov in Bing)** – Research publications in hematology

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	L	L	M	L
CO2	S	S	S	S	M	M	M	M	M	L
CO3	S	S	S	S	M	S	M	M	M	L
CO4	S	S	S	S	M	M	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
THIRD YEAR - SEMESTER – V
CORE – VII – CLINICAL PATHOLOGY

Objectives

- To introduce clinical pathology and general laboratory practices including specimen handling and safety.
- To perform urine and stool analysis with emphasis on physical, chemical, and microscopic examination.
- To analyze biochemical pathology including blood chemistry, fluid analysis, and infectious disease testing.
- To evaluate systemic pathology covering cardiovascular, respiratory, hepatic, and renal disorders.
- To apply microbiology and quality control in clinical laboratories with recent diagnostic advances.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To describe general laboratory practices in clinical pathology	K2 – Understanding
CO2	To perform urine and stool analysis and interpret abnormal findings	K3 – Application
CO3	To analyze biochemical pathology including blood chemistry and infectious disease testing	K4 – Analysis
CO4	To evaluate systemic pathology of cardiovascular, respiratory, hepatic, and renal systems	K5 – Evaluation
CO5	To apply microbiology and quality control with automation and molecular diagnostics	K6 – Creation

UNIT I

Introduction & General Laboratory Practices: Definition, scope, and importance of clinical pathology, Collection, preservation, and transportation of clinical specimens (urine, stool, sputum, CSF, pleural/peritoneal/synovial fluids), Pre-analytical variables affecting results, Laboratory safety, biomedical waste management.

UNIT II

Urine & Stool Analysis: Urine examination: physical (colour, volume, pH), chemical (protein, glucose, ketones, bile salts/pigments), and microscopic (cells, casts, crystals), Pregnancy test – principle of immunological detection of β -hCG, Stool examination: parasites, ova, occult blood, chemical analysis, Clinical significance of abnormal findings.

UNIT III

Biochemical pathology: Blood chemistry: glucose, urea, creatinine, bilirubin, enzymes (SGOT, SGPT, ALP, LDH), Lipid profile and cardiac markers. CSF, pleural, peritoneal, and synovial fluid analysis, Testing for infectious diseases: HIV, Hepatitis B and C, STD.

UNIT IV

Systemic Pathology: Pathology of cardiovascular system: atherosclerosis, myocardial infarction, rheumatic heart disease, Pathology of respiratory system: pneumonia, tuberculosis, COPD, lung cancer, Pathology of liver and biliary system: hepatitis, cirrhosis, hepatocellular carcinoma, Pathology of kidney: glomerulonephritis, nephrotic syndrome, chronic renal failure.

UNIT V

Microbiology & Quality Control: Microbiology: sample collection for cultures, Gram staining, AFB staining, Albert staining, sensitivity testing, Internal and external quality assurance in clinical laboratories, Recent advances in clinical pathology - automation, molecular diagnostics, point-of-care testing.

Reference Books

- Henry's Clinical Diagnosis and Management by Laboratory Methods – McPherson & Pincus, 2017, Elsevier, 23rd Edition
- Clinical Pathology and Laboratory Techniques – Cheesbrough, 2019, Cambridge University Press, 2nd Edition
- Practical Haematology – Dacie & Lewis, 2017, Churchill Livingstone, 12th Edition
- Clinical Chemistry: Principles, Techniques, and Correlations – Bishop, Fody & Schoeff, 2021, Wolters Kluwer, 9th Edition
- District Laboratory Practice in Tropical Countries – Monica Cheesbrough, 2018, Cambridge University Press, 3rd Edition

Web Resources

- **Lab Tests Online** – Clinical laboratory test explanations
- **MedlinePlus – Pathology** – Patient-friendly laboratory test information
- **American Society for Clinical Pathology** – Professional guidelines and resources
- **WHO Laboratory Quality Standards (who.int in Bing) (bing.com in Bing)** – International standards for laboratory practice
- **PubMed Clinical Pathology Articles (pubmed.ncbi.nlm.nih.gov in Bing) (bing.com in Bing)** – Research publications

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	L	L	M	L
CO2	S	S	S	S	M	M	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L
CO4	S	S	S	S	M	M	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
THIRDYEAR - SEMESTER – V
CORE – VIII – CLINICAL LAB ETHICS AND DOCUMENTATION

Objectives

- To introduce laboratory ethics including principles, professional conduct, and patient rights.
- To explain regulatory frameworks and accreditation standards in clinical laboratories.
- To apply documentation and record keeping for accuracy, confidentiality, and compliance.
- To evaluate quality assurance and audits with ethical handling of laboratory errors.
- To explore emerging ethical issues and professional development in modern diagnostics.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To describe laboratory ethics including autonomy, beneficence, non-maleficence, justice	K2 – Understanding
CO2	To explain regulatory frameworks and accreditation standards (NABL, ISO, CAP, CLIA)	K3 – Application
CO3	To apply documentation practices including EMR, LIS, and archival policies	K4 – Analysis
CO4	To evaluate quality assurance and ethical handling of laboratory errors	K5 – Evaluation
CO5	To explore emerging ethical issues in molecular diagnostics and professional development	K6 – Creation

UNIT I

Introduction to Laboratory Ethics: Definition, scope, and importance of ethics in clinical laboratories, Principles of medical ethics: autonomy, beneficence, non-maleficence, justice, Professional conduct and responsibilities of laboratory personnel, Patient rights, confidentiality, and informed consent, Ethical dilemmas in laboratory practice.

UNIT II

Regulatory Frameworks & Accreditation: National and international guidelines for clinical laboratories, Good Laboratory Practices (GLP), Accreditation standards: NABL, ISO, CAP, CLIA, Role of WHO and CDC in laboratory ethics and safety, Legal aspects: malpractice, negligence, liability.

UNIT III

Documentation & Record Keeping: Importance of documentation in laboratory medicine, Types of records: patient requisition forms, test reports, logbooks, quality control charts, Electronic Medical Records (EMR) and Laboratory Information Systems (LIS), Data integrity, traceability, and confidentiality, Retention policies and archival of laboratory records.

UNIT IV

Quality Assurance & Audit: Internal and external quality control in laboratories, Standard Operating Procedures (SOPs), Laboratory audits and inspections, Error reporting, corrective and preventive actions (CAPA), Ethical handling of laboratory errors and discrepancies.

UNIT V

Emerging Issues & Professional Development: Ethical challenges in molecular diagnostics, genetic testing, and personalized medicine, Documentation in research and clinical trials, Role of laboratory professionals in multidisciplinary healthcare teams, Continuing professional education and ethical responsibility, Case studies on ethical violations and best practices.

Reference Books

- WHO – Laboratory Quality Management System Handbook – 2011, WHO Press, 1st Edition
- NABL – Accreditation Manual for Medical Laboratories – 2022, NABL India, Latest Edition
- CLSI Guidelines – Clinical and Laboratory Standards Institute – 2020, CLSI Publications
- Cheesbrough – District Laboratory Practice in Tropical Countries – 2018, Cambridge University Press, 3rd Edition
- Henry – Clinical Diagnosis and Management by Laboratory Methods – McPherson & Pincus, 2017, Elsevier, 23rd Edition

Web Resources

- **WHO Laboratory Quality Standards (who.int in Bing)** – Global guidelines for laboratory ethics and safety
- **NABL India** – Accreditation standards and manuals
- **CLSI Standards** – Clinical laboratory guidelines
- **CDC Laboratory Safety** – U.S. standards for laboratory ethics and safety
- **Lab Tests Online** – Documentation and test interpretation resources

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	L	L	M	L
CO2	S	S	S	M	M	M	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L
CO4	S	S	S	S	M	S	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
THIRD YEAR - SEMESTER – V
ELECTIVE – III – A) HEALTH AND HYGIENE

Objectives

- To introduce foundations of health including determinants, indicators, and healthcare systems.
- To explain nutrition and personal hygiene for disease prevention and healthy living.
- To apply hygiene and sanitation practices in community and occupational health.
- To analyze communicable and non-communicable diseases with emphasis on prevention and management.
- To evaluate public health education and emerging issues including global health challenges and alternative therapies.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To describe foundations of health including determinants and healthcare systems	K2 – Understanding
CO2	To explain nutrition and hygiene and identify nutritional disorders	K3 – Application
CO3	To apply sanitation practices for disease prevention	K4 – Analysis
CO4	To analyze communicable and non-communicable diseases	K5 – Evaluation
CO5	To evaluate public health education and address emerging global health issues	K6 – Creation

UNIT I

Foundations of Health: Definition and dimensions of health: physical, mental, social, spiritual, environmental, Determinants of health: heredity, environment, lifestyle, socio-cultural factors, Indicators of health and disease burden in India, Public and community health concepts, Healthcare systems: primary, secondary, tertiary care, National health policies and organizations (ICMR, NIN, WHO, UNICEF, IDA).

UNIT II

Nutrition and Personal Hygiene: Nutrition: definition, nutrients, balanced diet, BMR, Macronutrients (carbohydrates, proteins, fats) – sources, functions, deficiencies, Micronutrients (vitamins, minerals, water) – sources, functions, deficiencies, Malnutrition and nutritional disorders (kwashiorkor, marasmus, anemia, rickets), Personal hygiene practices: oral care, skin care, hair care, sleep hygiene, Role of exercise and lifestyle in maintaining health.

UNIT III

Hygiene and Sanitation: Importance of sanitation in disease prevention, Safe water supply, sewage disposal, waste management, Food hygiene and safety practices, Environmental hygiene: air, water, soil pollution and health impacts, Occupational health and safety measures.

UNIT IV

Communicable and Non-Communicable Diseases: Epidemiology and modes of disease transmission, Common communicable diseases: tuberculosis, malaria, HIV/AIDS, influenza, Vaccination and immunization programs, Non-communicable diseases: diabetes, hypertension, cancer, cardiovascular diseases, Lifestyle-related illnesses: obesity, stress disorders, substance abuse, Mental health: stress management, depression, anxiety, coping strategies.

UNIT V

Public Health, Education & Emerging Issues: Health promotion and disease prevention programs, Role of health education and awareness campaigns, Behavior change communication and digital health apps, Global health challenges: pandemics, antimicrobial resistance, climate change, Integration of yoga, naturopathy, and alternative therapies in health maintenance.

Reference Books

- Park K. – Textbook of Preventive and Social Medicine – 2021, Banarsidas Bhanot Publishers, 26th Edition
- Stanhope & Lancaster – Public Health Nursing: Population-Centered Health Care – 2020, Elsevier, 10th Edition
- Marmot & Wilkinson – Social Determinants of Health – 2019, Oxford University Press, 3rd Edition

- WHO – Health and Hygiene Guidelines – 2018, WHO Publications
- CDC – Healthy People 2030 – 2020, U.S. Department of Health and Human Services

🌐 Web Resources

- **WHO Health Topics ([who.int](https://www.who.int) in Bing)** – Global health and hygiene guidelines
- **CDC Healthy People 2030 ([health.gov](https://www.health.gov) in Bing)** – U.S. public health objectives
- **UNICEF Health Programs** – Child and maternal health initiatives
- **ICMR India** – National health research and policy
- **Nutrition and Balanced Diet – NIN** – Indian nutrition guidelines

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	L	L	M	L
CO2	S	S	S	S	M	M	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L
CO4	S	S	S	S	M	M	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
THIRD YEAR - SEMESTER – V
ELECTIVE – IV – B) HEALTH CARE MANAGEMENT

Objectives

- To introduce healthcare management including scope, levels of delivery, and principles of management.
- To explain healthcare organization and administration with hospital structures and patient care services.
- To analyze healthcare finance including budgeting, insurance, and reimbursement models.
- To evaluate quality assurance and healthcare technology with accreditation and patient safety.
- To explore public health and emerging trends including national programs, disaster management, and global health challenges.

Course Outcomes

On successful completion of this course, students should be proficient

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To describe foundations of healthcare management	K2 – Understanding
CO2	To explain healthcare organization and administration	K3 – Application
CO3	To analyze healthcare finance	K4 – Analysis
CO4	To evaluate quality assurance and technology	K5 – Evaluation
CO5	To explore public health and emerging trends	K6 – Creation

UNIT I

Foundations of Healthcare Management: Definition, scope, and importance of healthcare management. Levels of healthcare delivery: primary, secondary, tertiary. Role of healthcare managers in hospitals. Principles of management: planning, organizing, staffing, directing, controlling.

UNIT II

Healthcare Organization & Administration: Hospital organization: structure, departments, and functions, Roles of medical, nursing, and paramedical staff, Patient care services and workflow management, Health information systems and medical records management.

UNIT III

Healthcare Finance: Basics of healthcare economics, Budgeting and financial planning in hospitals, Cost analysis and resource allocation, Health insurance systems and reimbursement models, Public Vs private healthcare financing.

UNIT IV

Quality Assurance & Healthcare Technology: Concepts of quality in healthcare (Donabedian model: structure, process, outcome), Accreditation and certification (NABL, NABH, ISO, JCI), Patient safety and risk management, Role of technology in healthcare: EHR, telemedicine, AI in healthcare.

UNIT V

Public Health & Emerging Trends: National health programs and policies (NHM, Ayushman Bharat, WHO initiatives), Health education and promotion strategies, Disaster management and emergency preparedness in healthcare, Emerging issues: pandemic management, antimicrobial resistance, climate change and health.

Reference Books

- Sakharkar B.M. – Principles of Hospital Administration and Planning – 2010, Jaypee Brothers Medical Publishers, 2nd Edition
- Goel S.L. – Healthcare Management and Administration – 2018, Deep & Deep Publications, Latest Edition
- Ginter, Duncan & Swayne – Strategic Management of Health Care Organizations – 2018, Wiley, 7th Edition
- WHO – Health Systems Strengthening Guidelines – 2017, WHO Publications
- Park K. – Textbook of Preventive and Social Medicine – 2021, Banarsidas Bhanot, 26th Edition

Web Resources

- **WHO Health Systems (who.int in Bing)** – Global healthcare management guidelines
- **NABH India** – Accreditation standards for hospitals
- **National Health Mission** – Indian national health programs
- **ICMR** – Research and policy in healthcare
- **CDC Healthcare Management** – U.S. healthcare safety and management resources

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	L	L	M	L
CO2	S	S	S	S	M	M	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L
CO4	S	S	S	S	M	S	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
THIRD YEAR - SEMESTER – V
SKILL ENHANCEMENT COURSE – III – FORENSIC SCIENCE

Objectives

- To introduce the definition, scope, and history of forensic science.
- To develop skills in biological and serological evidence analysis.
- To train students in chemical and toxicological examination methods.
- To impart knowledge of ballistics and physical evidence analysis.
- To understand medico-legal aspects and crime scene investigation procedures.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Explain the scope, divisions, and ethical standards of forensic science	K2 – Understanding
CO2	Identify and analyze biological evidence using DNA and serology techniques	K3 – Applying
CO3	Perform chemical and toxicological analysis of drugs, poisons, and adulterants	K4 – Analyzing
CO4	Examine ballistics, firearms, and physical evidence using microscopy and instruments	K4 – Analyzing
CO5	Interpret medico-legal findings and apply criminalistics in crime scene investigation	K5 – Evaluating

UNIT I

Introduction to Forensic Science: Definition, scope, and history of forensic science, Structure of forensic laboratories and divisions, Role of forensic science in the criminal justice system, Ethical issues and professional standards.

UNIT II

Forensic Biology and Serology: Analysis of biological evidence: blood, semen, saliva, hair, and tissue, Blood grouping, DNA fingerprinting, and PCR techniques, Forensic serology methods and applications, Case studies involving biological evidence.

UNIT III

Forensic Chemistry and Toxicology: Analysis of drugs, narcotics, alcohol, and poisons, Techniques for detection of toxins in biological samples, Chromatography, spectroscopy, and modern analytical tools, Forensic applications in food adulteration and environmental samples.

UNIT IV

Forensic Physics and Ballistics: Principles of ballistics: internal, external, and terminal, Firearms identification, gunshot residues, and trajectory analysis, Forensic examination of glass, soil, fibers, and paint, Use of microscopy and instrumental methods in physical evidence.

UNIT V

Forensic Medicine and Criminalistics: Postmortem examination and medico-legal aspects, Determination of cause, manner, and time of death, Injury analysis: blunt force, sharp force, firearm injuries, Crime scene investigation, evidence collection, chain of custody.

Reference Books

- B.S. Nabar (2019) – Forensic Science in Crime Investigation, Asia Law House, 3rd Edition
- R.C. Sharma & K. Sharma (2018) – Forensic Science: Principles and Applications, PHI Learning, 2nd Edition
- Richard Saferstein (2015) – Criminalistics: An Introduction to Forensic Science, Pearson, 11th Edition
- Jackson & Jackson (2011) – Forensic Science, Pearson Education, 2nd Edition
- Kumar, A. (2020) – Fundamentals of Forensic Science, Academic Press, 1st Edition

🌐 Web Resources

- [National Forensic Sciences University](#) – India's premier forensic education hub
- [NIJ Forensic Sciences](#) – US National Institute of Justice forensic resources
- [Forensic Science Society](#) – Professional body for forensic scientists
- ScienceDirect – Forensic Journals ([sciencedirect.com in Bing](#)) – Peer-reviewed articles
- Interpol Forensics ([interpol.int in Bing](#)) – Global forensic practices

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	L	L	S	M	L	M	L
CO2	M	S	S	M	M	M	M	M	M	L
CO3	M	S	S	M	S	M	M	M	M	M
CO4	M	S	S	S	S	M	M	M	M	M
CO5	M	S	S	S	M	S	S	S	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SEMESTER – V
SKILL ENHANCEMENT COURSE (SEC) –
COMMUNICABLE AND NON-COMMUNICABLE DISEASES

(Only for NMSDC Reappear Students)

Objectives

- To provide knowledge of etiology, transmission, and prevention of communicable diseases.
- To understand the pathophysiology and risk factors of non-communicable diseases.
- To train students in diagnostic laboratory techniques for both categories.
- To correlate laboratory findings with clinical conditions.
- To emphasize public health strategies, prevention, and ethical practices.

Course Outcome

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Explain principles of communicable and non-communicable diseases	K2 – Understanding
CO2	Apply diagnostic techniques for bacterial, viral, and parasitic diseases	K3 – Application
CO3	Analyze diagnostic approaches for cardiovascular, metabolic, and respiratory disorders	K4 – Analysis
CO4	Evaluate laboratory markers in hepatic, renal, and oncological disorders	K5 – Evaluation
CO5	Demonstrate preventive, ethical, and public health practices	K6 – Creation

UNIT I

Introduction: Definition, classification, epidemiology, host–pathogen interaction, risk factors.

UNIT II

Communicable Diseases: Bacterial, viral, parasitic, and fungal diseases; diagnostic tests (Gram stain, ELISA, PCR, blood smear).

UNIT III

Non-Communicable Diseases I: Cardiovascular and metabolic disorders; diagnostic markers (HbA1c, lipid profile, ECG, troponins).

UNIT IV

Non-Communicable Diseases II: Respiratory, hepatic, renal, and oncological disorders; diagnostic imaging and lab correlation.

UNIT V

Prevention and Public Health: Immunization, screening programs, lifestyle modification, biosafety, ethics, and quality assurance.

References

- Communicable Diseases: A Global Perspective – Roger Webber, *6th Edition*, 2019, CABI Publishing
- Infectious Disease Epidemiology: Theory and Practice – Kenrad E. Nelson, Carolyn Masters Williams, *3rd Edition*, 2020, Jones & Bartlett Learning
- Park’s Textbook of Preventive and Social Medicine – K. Park, *28th Edition*, 2025, Banarsidas Bhanot Publishers
- Noncommunicable Diseases: A Compendium – Nick Banatvala, Pascal Bovet (Editors), *1st Edition*, 2023, Routledge / Taylor & Francis Ltd
- Park’s Textbook of Preventive and Social Medicine – K. Park, *28th Edition*, 2025, Banarsidas Bhanot Publishers (covers both communicable and non-communicable diseases) 🌐 Web Resources – Non-Communicable Diseases.

🌐 Web Resources

- **WHO – Communicable Diseases ([who.int](https://www.who.int) in Bing)** – Global strategies, prevention, and surveillance.
- **CDC – Infectious Diseases** – Epidemiology, diagnostic protocols, and control measures.

- **PubMed – Communicable Disease Articles** (pubmed.ncbi.nlm.nih.gov in Bing) – Peer-reviewed research and case studies.
- **WHO – Noncommunicable Diseases (NCDs)** (who.int in Bing) – Global action plans, statistics, and prevention strategies.
- **CDC – Chronic Disease Center** (cdc.gov in Bing) – Resources on cardiovascular, diabetes, cancer, and respiratory diseases.
- **NCBI Bookshelf – Noncommunicable Diseases** (ncbi.nlm.nih.gov in Bing) – Free access to textbooks and reference materials.

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	L	L	L	L	L	M
CO2	M	S	M	M	L	M	L	L	L	M
CO3	M	M	S	S	M	M	L	L	M	S
CO4	M	M	S	S	M	M	M	M	M	S
CO5	L	M	M	M	M	S	M	M	M	S

S - Strong

M - Medium

L - Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
THIRD YEAR - SEMESTER – VI
CORE – IX – HISTOPATHOLOGY

Objectives

- To introduce histopathology including scope, laboratory organization, specimen handling, and safety.
- To explain tissue processing including fixation, embedding, microtomy, and troubleshooting.
- To apply staining techniques including routine, special, and immunohistochemistry methods.
- To analyze pathological changes such as cellular adaptations, degeneration, inflammation, and neoplasia.
- To evaluate applied diagnostics and ethics in clinical, forensic, and research pathology.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
COs	To describe histopathology basics including lab setup and safety	K2 – Understanding
CO1	To explain tissue processing methods and artifacts	K3 – Application
CO2	To apply staining techniques including routine and special stains	K4 – Analysis
CO3	To analyze pathological changes in tissues and organs	K5 – Evaluation
CO4	To evaluate applied diagnostics and ethical issues in pathology	K6 – Creation

UNIT I

Introduction: Definition, scope, and importance of histopathology, Organization of histopathology laboratories, Collection, fixation, and preservation of tissue specimens, Principles of microscopy in histopathology, Laboratory safety and ethical considerations.

UNIT II

Tissue Processing: Methods of tissue sampling: biopsy, autopsy, surgical specimens, Fixatives and fixation techniques, Tissue processing: dehydration, clearing, embedding, Microtomy: section cutting and mounting, Common artifacts and troubleshooting.

UNIT III

Staining Techniques: Principles of staining in histopathology, Routine stains: Hematoxylin and Eosin (H&E), Special stains: PAS, silver, trichrome, reticulin, Gram, Ziehl–Neelsen, Basics of immunohistochemistry, Quality control in staining procedures.

UNIT IV

Pathological Changes: Cellular adaptations: hypertrophy, hyperplasia, atrophy, metaplasia, Degenerative changes: necrosis, apoptosis, autolysis, Inflammation and tissue repair, Neoplastic changes: benign vs malignant tumors, Histopathological features of common diseases.

UNIT V

Applied Diagnostics and Ethics: Histopathology in clinical diagnosis and research, Role in cancer diagnosis and grading, Histopathology in forensic investigations, Ethical issues in diagnostic pathology, Professional standards and patient confidentiality.

Reference Books

- Bancroft J.D. & Gamble M. – Theory and Practice of Histological Techniques – 2019, Elsevier, 8th Edition
- Kumar, Abbas & Aster – Robbins and Cotran Pathologic Basis of Disease – 2020, Elsevier, 10th Edition
- Carson F.L. – Histotechnology: A Self-Instructional Text – 2018, ASCP Press, 4th Edition
- Rosai J. – Rosai and Ackerman's Surgical Pathology – 2018, Elsevier, 11th Edition
- Henry – Clinical Diagnosis and Management by Laboratory Methods – McPherson & Pincus, 2017, Elsevier, 23rd Edition

Web Resources

- **WHO Laboratory Standards (who.int in Bing) (bing.com in Bing)** – International pathology guidelines
- **American Society for Clinical Pathology** – Histopathology resources and standards

- **PubMed Histopathology Articles (pubmed.ncbi.nlm.nih.gov in Bing)** – Research publications
- **Lab Tests Online** – Diagnostic pathology explanations
- **ICMR India** – National pathology and diagnostic research guidelines

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	L	L	M	L
CO2	S	S	S	S	M	M	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L
CO4	S	S	S	S	M	M	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
THIRD YEAR - SEMESTER – VI
CORE – X – CLINICAL LABORATORY TESTS AND INTERPRETATION

Objectives

- To introduce clinical laboratory testing including organization, pre-analytical variables, and ethical standards.
- To perform clinical biochemistry tests for glucose, renal, liver, lipid, and cardiac markers.
- To apply microbiological techniques including culture, sensitivity, and rapid diagnostics.
- To analyze serology and immunology for infectious and autoimmune disorders.
- To evaluate advanced diagnostics, including endocrine assays, tumour markers, molecular diagnostics, and medico-legal reporting.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To describe basics of laboratory testing	K2 – Understanding
CO2	To perform biochemical investigations	K3 – Application
CO3	To apply microbiological diagnostics	K4 – Analysis
CO4	To interpret serological and immunological assays	K5 – Evaluation
CO5	To evaluate advanced diagnostic techniques	K6 – Creation

UNIT I

Introduction and Basics: Definition, scope, and importance of clinical laboratory testing, Organization of clinical laboratories and divisions, Pre-analytical variables: patient preparation, sample collection, transport, and storage, Ethical issues and professional standards in reporting.

UNIT II

Clinical Biochemistry: Blood glucose estimation and interpretation (FBS, PPBS, HbA1c), Renal function tests: urea, creatinine, electrolytes, Liver function tests: bilirubin, SGOT, SGPT, alkaline phosphatase, Lipid profile and cardiac markers (CK-MB, troponins), Interpretation of biochemical abnormalities in systemic diseases.

UNIT III

Clinical Microbiology: Sample collection for microbiological analysis (blood, urine, sputum, stool, CSF), Culture techniques and sensitivity testing, Rapid diagnostic tests and point-of-care testing, Interpretation of infectious disease laboratory results, Case studies in microbiological diagnosis.

UNIT IV

Serology and Immunology: Principles of serological testing, Common tests: WIDAL, VDRL, ELISA, CRP, RA factor, Immunological assays: antigen-antibody reactions, rapid kits, Applications in infectious disease diagnosis and autoimmune disorders, Interpretation of serological results in clinical practice.

UNIT V

Advanced Diagnostics: Endocrine function tests: thyroid profile, reproductive hormones, insulin assays, Tumor markers: PSA, AFP, CEA, CA-125, Molecular diagnostics: PCR, DNA fingerprinting, RT-PCR in clinical practice, Clinical correlation of lab results with patient history and symptoms, Reporting formats, chain of custody, and medico-legal aspects.

Reference Books

- Tietz Textbook of Clinical Chemistry and Molecular Diagnostics – Burtis, Ashwood & Bruns, 2018, Elsevier, 6th Edition
- Clinical Biochemistry: Metabolic and Clinical Aspects – Marshall & Bangert, 2014, Churchill Livingstone, 3rd Edition
- Medical Microbiology – Murray, Rosenthal & Pfaller, 2020, Elsevier, 9th Edition
- Immunology – Kuby, 2018, W.H. Freeman, 8th Edition
- Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications – Buckingham & Flaws, 2019, F.A. Davis Company, 3rd Edition

Web Resources

- **Lab Tests Online** – Clinical laboratory test explanations
- **WHO Laboratory Standards (who.int in Bing) (bing.com in Bing)** – International guidelines
- **CDC Laboratory Medicine** – U.S. standards and resources
- **PubMed Clinical Diagnostics (pubmed.ncbi.nlm.nih.gov in Bing) (bing.com in Bing)** – Research publications
- **ICMR India** – National laboratory and diagnostic guidelines

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	L	L	M	L
CO2	S	S	S	S	M	M	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L
CO4	S	S	S	S	M	M	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
THIRD YEAR - SEMESTER – VI
CORE – XI – QUALITY CONTROL AND SAFETY IN CLINICAL LABORATORY

Objectives

- To introduce quality and safety in clinical laboratories including accreditation and ethics.
- To apply internal quality control with calibration, documentation, and troubleshooting.
- To analyze external quality assurance through proficiency testing and corrective actions.
- To evaluate laboratory safety protocols including physical, chemical, biological, and PPE measures.
- To explore ethics and accreditation with professional standards and patient confidentiality.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To describe quality and safety in laboratories	K2 – Understanding
CO2	To apply internal QC methods and documentation	K3 – Application
CO3	To analyze external QA programs and improvement strategies	K4 – Analysis
CO4	To evaluate safety protocols in laboratory practice	K5 – Evaluation
CO5	To explore ethics and accreditation in laboratory standards	K6 – Creation

UNIT I

Introduction to Quality and Safety: Definition, scope, and importance of quality control in laboratories, Principles of laboratory safety and biosafety levels (BSL-1 to BSL-4), Organization of clinical laboratories and accreditation standards (NABL, ISO, CLSI), Ethical issues and professional responsibilities.

UNIT II

Internal Quality Control: Daily quality checks using control samples, Calibration of instruments (photometer, auto-analyzer, hematology analyzer), Monitoring precision and accuracy of test results, Documentation: SOPs, log books, audit trails, Troubleshooting errors in routine testing.

UNIT III

External Quality Assurance: Proficiency testing programs (NABL, CAP, WHO schemes), Inter-laboratory comparison and peer review, Corrective and preventive actions for deviations, Continuous improvement strategies, Case studies in external quality assurance.

UNIT IV

Laboratory Safety Protocols: Physical safety: handling glassware, sharps, electrical equipment, fire safety, Chemical safety: storage, labelling, MSDS compliance, fume hoods, Biological safety: biosafety cabinets, infectious sample handling, biomedical waste disposal, Personal protective equipment (PPE): lab coats, gloves, masks, goggles, Emergency preparedness and accident reporting.

UNIT V

Ethics, Accreditation, and Professional Standards: Patient confidentiality and ethical reporting of results, Laboratory accreditation processes (ISO 15189, NABL), Role of audits and inspections in maintaining standards, Professional conduct and responsibilities of lab personnel.

Reference Books

- Henry's Clinical Diagnosis and Management by Laboratory Methods – McPherson & Pincus, 2017, Elsevier, 23rd Edition
- District Laboratory Practice in Tropical Countries – Monica Cheesbrough, 2018, Cambridge University Press, 3rd Edition
- WHO – Laboratory Quality Management System Handbook – 2011, WHO Publications, 1st Edition
- NABL – Accreditation Manual for Medical Laboratories – 2022, NABL India, Latest Edition
- CLSI Guidelines – Clinical and Laboratory Standards Institute – 2020, CLSI Publications

Web Resources

- **WHO Laboratory Quality Standards** (who.int in Bing) (bing.com in Bing) – International guidelines
- **NABL India** – Accreditation standards and manuals
- **CLSI Standards** – Clinical laboratory guidelines
- **CDC Laboratory Safety** – U.S. standards for laboratory safety
- **PubMed Laboratory Quality Articles** (pubmed.ncbi.nlm.nih.gov in Bing) (bing.com in Bing) – Research publications

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	L	L	M	L
CO2	S	S	S	S	M	M	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L
CO4	S	S	S	S	M	S	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
THIRD YEAR - SEMESTER – VI
CORE PRACTICAL – III – CLINICAL HAEMATOLOGY AND
HISTOPATHOLOGY

Objectives

- To perform basic hematology tests including hemoglobin estimation, RBC/WBC counts, platelet counts, ESR, and coagulation studies.
- To apply blood grouping techniques for ABO and Rh typing.
- To demonstrate histopathology procedures including fixation, processing, microtomy, and staining.
- To identify pathological tissues using routine and special stains.
- To correlate laboratory findings with clinical conditions for diagnostic interpretation.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To perform hematology assays (Hb, RBC, WBC, Platelets, ESR, PCV, coagulation)	K3 – Application
CO2	To apply blood grouping and transfusion-related tests	K4 – Analysis
CO3	To demonstrate histopathology techniques (fixation, processing, microtomy, staining)	K3 – Application
CO4	To analyze stained tissues and identify normal vs pathological features	K5 – Evaluation
CO5	To correlate lab findings with clinical diagnosis	K6 – Creation

I. Clinical Haematology

1. Hemoglobin Estimation – Sahli's or Cyanmethemoglobin method
2. Total RBC Count – Using hemocytometer
3. Total WBC Count – Hemocytometer method
4. Differential Leukocyte Count – Peripheral smear staining and identification
5. Platelet Count – Direct or indirect method
6. Packed Cell Volume (PCV) – Microhematocrit method
7. Erythrocyte Sedimentation Rate (ESR) – Wintrobe or Westergren method
8. Blood Grouping – ABO and Rh typing
9. Coagulation Tests – Bleeding time, clotting time, PT

II. Histopathology

1. Tissue Fixation – Formalin fixation and principles
2. Tissue Processing – Dehydration, clearing, embedding
3. Microtomy – Section cutting using rotary microtome
4. Hematoxylin and Eosin (H&E) Staining – Routine histological staining
5. Histopathology Spotters – Identification of normal and pathological tissues

Reference Books

- Dacie & Lewis – Practical Haematology – 2017, Churchill Livingstone, 12th Edition
- Rodak B.F. – Hematology: Clinical Principles and Applications – 2020, Elsevier, 5th Edition
- Bancroft J.D. & Gamble M. – Theory and Practice of Histological Techniques – 2019, Elsevier, 8th Edition
- Carson F.L. – Histotechnology: A Self-Instructional Text – 2018, ASCP Press, 4th Edition
- Kumar, Abbas & Aster – Robbins and Cotran Pathologic Basis of Disease – 2020, Elsevier, 10th Edition

🌐 Web Resources

- **American Society of Hematology** – Hematology resources and guidelines
- **ASCP – American Society for Clinical Pathology** – Histopathology standards and training
- **WHO Laboratory Standards (who.int in Bing) (bing.com in Bing)** – International guidelines
- **PubMed Hematology & Histopathology Articles (pubmed.ncbi.nlm.nih.gov in Bing) (bing.com in Bing)** – Research publications
- **Lab Tests Online** – Clinical test explanations

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	L	M	M	L
CO2	S	S	S	S	M	S	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L
CO4	S	S	S	S	M	M	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
THIRD YEAR - SEMESTER – VI
CORE PRACTICAL – IV – BIOCHEMICAL TESTS IN CLINICAL LABORATORY

Objectives

- To perform blood biochemical estimations including glucose, creatinine, proteins, urea, and cholesterol.
- To analyze urine constituents both quantitatively and qualitatively.
- To determine serum marker enzyme activity for SGOT and SGPT.
- To correlate biochemical findings with clinical conditions.
- To develop laboratory skills in handling samples, applying methods, and interpreting results.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To estimate blood biochemistry (glucose, creatinine, proteins, urea, cholesterol)	K3 – Application
CO2	To perform urine analysis (urea, creatinine, uric acid, qualitative tests)	K3 – Application
CO3	To assay serum enzymes (SGOT, SGPT)	K4 – Analysis
CO4	To interpret biochemical results in relation to clinical diagnosis	K5 – Evaluation
CO5	To apply laboratory techniques with accuracy, precision, and safety	K6 – Creation

I. Blood Biochemical Analysis

- a. Estimation of Blood Glucose – Orthotoluidine (OT) method
- b. Estimation of Serum Creatine and Creatinine – Alkaline Picrate method
- c. Estimation of Total Proteins – Lowry's method
- d. Estimation of Urea – DAM–TSC method
- e. Estimation of Cholesterol – Zak's method

II. Urine Analysis

- a. Estimation of Urea – DAM–TSC method
- b. Estimation of Creatine and Creatinine – Alkaline Picrate method
- c. Estimation of Uric Acid – Caraway's method
- d. Qualitative analysis of normal and abnormal constituents of urine

III. Assay of Serum Marker Enzymes

- a. Determination of SGOT (AST) activity
- b. Determination of SGPT (ALT) activity

Reference Books

- Tietz Textbook of Clinical Chemistry and Molecular Diagnostics – Burtis, Ashwood & Bruns, 2018, Elsevier, 6th Edition
- Practical Clinical Biochemistry – Varley, Gowenlock & Bell, 2019, CBS Publishers, Latest Edition
- Clinical Chemistry: Principles, Techniques, and Correlations – Bishop, Fody & Schoeff, 2021, Wolters Kluwer, 9th Edition
- Harper's Illustrated Biochemistry – Victor W. Rodwell et al., 2021, McGraw Hill, 31st Edition
- Lehninger Principles of Biochemistry – Nelson & Cox, 2021, W.H. Freeman, 8th Edition

🌐 Web Resources

- **Lab Tests Online** – Explanations of biochemical tests
- **WHO Laboratory Standards (who.int in Bing) (bing.com in Bing)** – International guidelines
- **PubMed Clinical Biochemistry (pubmed.ncbi.nlm.nih.gov in Bing)** – Research publications
- **ICMR India** – National laboratory and diagnostic guidelines
- **MedlinePlus – Blood and Urine Tests** – Patient-friendly test information

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	L	M	M	L
CO2	S	S	S	S	M	M	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L
CO4	S	S	S	S	M	M	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low

B. Sc., CLINICAL LABORATORY TECHNOLOGY
SEMESTER – VI
SKILL ENHANCEMENT COURSE (SEC) – DIAGNOSTIC APPROACHES TO
CLINICAL DISORDERS

(Only for NMSDC Reappear Students)

Objectives

- To provide foundational knowledge of diagnostic principles in human disorders.
- To train students in laboratory and clinical diagnostic methods.
- To correlate laboratory findings with clinical conditions.
- To develop skills in interpreting diagnostic data for patient care.
- To emphasize ethical practices and quality assurance in diagnostics.

Course Outcome

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Explain the principles of diagnosis in human disorders	K2 – Understanding
CO2	Apply laboratory techniques for metabolic, endocrine, cardiovascular, and respiratory disorders	K3 – Application
CO3	Analyze diagnostic approaches for gastrointestinal, hepatic, and renal disorders	K4 – Analysis
CO4	Evaluate diagnostic markers in neurological and immunological disorders	K5 – Evaluation
CO5	Demonstrate ethical and quality practices in laboratory diagnostics	K6 – Creation

UNIT I

Principles of Human Disorder Diagnosis: Definition and classification of human disorders, Clinical vs. laboratory diagnosis, Screening methods and preventive diagnostics, Role of CLT in healthcare delivery.

UNIT II

Metabolic and Endocrine Disorders: Diabetes mellitus: diagnostic criteria, HbA1c, glucose tolerance tests, Thyroid disorders: TSH, T3, T4 assays, Obesity and metabolic syndrome: biochemical markers, Laboratory approaches to endocrine dysfunction,

UNIT III

Cardiovascular and Respiratory Disorders: Hypertension: diagnostic protocols and monitoring, Ischemic heart disease: ECG, cardiac biomarkers (Troponins, CK-MB), Heart failure: BNP and echocardiography correlation, Asthma and COPD: pulmonary function tests, arterial blood gases.

UNIT IV

Gastrointestinal, Hepatic, and Renal Disorders: Peptic ulcer disease and gastritis: endoscopy, H. pylori testing, Hepatitis and cirrhosis: liver function tests, viral markers, Kidney disorders: urinalysis, creatinine clearance, eGFR, Diagnostic imaging and laboratory correlation.

UNIT V

Neurological and Immunological Disorders: Epilepsy and neurodegenerative disorders: EEG, imaging, biomarkers, Autoimmune diseases: RA factor, CRP, ESR, Allergic disorders: skin tests, IgE assays, Laboratory markers in neurological and immune dysfunction.

References

- Henry's Clinical Diagnosis and Management by Laboratory Methods, 23rd Edition, Elsevier.
- Bishop ML, Fody EP, Schoeff LE. Clinical Chemistry: Principles, Techniques, and Correlations, 9th Edition, Wolters Kluwer.
- Cheesbrough M. District Laboratory Practice in Tropical Countries, Cambridge University Press.
- Burtis CA, Ashwood ER, Bruns DE. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics, 6th Edition, Elsevier.

Web Resources

- WHO – Laboratory Diagnostics (who.int in Bing)
- NIH – Clinical Laboratory Standards
- PubMed – Diagnostic Research Articles (pubmed.ncbi.nlm.nih.gov in Bing)
- FDA – Medical Devices and Diagnostics (fda.gov in Bing)
- CDC – Laboratory Quality Assurance

Mapping with Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	L	L	L	L	L	M
CO2	M	S	M	M	L	M	L	L	L	M
CO3	M	M	S	S	M	M	L	L	M	S
CO4	M	M	S	S	M	M	M	M	M	S
CO5	M	M	S	S	S	M	M	M	M	S

S - Strong

M - Medium

L - Low

NON-MAJOR ELECTIVE OFFERED TO OTHER DEPARTMENTS
FIRST YEAR - SEMESTER – I
NME – I – LIFESTYLE DISEASES

Objectives

- To introduce lifestyle diseases including definitions, risk factors, and socio-cultural influences.
- To explain cardiovascular and metabolic disorders with preventive strategies and diagnostic tests.
- To analyze respiratory, gastrointestinal, and hepatic disorders and their lifestyle associations.
- To evaluate cancer and mental health disorders with emphasis on psychosocial interventions.
- To apply public health approaches for prevention, management, and awareness of lifestyle diseases.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To describe lifestyle diseases and calculate BMI, WHR, stress indices	K2 – Understanding
CO2	To explain cardiovascular and metabolic disorders and perform BP, glucose, lipid tests	K3 – Application
CO3	To analyze respiratory, GI, and hepatic disorders with diagnostic tools	K4 – Analysis
CO4	To evaluate cancer and mental health disorders and screening methods	K5 – Evaluation
CO5	To apply preventive and public health strategies including yoga, surveys, and dietary assessments	K6 – Creation

UNIT I

Introduction to Lifestyle Diseases: Definition and scope of lifestyle diseases, Global and Indian scenario, Risk factors: diet, physical inactivity, smoking, alcohol, stress, Socio-economic and cultural influences, BMI and Waist-Hip Ratio calculation, Stress assessment tools.

UNIT II

Cardiovascular and Metabolic Disorders: Hypertension, coronary artery disease, stroke, Diabetes mellitus (Type 2) and metabolic syndrome, Obesity and dyslipidemia, Preventive strategies: diet, exercise, stress management, Blood pressure measurement, Blood glucose estimation, Lipid profile test.

UNIT III

Respiratory, Gastrointestinal, and Hepatic Disorders: Chronic obstructive pulmonary disease (COPD), asthma, Gastroesophageal reflux disease (GERD), Non-alcoholic fatty liver disease (NAFLD), Role of environment and lifestyle in progression, Pulmonary function test, Liver function test

UNIT IV

Cancer and Mental Health Disorders: Lifestyle-related cancers: lung, breast, colorectal, Role of tobacco, alcohol, diet, and environment, Stress, anxiety, depression, sleep disorders, Psychosocial interventions and counseling, Cancer screening methods (awareness-based demonstrations), Mental health assessment tools.

UNIT V

Prevention, Management, and Public Health Approaches: Screening and early detection, Lifestyle modification programs, Role of yoga, meditation, and alternative therapies, National and global health initiatives for NCD control, Community health survey, Dietary assessment tools.

Reference Books

- Park K. – Textbook of Preventive and Social Medicine – 2021, Banarsidas Bhanot Publishers, 26th Edition
- Kumar & Clark – Clinical Medicine – 2020, Elsevier, 10th Edition
- Davidson's Principles and Practice of Medicine – 2022, Elsevier, 24th Edition
- Lifestyle Medicine – Rippe J.M. – 2019, CRC Press, 2nd Edition
- WHO – Global Report on Noncommunicable Diseases – 2020, WHO Publications

Web Resources

- **WHO NCDs** (who.int in Bing) (bing.com in Bing) – Global non-communicable disease initiatives
- **ICMR India** – National health research and NCD programs
- **CDC Lifestyle Diseases** (cdc.gov in Bing) – U.S. chronic disease prevention resources
- **UNICEF Health Programs** – Child and maternal health initiatives
- **PubMed Lifestyle Disease Articles** (pubmed.ncbi.nlm.nih.gov in Bing) (bing.com in Bing) – Research publications

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	L	L	M	L
CO2	S	S	S	S	M	M	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L
CO4	S	S	S	S	M	M	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low

NON-MAJOR ELECTIVE OFFERED TO OTHER DEPARTMENTS
FIRST YEAR - SEMESTER – II
NME – II – COMMUNICABLE DISEASES

Objectives

- To introduce communicable diseases with definitions, classification, transmission, and host–pathogen interactions.
- To explain bacterial communicable diseases including pathogenesis, prevention, and diagnostic tests.
- To analyze viral communicable diseases with replication, host response, and laboratory diagnosis.
- To evaluate parasitic and fungal diseases with emphasis on control measures and public health importance.
- To apply public health approaches including epidemiology, immunization, and outbreak management.

Course Outcomes

On successful completion of this course, students should be proficient to

CO No.	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	To describe communicable diseases and laboratory basics	K2 – Understanding
CO2	To explain bacterial diseases and perform TB and typhoid tests	K3 – Application
CO3	To analyze viral diseases and interpret ELISA, antigen, and serology results	K4 – Analysis
CO4	To evaluate parasitic and fungal diseases with diagnostic methods	K5 – Evaluation
CO5	To apply public health strategies for prevention and control	K6 – Creation

UNIT I

Introduction to Communicable Diseases: Definition, classification, and epidemiology of communicable diseases, Modes of transmission: direct, indirect, vector-borne, airborne, waterborne, Host–pathogen interaction and immunity, Microscopic examination of pathogens, Gram staining of bacteria.

UNIT II

Bacterial Communicable Diseases: Tuberculosis, typhoid, cholera, diphtheria, meningitis, Pathogenesis, clinical features, prevention, and control, Role of vaccines and antibiotics, Sputum smear for TB, WIDAL test for typhoid.

UNIT III

Viral Communicable Diseases: Influenza, measles, mumps, rubella, hepatitis, HIV/AIDS, COVID-19, Viral replication and host response, Antiviral drugs and vaccination programs, ELISA for HIV, Rapid antigen tests, Hepatitis serology.

UNIT IV

Parasitic and Fungal Communicable Diseases: Malaria, filariasis, amoebiasis, giardiasis, Candidiasis, dermatophytosis, Control measures and public health importance. Blood smear for malaria parasite, KOH mount for fungi, Stool examination.

UNIT V

Prevention, Control, and Public Health Approaches: Principles of epidemiology and surveillance, National immunization programs and WHO initiatives, Quarantine, isolation, and outbreak management, Role of health education and sanitation. Vaccination demonstration, Water quality testing, Vector identification.

Reference Books

- Park K. – Textbook of Preventive and Social Medicine – 2021, Banarsidas Bhanot Publishers, 26th Edition
- Ananthanarayan & Paniker – Textbook of Microbiology – 2020, Universities Press, 10th Edition
- Jawetz, Melnick & Adelberg – Medical Microbiology – 2021, McGraw Hill, 28th Edition
- Ryan K.J. – Sherris Medical Microbiology – 2018, McGraw Hill, 7th Edition
- WHO – Communicable Disease Surveillance and Response Guidelines – 2019, WHO Publications

Web Resources

- **WHO Communicable Diseases (who.int in Bing) ([bing.com in Bing](https://www.bing.com/search?q=who.int))** – Global guidelines and initiatives

- **CDC Infectious Diseases** – U.S. resources on communicable diseases
- **ICMR India** – National research and disease control programs
- **PubMed Communicable Disease Articles (pubmed.ncbi.nlm.nih.gov in Bing) (bing.com in Bing)** – Research publications
- **UNICEF Health Programs** – Child health and immunization initiatives

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	L	S	L	L	M	L
CO2	S	S	S	S	M	M	M	M	M	L
CO3	S	S	S	S	M	M	M	M	M	L
CO4	S	S	S	S	M	M	M	M	M	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong

M - Medium

L – Low