



SNDT Women's University, Mumbai

**Undergraduate Degree / UG
Programme (Syllabus as Per NEP) -
Faculty of Science & Technology**

**Bachelor of Science
(Clinical Laboratory Science) (Non-
AEDP)**

**B.Sc. (Clinical Laboratory Science)
(Non-AEDP)**

As Per NEP – 2020

Semester – I to IV

**Syllabus
(W.E.F. Academic Year 2025-26)**

Terminologies

Vertical	Full-Form/Definition	Remarks	Related To Major And Minor Courses
Major (Core)	Subject Comprising Mandatory and Elective Courses, Major Specific IKS, Vocational Skill Courses, Internship/ Apprenticeship, Field Projects, Research Projects Connected to Major	Minimum 50% Of Total Credits Corresponding to Three/Four - Year UG Degree- Mandatory Courses	Related To The Major
Minor Course	Course From Same Or Different Faculty	Minimum 18-20 Credits to Be Completed in The First Three Years of UG Programme	Related To the Minor
OEC	Open Elective Courses/ Generic Courses	10-12 Credits to Be Offered in I And/Or II Year. Faculty-Wise Baskets of OEC To Be Prepared	OEC Is to Be Chosen Compulsorily from Faculty Other Than That of the Major
VSC	Vocational Skill Courses, Including Hands On Training Corresponding To The Major And/Or Minor Subject	8-10 Credits, To Be Offered in First Three Years, Wherever Applicable Vocational Courses Will Include Skills Based on Advanced Laboratory Practical's of Major	Related To the Major or Minor
SEC	Skill Enhancement Courses	06 Credits, To Be Offered in I And II Year, To Be Selected from The Basket of Skill Courses Approved by University	Related To the Major or Minor Any Relevant Skill
AEC	Ability Enhancement Courses	08 Credits, To Be Offered in I And II Year, English: 04 Credits to Be Earned in Sem - I, Modern Indian Language Of 04 Credits to Be Offered in II Year	NA
VEC	Value Education Courses	Understanding India, Environmental Science/Education, Digital	NA

		and Technological Solutions, Health & Wellness, Yoga Education, Sports, And Fitness	
IKS	Indian Knowledge System	Generic IKS Course: Basic Knowledge Of The IKS To Be Offered At First Year Level	Major-Specific IKS Courses: Advanced Information About the Major, Part of the Major Credit to Be Offered at Second- Or Third-Year Level
OJT	On-Job Training (Internship / Apprenticeship)	Corresponding To the Major Subject	Related To The Major
FP	Field Projects	Corresponding To the Major Subject	Related To the Major
CC	Co-Curricular Courses	Health And Wellness, Yoga Education Sports, And Fitness, Cultural Activities, NSS/NCC And Fine/ Applied/Visual/ Performing Arts	NA
CE	Community Engagement and Service		Related To Major
RP	Research Project	Corresponding To the Major Subject	Related To Major

Programme Template

Faculty		Science & Technology
Degree		B.Sc.
Programme		Clinical Laboratory Science
Preamble		B.Sc. Clinical Laboratory Science (B.Sc. CLS) is an allied health professional degree programme. This programme includes clinically oriented subjects such as Microbiology, Hematology, Immunology, Biochemistry, Anatomy, and Physiology. It covers the diagnosis, treatment, and prevention of diseases through the use of clinical laboratory tests on body fluids, including biochemical, pathological, and microscopic analyses. The programme also imparts knowledge of sample collection, testing, documentation, and reporting. Clinical laboratory professionals play a crucial role in providing the best patient care by collecting and analyzing the information required for diagnosis and treatment. Clinical laboratory professionals have a wide range of career opportunities in hospitals, clinics, nursing homes, and commercial laboratories.
Programme Specific Outcomes (PSOs)		After completing this programme, the learners will be able to:
	1	Apply the knowledge and technical skills associated with Clinical Laboratory Science.
	2	Be eligible for enrollment in Master's and/or Ph.D. programmes.
	3	Obtain employment in private, municipal, public, semi-government, State Government, and Central Government laboratories and hospitals.
	4	Be eligible to obtain a paramedical practice license and become an entrepreneur.
	5	Work as a leader in professional and industrial research organizations across the globe.
	6	Apply appropriate tools and techniques learned during the programme.
	7	Use available resources and information technology (IT) tools for the analysis and synthesis of data, particularly in the outcome-based learning of the final-year subjects.
Eligibility Criteria for Programme		Female candidates who have passed the 12th Standard (Science) with Physics, Chemistry, and Biology (PCB). Female candidates who have completed a three-year full-time Diploma in Medical Laboratory Technology (DMLT) approved by the Directorate of Technical Education (DTE), AICTE, and the State Government are eligible for Direct

		Second Year admission. <i>(Note: Admissions will be based on merit.)</i>
Intake (For SNTD WU Departments and Conducted Colleges)		First Year 30 seats Direct Second Year 50% of the approved intake of the First Year.

Structure with Course Titles

B. Sc. (Clinical Laboratory Science) (Non-AEDP)

Semester - I

SN	Courses	Type of Course	Credits	Marks	Int Marks	Ext Marks
	Semester - I					
10034301	Biochemistry-Part A (Th)	Major (Core)	2	50	50	0
	Subject 2	Major (Core)	2	50	50	0
	Subject 3	Major (Core)	2	50	50	0
10434311	Haematology-I (Th+Pr)	OEC	4	100	50	50
10634302	Basics of Biochemistry (Pr)	VSC S1	2	50	50	0
10734321	Microbiology-I (Pr)	SEC	2	50	0	50
	Ability Enhancement Course (AEC) Link: https://sndt.ac.in/pdf/academics/syllabus-as-per-nep/aec-syllabus/ug-degree/ability-enhancement-course.pdf (Available on Website)	AEC (English) (Any One)	2	50	0	50
10810111	English For Academic Writing - Paper I (For Students of English Medium)					
10810112	English Language and Literature - I (For Students of Non-English medium)					
11051111	Inception of India Knowledge System IKS Link: https://www.sndt.ac	IKS (Generic)	2	50	0	50

	.in/pdf/academics/syllabus-as-per-nep/iks-syllabus/ug-degree/inception-of-indian-knowledge-system.pdf (Available on Website)					
10952111	Introduction to Indian Constitution Link: https://www.sndt.ac.in/pdf/academics/syllabus-as-per-nep/vec-syllabus/ug-degree/introduction-to-indian-constitution.pdf (Available on Website)	VEC	2	50	0	50
11450121	Basics of National Service Scheme	CC (Any One)	2	50	50	0
11450221	National Cadets Corps. (NCC) Studies – I					
11450322	Health and Wellness					
11450421	Performing Arts Exploration					
			22	550	300	250

Semester – II

SN	Courses	Type of Course	Credits	Marks	Int Marks	Ext Marks
	Semester – II					
20034311	Biochemistry-Part B (Th)	Major (Core)	2	50	0	50
	Subject 2	Major (Core)	2	50	0	50
	Subject 3	Major (Core)	2	50	0	50
		VSC-S2	2	50	50	0
		VSC-S3	2	50	50	0
20434311	Microbiology-II (Th+Pr)	OEC	4	100	50	50
20734301	Computer Application (Th)	SEC	2	50	50	0
	Ability Enhancement Course (AEC) Link: https://www.sndt.ac.in/pdf/academics/syllabus-as-per-nep/aec-syllabus/ug-degree/ability-enhancement-course.pdf (Available on Website)	AEC (English) (Any One)	2	50	0	50
20810111	English For Academic Writing - Paper II (For Students of English Medium)					
20810112	English Language and Literature – II (For Students of Non-English medium)					
20952111	Environment Awareness Link: https://www.sndt.ac	VEC	2	50	0	50

	.in/pdf/academics/syllabus-as-per-nep/vec-syllabus/ug-degree/environment-awareness.pdf (Available on Website)					
	Co-Curricular Course (CC) Link: https://www.sndt.ac.in/pdf/academics/syllabus-as-per-nep/cc-syllabus/ug-degree/co-curricular-course-as-per-nep-2020-semester-ii-syllabus.pdf (Available on Website)	CC (Any One)	2	50	50	0
21450121	Volunteerism and National Service Scheme					
21450221	National Cadets Corps. (NCC) Studies - II					
21450323	Yoga Education					
21450421	Fine Art					
			22	550	250	300

Exit with UG Certificate with 4 extra credits (44 + 4 credits)

Semester – III

SN	Courses	Type of Course	Credits	Marks	Int Marks	Ext Marks
	Semester – III					
30134311	Biochemistry-III (Th+Pr)	Major (Core)	4	100	50	50
30134312	Haematology-I (Th+Pr)	Major (Core)	4	100	50	50
30134313	Design Thinking and Innovation in Microbiology (Th)	Major (Core)	4	100	50	50
30334311	General Chemistry (Th)	Minor Stream	2	50	0	50
30434311	Study Of Cells and Tissues (Th)	OEC	2	50	0	50
	Modern Indian Language Ability Enhancement Course (AEC) Link: https://sndt.ac.in/pdf/academics/syllabus-as-per-nep/aec-syllabus/ug-degree/aec-semester-iii.pdf (Available on Website)	AEC (Any One)	2	50	50	0
30810201	શીખો ગુજરાતી – પ્રાથમિક ભાગ ૧: પરિચય, લેખન અને વાચન કૌશલ્ય (ગુજરાતી) Shikho Gujarati – Prathmik Bhag 1: Parichay, Lekhan ane Vachan Kaushalya (Gujarati)					
30810301	रचनात्मक लेखन (हिन्दी) Rachnatmak Lekhan (Hindi)					
30810401	मराठी भाषेचा परिचय भाग १ - (मराठी) Marathi Bhashecha					

	Parichay- Bhaag 1 (Marathi)					
30810501	लौकिक संस्कृत न्यायः (संस्कृत) Contemporary Sanskrit Nyaya (Sanskrit)					
30134304	Medical Microbiology- Part I	Major (Core)	2	50	50	0
	Co-Curricular Course (CC) Link: https://sndt.ac.in/pdf/academics/syllabus-as-per-nep/cc-syllabus/ug-degree/co-curricular-course-as-per-nep-2020-semester-iii-syllabus.pdf (Available on Website)	CC (Any One)	2	50	50	0
31450121	Social issues Advocacy and Action					
31450221	National Cadets Corps. (NCC) Studies – III					
31450321	Traditional Sports and Fitness					
31450421	Unfolding The Beauty of Indian Music					
			22	550	300	250

Semester – IV

SN	Courses	Type of Course	Credits	Marks	Int Marks	Ext Marks
	Semester – IV					
40134311	Biochemistry-IV (Th+Pr)	Major (Core)	4	100	50	50
40134312	Microbiology-II (Th+Pr)	Major (Core)	4	100	50	50
40334311	Haematology-II (Th+Pr)	Minor Stream	4	100	50	50
40434311	Blood Bank and Related Technique's (Th)	OEC	2	50	0	50
40734321	Histopathology-I (Pr)	SEC	2	50	0	50
	Modern Indian Language Ability Enhancement Course (AEC) Link: https://sndt.ac.in/pdf/academics/syllabus-us-as-per-nep/aec-syllabus/ug-degree/aec-semester-iv.pdf (Available on Website)	AEC (Any One)	2	50	0	50
40810211	શીખો ગુજરાતી - પ્રાથમિક (ગુજરાતી) Shikho Gujarati – Prathmik (Gujarati)					
40810311	सूचना प्रौद्योगिकी और हिन्दी भाषा (हिन्दी) Suchana Praudyogiki aur Hindi Bhasha (Hindi)					
40810411	मराठी भाषेचा परिचय भाग -२ (मराठी) Marathi Bhashecha Parichay- Bhaag 2					

	(Marathi)					
40810511	वाल्मीकीयकृत रामायणम् – अयोध्याकाण्डः (संस्कृत) Valmikiyakrut Ramayanam – Ayodhyakanda (Sanskrit)					
40334302	Immunohistochemistry + Cytology (Th)	Minor Stream	2	50	50	0
	Co-Curricular Course (CC) Link: https://sndt.ac.in/pdf/academics/syllabus-as-per-nep/cc-syllabus/ug-degree/co-curricular-course-as-per-nep-2020-semester-iv-syllabus.pdf (Available on Website)	CC (Any One)	2	50	50	0
41450121	NSS Volunteers under National service scheme special camp					
41450122	Personality and Leadership Development through National Service Scheme					
41450221	National Cadets Corps. (NCC) Studies – IV					
41450321	Basics of Self Defence and Fitness Training					
41450421	Theatre & Dance					
			22	550	250	300

Exit with UG Diploma with 4 extra credits (44 + 4 credits)

Course Syllabus

Semester – I

.1.1 Major (Core)

Course Titles	Biochemistry - Part A (Th)
Course Credits	2 Credit's
Course Outcomes	After going through the course, learners will be able to,
	1. Recognize different types of carbohydrates and their functions.
	2. Identify the different types of cells and transport processes.
	3. Summarize different types of buffers, role and importance of glassware.
	4. Interpret different biochemical tests and instruments used.
	5. Exemplify about care and maintenance of equipment.
Module 1 (Credit 1) – Cell and Transport	
Learning Outcomes	After learning the module, learners will be able to,
	1. Apply the basic concepts of Biochemistry.
	2. Elucidate different cells and their transport mechanisms.
Content Outline	• Structure, components, and their respective functions of the following cells: human cell, bacterial cell, red blood cell, and white blood cell.
Module 2 (Credit 1) – Buffer Systems	
Learning Outcomes	After learning the module, learners will be able to,
	1. Recognize different types of buffers and their uses in Clinical Biochemistry.
	2. Evaluate the factors causing diseases.
Content Outline	• Buffer systems of the cell and the importance of maintaining the pH of cellular constituents. • Introduction to Clinical Biochemistry and the major factors responsible for causing diseases.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

- Group discussion on types of carbohydrates and their functions.
- Group discussion on different types of cells and their transport systems.
- Create a detailed diagram illustrating the structure of a cell, labelling its main components and organelles.
- Chart preparation on biochemical tests commonly used in clinical practice and their

relevance to specific disease conditions.

- Seminar on the major factors responsible for causing diseases at the biochemical level, such as genetic mutations, environmental toxins, and metabolic dysregulation.

References

1. Textbook of Medical Laboratory Technology, Dr. P. B. Godkar, 3rd Edition, Published 2018.
2. Biochemistry, U. Satyanarayana, Published 2005, Reprinted 2010, Publisher: Anuradha Sen.
3. Schaum's Outline of Biochemistry, 3rd Edition, Ralston and Kuchel.
4. Harper's Biochemistry, 31st Edition, Robert K. Murray.
5. Medical Biochemistry, Rana Shinde, 8th Edition, Jaypee Brothers.
6. Principles of Biochemistry, Lehninger, 7th Edition, David L. Nelson.

Semester – I

1.4 Open Elective Courses / Generic (OEC)

Course Titles	Haematology - I (Th+Pr)
Course Credits	4 Credit's (2 Th + 2 Pr)
Course Outcomes	After going through the course, learners will be able to,
	1. Collect blood samples.
	2. Carry out complete hemogram.
	3. Identify various blood parasites.
	4. Handle the autoanalyzer.
	5. Perform quality control procedures.
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to,
	1. Differentiate various blood cells.
	2. Appraise the techniques of blood collection, cell count, and hemoglobin determination.
Content Outline	• Introduction to Hematology. • Blood and its functions. • Phlebotomy. • Haematopoiesis. • Cell count.
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to,
	1. Calculate cell indices.
	2. Perform blood smear preparation, differential count, identify abnormal cell morphology, and blood parasites.
Content Outline	• Determination of PCV, ESR, and cell indices. • Differential WBC count and morphology of all blood cells and parasites. • Autoanalyzers.
Module 3 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to,
	1. Evaluate the pathophysiology of different anemic conditions.
	2. Prepare blood smears.
	3. Investigate different anemic conditions and erythropoiesis.

Content Outline	• Determination of anisocytosis and poikilocytosis. • Cell count using Neubauer's chamber and cell counter. • Differential WBC count and morphology of RBCs and WBCs using autoanalyzers.
Module 4 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to,
	1. Recognize the pathophysiology of thrombopoiesis.
	2. Investigate different leukocyte disorders.
Content Outline	• Determination of platelet count. • Staining techniques (Wright's stain and Field stain). • Determination of Mentzer's Index. • Determination of ESR by Wintrobe's and Westergren's methods.

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE)

- Project work: Interview a hematologist or hematopathologist to learn about their career path, daily responsibilities, and the challenges they face in their field.
- Project work: Prepare a comparative analysis of the structure and function of red blood cells, white blood cells, and platelets.
- Seminar presentation on blood cell morphology.
- Seminar presentation on blood cell indices.
- Discuss safety precautions, infection control measures, and potential complications associated with phlebotomy procedures.
- Perform calculations to determine MCV, MCH, and MCHC values based on the provided blood analysis data.

References

1. Textbook of Medical Laboratory Technology, Dr. P. B. Godkar, 3rd Edition, Published 2018.
2. Dacie and Lewis Practical Haematology, 12th Edition, Barbara Bain.
3. Williams Manual of Hematology, Marshall Lichtman, 10th Edition, McGraw Hill.
4. Medical Laboratory Technology, Kanai L. Mukherjee, 4th Edition, CBS Publishers.
5. Bethesda Handbook of Clinical Haematology, 4th Edition, Wolters Kluwer.

Semester – I

.1.5 Vocational Skill Courses (VSC-S1)

Course Titles	Basics of Biochemistry (Pr)
Course Credits	2 Credit's
Course Outcomes	After going through the course, learners will be able to
	1. Demonstrate proficiency in safe laboratory practices, proper handling of glassware, and accurate preparation of standard and percentage solutions.
	2. Operate common biochemical instruments and equipment with appropriate calibration, care, and maintenance.
	3. Adhere to good laboratory practices by maintaining equipment, ensuring safety, and producing reliable and reproducible results.
Module 1 (Credit 1) – Introduction to Biochemistry Laboratory	
Learning Outcomes	After learning the module, learners will be able to
	1. Students will be able to understand the basic structure, rules, and safety measures of a biochemistry laboratory.
	2. Students will be able to perform accurate pipetting and dispensing techniques and determine the normality of the solution.
Content Outline	• Introduction to the Biochemistry laboratory, responsibilities, and related safety measures. • Introduction to various types of glassware and maintenance of glassware. • Determination of the normality of 10% sodium hydroxide and learning pipetting and dispensing techniques. • Standardization of 1.0 ml volumetric pipette and learning to use, care, and maintain various balances. • Preparation of primary normal solution (1N sodium carbonate). • Preparation of normal solutions (1N hydrochloric acid). • Preparation of percent solution (V/V): 2% (V/V) acetic acid (WBC diluting fluid).
Module 2 (Credit 1) – Introduction to the Instrumentation	
Learning Outcomes	After learning the module, learners will be able to
	1. Students will be able to operate an instrument accurately and demonstrate proper calibration, care, and maintenance.
	2. Students will integrate theoretical knowledge with practical skills to perform basic biochemical investigations and interpret instrumental readings.

Content Outline	• Learning use, care, and maintenance of pH meter. • Preparation of protein-free filtrate, separation of serum and plasma from appropriate blood, and learning to use, care, and maintain a centrifuge. • Learning use, care, and maintenance of a hot air oven, water bath, and incubator. • Preparation of a complex reagent (e.g., Benedict's qualitative reagent) and learning to use, care, and maintain the hot plate and magnetic stirrer. • Learning use, care, maintenance, and operation of a photometer and spectrophotometer.
------------------------	---

References:

1. Textbook of Medical Laboratory Technology by Dr. P. B. Godkar, 3rd Edition, published in 2018.

Semester – I

.1.6 Skill Enhancement Courses (SEC)

Course Titles	Microbiology - I (Pr)
Course Credits	2 Credit's
Course Outcomes	After going through the course, learners will be able to
	1. Apply their knowledge of sterilization and disinfection methods in diverse settings, including healthcare facilities, laboratories, food processing plants, and other industries where microbial control is essential for public health and safety.
	2. Evaluate the effectiveness and efficiency of different sterilization and disinfection methods in various contexts and propose solutions to challenges or limitations encountered in practice.
	3. Demonstrate competency in using an inoculating hood and light microscope to perform aseptic procedures, such as culture inoculation, colony isolation, and microscopic examination of microbial specimens.
	4. Evaluate the appropriateness of different staining techniques based on clinical scenarios and laboratory findings.
Module 1 (Credit 1) – Sterilization and Disinfection	
Learning Outcomes	After learning the module, learners will be able to,
	1. Recognize physical methods of sterilization, filtration techniques, and indicators of sterilization.
Content Outline	• Different methods of sterilization and disinfection • Dry heat, Moist heat • Radiation
Module 2 (Credit 1) – Staining Methods & Instrumentation	
Learning Outcomes	After learning the module, learners will be able to
	1. Perform Gram staining, Acid-Fast, Metachromatic granule staining.
	2. Illustrate structure, principle, and applications of Incubator, Hot-air oven, Autoclave, Inspissator.
Content Outline	• Different types of staining and clinical significance of staining • Different aseptic techniques in the routine laboratory • Use inoculating hood and laminar microscopy

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE)

- Compile a comprehensive list of different methods of sterilization and disinfection commonly used in laboratory and healthcare settings.
- Prepare a diagrammatic report on historic events in microbiology.

- Research and prepare a chart of different staining techniques used in microbiology, including simple staining, differential staining (e.g., Gram staining, acid-fast staining), and special staining (e.g., endospore staining, capsule staining).

Reference Books

1. Textbook of Medical Laboratory Technology by Dr. P. B. Godkar, 3rd Edition, Published in 2018.
2. Medical Microbiology by Dr. Ananthnarayan, 12th Edition, Universities Press, India.
3. Shoum's Outline Microbiology, 2023.
4. Microbiology: An Introduction by Gerald J. Tortora, Berdell R. Funke, and Christine L. Case, 13th Edition, 2018, Published by Pearson.
5. Prescott's Microbiology, 10th Edition, Published by McGraw Hill.

Course Syllabus

Semester – II

.2.1 Major (Core)

Course Titles	Biochemistry - Part B (Th)
Course Credits	2 Credit's
Course Outcomes	After going through the course, learners will be able to,
	1. Analyze different biochemical tests and instruments used.
	2. Exemplify about care and maintenance of equipment.
	3. Demonstrate competency in operating and maintaining laboratory equipment safely and effectively, following manufacturer instructions and best practices.
	4. Empower students to become competent and responsible laboratory practitioners, capable of contributing meaningfully to scientific advancements and discoveries while upholding the highest standards of safety, accuracy, and integrity in their work.
Module 1 (Credit 1) – Vitamins and Minerals	
Learning Outcomes	After learning the module, learners will be able to,
	1. Identify the different types of Vitamins and minerals.
	2. Evaluate their physiological role and its significance.
Module 2 (Credit 1) – Carbohydrates	
Learning Outcomes	After learning the module, learners will be able to,
	1. Identify the different types of carbohydrates.
	2. Elucidate various metabolic pathways of carbohydrates.
Content Outline	• Carbohydrate Chemistry, Definition, importance, classification, properties, structural formulae of various mono and disaccharides, Isomerism. • Digestion and absorption of carbohydrates, Metabolism of carbohydrates – Glycolysis, TCA cycle, HMP Pathway, Glycogenesis, Gluconeogenesis, etc.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

- Chart preparation on identification of various dietary sources of vitamins, highlighting specific foods rich in each vitamin category.
- Group discussion on various topics such as vitamin deficiency diseases and their clinical manifestations, emphasizing the importance of adequate vitamin intake for maintaining health.
- Provide evidence-based recommendations for optimizing vitamin and mineral intake in the general population.
- Group discussion on the interconversion of carbohydrates with various metabolic

pathways.

- Discuss case study on clinical case or scenario involving carbohydrate metabolic disorders, such as diabetes mellitus.

References

1. Textbook of Medical Laboratory Technology: Dr. P. B. Godkar, 3rd Edition, Published 2018.
2. Biochemistry: U. Satyanarayana, Published 2005, Reprinted 2010, Publisher Anurabha Sen.
3. Shaum's Outline Biochemistry, 3rd Edition, Published by Ralston, Kuchel.
4. Harper's Biochemistry, 31st Edition, Published by Robert K. Murray.
5. Medical Biochemistry, Rana Shinde, 8th Edition, Published by Jaypee Brothers.
6. Principles of Biochemistry, Lehninger, 7th Edition, by David Nelson.

Semester – II

.2.6 Open Elective Courses/ Generic (OEC)

Course Titles	Microbiology - II (Th+Pr)
Course Credits	4 Credit's (2 Th + 2 Pr)
Course Outcomes	After going through the course, learners will be able to
	1. Classify different types of bacteria based on Gram staining.
	2. Perform various methods of preparing cultures.
	3. Evaluate different culture media.
Module 1 (Credit 1) – Classification of Bacteria, Growth & Multiplication	
Learning Outcomes	After learning the module, learners will be able to
	1. Explore different types of Gram-negative and Gram-positive bacteria.
	2. Evaluate the bacterial growth curve, generation time, and population doubling time.
Content Outline	• Classification of Gram-negative and Gram-positive bacteria. • Factors affecting the growth and multiplication of bacteria. • Significance of the growth curve in routine culture. • Perform tests on biochemical media.
Module 2 (Credit 1) – Cultivation of Microorganisms	
Learning Outcomes	After learning the module, learners will be able to
	1. Analyze normal flora with examples.
	2. Identify and study general-purpose, enrichment, enriched, selective, and transport culture media.
Content Outline	• Different types of culture media classification based on ingredients. • Classification of culture media based on consistency. • Preparation of biochemical media.
Module 3 (Credit 1) – Microbial Metabolism	
Learning Outcomes	After learning the module, learners will be able to
	1. Analyze metabolic pathways of microorganisms such as glycolysis, fermentation, aerobic respiration, and anaerobic respiration.
	2. Evaluate autotrophs and heterotrophs.
Module 4 (Credit 1) – Pathogenesis of Bacterial Infection and Study of Gram-negative Bacteria	
Learning	After learning the module, learners will be able to

Outcomes	1. Explain the epidemiology and pathophysiology of diseases.
	2. Illustrate the morphological, cultural, and biochemical study of Gram-negative bacilli.
	3. Identify the characteristics of the Enterobacteriaceae family.
Content Outline	• Sources of infection and incubation period. • Clinical symptoms. • Diagnostic techniques in the routine laboratory. • Colony characteristics and biochemical reactions. • Pathogenesis and clinical symptoms. • Laboratory diagnosis and treatment.

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

1. Provide examples of Gram-negative and Gram-positive bacterial species, including their morphological features, habitats, and pathogenicity.
2. Prepare a chart on how growth curves are generated using microbial cultures incubated under controlled laboratory conditions.
3. Select and perform biochemical tests commonly used for bacterial identification and characterization, such as the catalase test, oxidase test, indole test, and citrate utilization test.
4. Prepare a chart on the classification of culture media based on their ingredients, including complex media, defined media, selective media, and differential media.
5. Discuss the advantages, limitations, and clinical utility of different diagnostic methods in routine laboratory practice, considering factors such as sensitivity, specificity, turnaround time, and cost-effectiveness.
6. Prepare a chart for the schematic representation of the pathogenesis of infectious diseases, including the mechanisms by which pathogens invade host tissues, evade immune defenses, and cause tissue damage or systemic effects.

Reference Books:

1. Ananthanarayan Textbook of Microbiology, 12th Edition. Publisher: Universities Press.
2. Jawetz, Melnick and Adelberg's *Medical Microbiology*, 27th Edition. Publisher: McGraw-Hill Education.
3. *Textbook of Medical Laboratory Technology* by Dr. P. B. Godkar, 3rd Edition, Published 2018.
4. D. K. Sharma's *Microbiology*. Published by MKM Publishers Pvt. Ltd.
5. *Clinical Microbiology* by Keith Struthers.

Semester – II

.2.7 Skill Enhancement Courses (SEC)

Course Titles	Computer Application (Th)
Course Credits	2 Credit's
Course Outcomes	After going through the course, learners will be able to
	1. Carry out the basic computer operations.
	2. Analyze documents and generate e-records.
	3. Apply presentation and data representation analytics.
	4. Evaluate data in tabular format and perform arithmetic calculations on the same.
	5. Analyze medical laboratory data and format it according to categories.
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	1. Apply the basic computer operations.
	2. Design documents and generate e-records.
	3. Design presentations and data representation analytics.
	4. Analyze the basic computer operations.
Content Outline	• Introduction to computers and their functions. • Classification of computer hardware. • Introduction to Windows.
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	1. Evaluate data in tabular format and perform arithmetic calculations on the same.
	2. Analyze medical laboratory data and format it according to categories.
Content Outline	• Application of computers in the medical laboratory. • Features of Windows XP.

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

1. Research Paper on Present and Future Applications of Computers

- Conduct research on the current and potential future applications of computers in various fields such as healthcare, education, business, entertainment, and scientific research.
- Write a research paper summarizing the findings, including examples of how computers are currently used and potential advancements in the future. Discuss

the impact of emerging technologies such as artificial intelligence, machine learning, and quantum computing.

2. Types of Computers and Software/Hardware Components

- Create a presentation or infographic illustrating the different types of computers (mini, micro, mainframe, and supercomputers) and their respective applications.
- Prepare a comparison chart highlighting the key features and differences between each type of computer.
- Write a short essay, write-up, or report detailing the essential hardware and software components of a computer system, including the CPU, memory, storage devices, input/output devices, and operating systems.

3. Exploration of Application Software

- Select two or three types of application software (e.g., word processors, spreadsheets, and presentation graphics) and conduct hands-on exploration and experimentation with each.
- Develop a series of short tutorials or demonstration videos showcasing how to perform common tasks using each application software, such as creating documents, analyzing data, and designing presentations.

4. Computer Connectivity and Internet Usage

- Conduct a survey or interview to gather information about the usage of computer connectivity options and internet services among individuals in different demographics (e.g., age groups, professions, and geographical locations).
- Analyze the survey results and prepare a report summarizing the findings, including trends, preferences, and challenges related to computer connectivity and internet usage.
- Develop a set of recommendations or best practices for optimizing computer connectivity and internet usage based on the survey findings.

5. Microsoft Office Applications Exploration

- Design hands-on activities or exercises to familiarize participants with the basic features and functions of each Microsoft Office application.
- Participants will collaborate on practical projects or assignments using Microsoft Office tools, such as creating documents, spreadsheets, and presentations.

6. Internet and Web Technologies Workshop

- Facilitate interactive discussions and hands-on activities to explore practical aspects of using the internet and web-based applications effectively and safely.

Submission Guidelines

- Assignments can be submitted in various formats, including reports, presentations, infographics, videos, or online portfolios.
- Ensure clarity, coherence, and organization in presenting assignment tasks and findings.
- Encourage creativity, critical thinking, and active participation in completing the assignments.

Assessment Criteria

- Depth of understanding demonstrated in exploring computer basics, types, software/hardware components, connectivity options, and internet/web

technologies.

- Clarity and accuracy of explanations regarding the usage and practical applications of computer concepts and tools.
- Relevance and practicality of examples provided for illustrating concepts and applications.
- Creativity and professionalism in presenting assignment tasks and findings.
- Compliance with submission guidelines and formatting requirements.

References

1. *Introduction to Computers* by Satish Sahani.
2. *Computer Programs in Clinical and Laboratory Medicine* by D. John Doyle.
3. *Computer Application* by Sumita Arora.
4. Study of Labsmart Software.
5. *Introduction to Computer Applications* by Dr. Mauparna Nandan and Dr. Ajay Sharma.

Course Syllabus

Semester – III

.3.1 Major (Core)

Course Titles	Biochemistry-III (Th+Pr)
Course Credits	4 Credit's (2 Th + 2 Pr)
Course Outcomes	After going through the course, learners will be able to -
	1. Recognize concepts of thermodynamics with its laws.
	2. Identify the factors which influence distribution of water.
	3. Summarize mineral metabolism.
	4. Interpret complete lipid profile.
	5. Analyze working of various instruments in laboratory
Module 1 (Credit 1): Thermodynamics and Water and mineral metabolism	
Learning Outcomes	After learning the module, learners will be able to -
	1. Identify the different concepts of thermodynamics.
	2. Summarize the importance of high energy phosphate compounds
	3. Recognize the mineral metabolism
Content Outline	● Basic concepts. Systems: Open, closed and isolated Laws of Thermodynamics, enthalpy, entropy and Gibbs free energy ● Importance of high-energy phosphate compounds (ATP,ADPetc) inmetabolism ● General consideration, body fluid distribution. factors which influence distribution of water. ● Mineral metabolism (Sodium, potassium, chlorides, calcium and inorganic phosphorus)
Module 2 (Credit 1): Chemistry of lipids (part 1)	
Learning Outcomes	After learning the module, learners will be able to -
	1. Interpret the basics concept of lipids
	2. Evaluate the mechanism of lipids
	3. Express general lipid metabolism
Content Outline	● Definition, importance, properties. ● Classification, digestion and absorption of lipids. ● Beta oxidation of fatty acids. ● General lipid metabolism, cholesterol absorption & synthesis
Module 3 (Credit 1): Serum Determination by Different Methods	
Learning	After learning the module, learners will be able to -

Outcomes	1. Perform different serum test by various methods.
	2. Carry out SGPT, SGOT and HDL cholesterol tests.
	3. Evaluate serum bilirubin by Malloy-Evelyn's method.
Content Outline	● Determination of serum creatinine by visible rate of reaction method. ● Determination of serum urea by Berthelot reaction method. ● Determination of creatinine clearance. ● Determination of urea clearance. ● Determination of serum bilirubin by Malloy-Evelyn's method. ● Determination of SGPT by rate of reaction method. ● Determination of SGOT by rate of reaction method. ● Determination of alkaline phosphates by rate of reaction method. ● Determination of serum total cholesterol. ● Determination of HDL-Cholesterol.
Module 4 (Credit 1): Working of Autoanalyzer	
Learning Outcomes	After learning the module, learners will be able to -
	1. Identify urine amino acids by paper chromatography method
	2. Perform fraction of serum protein by agarose gel electrophoresis
	3. Handle semi-autonalyzer
Content Outline	● Determination of serum-triglycerides. ● Determination of serum sodium, potassium by ● Determination of serum chlorides. ● Determination of CSF and urine chlorides. ● Determination of serum calcium. ● Determination of inorganic phosphorus. ● Identification of urine amino acids by paper chromatography. ● Fractionation of serum proteins by agarose gel electrophoresis. ● Working of Semi-autoanalyzer.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Group discussion on
 - a. Types of thermodynamics
 - b. Identify mineral metabolism
2. Seminar on general lipid metabolism

3. Prepare a chart on Beta oxidation of fatty acids.
4. Select and perform serum determination test in laboratory

References:

1. Textbook of medical laboratory technology: Dr. P. B. Godkar, 3rd edition, Published 2018.
2. Biochemistry: U. Satyanarayana Published 2005, reprinted 2010 Publisher Anurabha Sen.
3. Shaum's outline Biochemistry 3rd edition, Published by Ralston, Kuchel.
4. Harper's Biochemistry. 31st edition, Published by Robert K Murray.
5. Medical Biochemistry Rana Shinde 8th edition, Published by Jaypee Brothers.
6. Principles of Biochemistry, Lehninger, 7th edition, by David Nelso

Semester – III

.3.2 Major (Core)

Course Titles	Hematology - I (Th+Pr)
Course Credits	4 Credit's (2 Th + 2 Pr)
Course Outcomes	After going through the course, the learner will be able to
	1. Recognize and analyze different types of blood cells and their function
	2. Common tests used for each blood sample
Module 1 (Credit 1): Hematology Theory – I	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Introduce the Hematology section in the Laboratory
	2. Understand the brief introduction to the hematopoiesis
Course Outline	● Introduction to Hematology: Blood and hematopoietic system of the body. The blood, its component, and their functions. ● Hemoglobinsynthesisand iron metabolism: Role of Iron, Vitamin, and metallic ions in Hemoglobin Synthesis, Factors which affect Normal Hemoglobin synthesis. Normal and abnormal Hb with clinical significance. ● Hemopoiesis and its regulation: - Erythropoiesis: Process, structure of RBC. Role of erythropoiesis in regulation. ● Leucopoiesis, Factors Influencing Leucopoiesis, Lymphopoiesis, the lymphoid series, T and B lymphocytes, macrophages.
Module 2 (Credit 1): Hematology Theory – II	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Understand the different maturation stages of blood cells.
	2. Importance of automation in the hematology laboratory.
Course Outline	● Thrombopoiesis, Morphology of platelets, Coagulation Cascade, the process of blood coagulation. Factors affecting the blood coagulation. Use of various anticoagulants, Effects of anticoagulant on cell morphology. ● Hematocrit: Determination by different methods, clinical significance. Erythrocyte Indices, calculations, and clinical significance. ● Automation in Hematology: Introduction & Basic Principle, Cell counting by impedance method & Advantages Coulter Counter

	● General measurement parameters by hematological autoanalyzer. Study of complete Histogram & Laboratory diagnosis of Diseases. ● Anemia: Definition, Clinical features, Morphological classification of anemia, Causes of anemia. (only basic information on these topics)
Module 3 (Credit 1): Hematology Practical – I	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Understanding the hematology laboratory setup.
	2. Different methods of collection and anticoagulants used in the laboratory.
Course Outline	● Introduction to Hematology Laboratory setup and laboratory safety. ● Use of Hb, WBC, and RBC pipette and its maintenance. ● Use of improved Neubauer's chamber and its maintenance. ● Use and maintenance of Westergren and Wintrobe's tubes. ● Preparation of Drabkin's reagent and determination ● Preparation of WBC diluting fluid and determination of total WBC count. ● Blood Collection by Different Methods and Preparation of Different ● Reagent Stains and Anticoagulants Used in Hematology.
Module 4 (Credit 1): Hematology Practical – II	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Perform blood smear preparation and differential blood count.
	2. Understand the phlebotomy.
Course Outline	● Estimation of Hb by cyanmethemoglobin and Clinical significance. ● Determination of hemoglobin by copper sulphate and Sahli's method. ● Preparation of blood smear and staining by Wright's stain its observation under the microscope. ● Determination of differential WBC count by using Wright's stain and Field's stain.

	● Determination of total RBC count and study of blood smear for RBC morphology. ● Determination of ESR by Westergren's Methods. ● Determination of platelet ● Phlebotomy technique.
--	--

Assessment/ Workshop

1. Phlebotomy Workshop
2. Presentation (Related to Syllabus) 10 Marks
3. Assignment 10 Marks

Reference Books:

1. Textbook of Medical Laboratory Technology by Dr. P. B. Godkar, 4th edition, 2024
2. Textbook of Hematology by Dr. Tejinder Singh, 3rd edition, 2017
3. Textbook of Dacie and Lewis Practical Hematology, 11th edition, 2011
4. Essential in hematology and clinical pathology by Dr. Ramdas Nayak, 2nd edition, 2017

Semester – III

.3.3 Major (Core)

Course Titles	Design Thinking and Innovation in Microbiology (Th)
Course Credits	4 Credit's
Course Outcomes	Upon successful completion of this course, the learner will be able to:
	1. Know and apply the principles of design thinking in microbiology-related contexts.
	2. Identify user-centric problems in microbiology laboratories and Health care/ industrial settings.
	3. Ideate innovative, practical, and frugal solutions to microbiological challenges.
	4. Develop and test prototypes based on real-world microbiological needs.
	5. Effectively communicate innovative ideas using scientific reasoning and creative methods.
Module 1 (Credit 1): Introduction to Design Thinking in Microbiology	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Explain the design thinking framework and its relevance to microbiological applications.
	2. Analyze case studies of innovations in microbiology from a design thinking lens.
Course Outline	● Definition and stages of design thinking: Empathize, Define, Ideate, Prototype, Test ● Importance of innovation in microbiology ● Introduction to frugal and sustainable innovations ● Case studies: rapid diagnostic kits, microbial sensors, frugal bioincubators, etc. ● Classroom Activity: User journey mapping in a microbiology lab
Module 2 (Credit 1): Empathy and Problem Framing in Microbiology	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Conduct empathy-based observations and interviews to understand user needs.
	2. Formulate well-defined microbiology-related problem statements using user perspectives
Course Outline	● Empathy techniques: interviews, shadowing, journey maps

	● Stakeholder identification: lab technicians, patients, students, healthcare workers ● Tools: empathy maps, user personas ● Framing “How Might We...” questions relevant to microbiological challenges ● Field/lab interaction: identifying inefficiencies in sample collection, hygiene, diagnostics, etc.
Module 3 (Credit 1): Ideation and Prototyping in Microbiology	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Apply brainstorming techniques to generate multiple innovative ideas.
	2. Build low-fidelity prototypes to address microbiology-focused challenges.
Course Outline	● Ideation tools: SCAMPER, mind mapping, reverse brainstorming ● Innovation themes: diagnostic tools, sample handling, water testing, hygiene indicators ● Prototype development: sketching, modelling with basic materials ● Tools: cardboard, digital mockups, simple sensors or Arduino (if applicable) ● Group activity: Build and document an early-stage prototype addressing a user-defined problem
Module 4 (Credit 1) – Testing, Feedback, and Communication	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Test prototypes, collect feedback, and refine designs iteratively.
	2. Present solutions with clarity, backed by user insights and scientific rationale.
Course Outline	● Usability testing: feedback collection tools (checklists, interviews, observations) ● Redesign and refinement cycles ● Preparing a final pitch: visual presentation, storytelling, and scientific explanation ● Peer feedback, expert review, and final demonstrations ● Poster + live demo presentation

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Problem-Solving Case Study (Individual/Group) Weightage: 15%

Task:

Identify a microbiology-related real-world issue (e.g., hospital-acquired infections, antibiotic resistance, biodegradable waste management) and apply the design thinking framework to propose a viable, innovative microbiological solution.

Deliverables:

- Written report (Design Thinking template: Empathize → Test)
- Poster or infographic summarizing the innovation
- Peer evaluation form

2. Innovation Journal/ Logbook Weightage: 10%

Task:

Maintain a weekly journal documenting ideation, background research, brainstorming, and reflections during the course/project.

Includes:

- Microbial concepts explored
- Ideas tested (successes/failures)
- Ethical/environmental considerations

3. Prototype Development and Presentation Weightage: 20%

Task:

Develop a low-cost prototype, model, or simulation that demonstrates your proposed microbial innovation.

Examples:

- DIY biofilm detector
- Home composting with microbial starter cultures
- Antibacterial coating from natural sources

Presentation Components:

- 3-minute pitch video or live demo
- Visual storyboard or flowchart
- Q&A session with feedback

4. Peer Collaboration Assignment Weightage: 10%

Task:

Work in pairs or small teams to peer-review another group's project using a rubric

focused on innovation, feasibility, and scientific merit. Provide constructive feedback and suggestions for improvement.

1. Micro-Innovation Hackathon / Pitch Event (Optional but high-impact)

Weightage: 15% (bonus or main CCE item)

Format:

Time-bound (e.g., 24–48 hours) event where students brainstorm and pitch microbiology-based solutions to specific challenges (e.g., water purification, food waste, infection control). Judges can be faculty or industry experts.

Evaluation Rubric (Suggested Criteria):

Criteria	Description	Marks
Problem Identification	Clarity and relevance of the microbial problem addressed	10
Scientific Understanding	Application of microbiology concepts	15
Innovation & Creativity	Uniqueness and feasibility of the solution	20
Prototype / Design Model	Functionality, relevance, low-cost, etc.	20
Communication & Presentation	Clarity, visuals, pitch effectiveness	15
Collaboration	Teamwork and peer review contribution	10
Reflection & Iteration	Learning from failure and feedback	10
Total		100

References & Resources:

Books:

1. Brown, Tim. *Change by Design* (Harvard Business Press, 2009) – Design Thinking framework
2. Krathwohl, Bloom – *Taxonomy of Educational Objectives* (useful for CCE design)
3. Pelczar, Chan, Krieg. *Microbiology: Concepts and Applications* –
4. foundational microbiology
5. Madigan, Martinko, et al. *Brock Biology of Microorganisms*

Articles/Online:

1. IDEO U: <https://www.ideo.com/pages/design-thinking>
2. "Design Thinking in STEM Education" – International Journal of STEM Education
3. Microbe Magazine (by American Society for Microbiology): <https://asm.org/Magazine>
4. Journal of Microbiological Methods

Semester – III

.3.4 Minor Stream

Course Titles	General Chemistry (Th)
Course Credits	2 Credit's
Course Outcomes	After going through the course, learners will be able to
	1. Draw and explain the structures of various molecules or ions based on the concept of ionic and covalent bonding
	2. Explain the Rate Law of a Chemical Reaction and Apply the knowledge of principles like Hammonds postulate, Reactivity and Selectivity Microscopic reversibility to predict the nature of reaction and product formation rate
	3. Differentiate the types of catalytic reactions and explain the role of catalyst
	4. Classify electrolytes/ elements and elaborate their physiological role.
	5. Explain use of physiological ions in replacement therapy, acid-base balance and combination therapy.
Module 1 (Credit 1): Introduction to General Chemistry	
Learning Outcomes	1. After learning the module, learners will be able to:
	2. Define and identify the structures of various molecules or ions, types of bonds
Content Outline	● Review of basic bonding concepts: Quantum numbers, atomic orbitals, electron configuration, electronic diagrams, polar covalent bonds, electronegativity group, electro negativities, electrostatic potential surfaces, inductive effects, bond dipoles, molecular dipoles ○ Lewis structures, formal charge. ○ VSEPR, hybridization involving s, p and d orbitals, hybridization effects ● Kinetics and reaction mechanism ○ Energy surfaces, reaction coordinate diagrams, activated complex/transition state rate and rate constants, reaction order and rate laws ○ Kinetic isotope effects ○ Hammond Postulate, reactivity vs selectivity, Curtin-Hammett Principle, microscopic reversibility, kinetic vs thermodynamic control ● Catalysis: ○ General principles of catalysis, Forms of catalysis –

	electrophilic catalysis, acid- base catalysis, nucleophilic catalysis, covalent catalysis, phase transfer catalysis. ○ Bronsted Acid-base catalysis, correlation of reaction rates with acidity functions.
Module 2 (Credit 1): Intra and Extracellular Electrolytes, Essential and Trace Elements	
Learning Outcomes	After learning the module, learners will be able to:
	1. Classify electrolytes/ elements and elaborate their physiological role
Content Outline	● Major physiological ions (Role and condition related to change in concentration of following ions: chloride, phosphate, bicarbonate, sodium, potassium, calcium, magnesium) ● Electrolytes used in replacement therapy: Sodium replacement (sodium chloride), potassium replacement (potassium chloride), calcium replacement (calcium chloride, calcium gluconate) ● Physiological acid base balance: Acids and Bases: Buffers (Pharmaceutical and Physiological) Electrolytes used in acid base therapy (sodium acetate, sodium bicarbonate, sodium biphosphate, sodium citrate, sodium lactate, ammonium chloride). Electrolyte combination therapy. Electrolytes used in replacement therapy: Sodium replacement (sodium chloride), potassium replacement (potassium chloride), calcium replacement (calcium chloride, calcium gluconate) ● Iron and haematinics, Copper, zinc, molybdenum, selenium and sulphur. Official iodine products (iodine, potassium iodide, sodium iodide)

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Poster presentation on given topic
2. Seminar presentation

References:

1. Eric V Anslyn and Dennis A Dougherty, Modern Physical Organic Chemistry, John Wiley.
2. Inorganic medicinal and pharmaceutical chemistry, J. H. Block, E. B. Roche, T. O. Soine, and C. O. Wilson. Lea &Febiger, Philadelphia, PA.
4. Modern Inorganic Pharmaceutical Chemistry, Clarence A. Discher. Wiley, New York.
5. Remington: the science and practice of pharmacy, Beringer, P. Lippincott Williams & Wilkins.
6. Inorganic Pharmaceutical Chemistry, Bothara, K. G., Nirali Prakashan. 6) Inorganic Pharmaceutical Chemistry, A. S. Dhake, H. P. Tipnis, Career Publication.

Semester – III**.3.5 Open Elective Courses/ Generic (OEC)**

Course Titles	Study of Cells and Tissues (Th)
Course Credits	2 Credit's
Course Outcomes	After going through the course, learners will be able to -
	1. Identify and describe the microscopic structure of normal cells and tissues in various organs and systems.
	2. Recognize the microscopic changes in cells and tissues caused by diseases.
	3. Understand the principles and applications of various histopathological techniques.
Module 1 (Credit 1): Introduction& orientation to Histopathology and cytological, Techniques.	
Learning Outcomes	After learning the module, learners will be able to -
	1. Understand the tissue processing techniques, sectioning, staining, and microscopy techniques.
	2. Learn to use a light microscope to examine tissue slides and identify microscopic structures.
	3. Illustrate different types of fixatives.
Content Outline	• The cell- i) Structure ii) cell division iii) Colloidal conception of tissue. • Methods of examination of tissues and cells. • Gross examination of organs. • Fixation - Introduction, aim of fixation. • Fixatives – Reagents used, advantages, disadvantages. • Gross fixation of different organs. • Decalcification – Technique, different types of fluids used. • Processing of tissue by manual methods. • Processing of tissue by using automatic tissue processor.
Module 2 (Credit 1): Processing of Tissue by Using Automated Tissue Processor	
Learning Outcomes	After learning the module, learners will be able to -
	1. Prepare tissue samples and properly handle autoanalyzer.
	2. Develop the ability to interpret histopathological findings.
	3. Examine different types of procedure methods.
Content	• Paraffin section cutting.

Outline	• Different types of cryostats. • Theory of staining. • Mountants, basic staining and mounting procedures. • Routine staining procedures and frozen section techni • Special staining techniques. • Exfoliative cytology techniques. • Museum techniques. • Immuno-histochemistry, introduction & techni • Electron microscopic techniques & recent advances.
----------------	---

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Group discussion around challenging cases or controversial topics in histopathology.
2. Prepare and present a slide on finding, offer a diagnosis and justify their reasoning.
3. Present students with clinical scenarios and accompanying histopathology images.
4. Assignments focusing on defining terms, explaining processes and using correct nomenclature are important.

References:

1. Histological Techniques, a practical manual by Dr. K. Laxminarayana 3rd edition, Published 2020.
2. Textbook of medical laboratory technology: Dr. P. B. Godkar, 3rd edition, Published 2018.
3. Techniques in Histopathology & Cytopathology by Jaypee Brothers Medical Publisher st Edition 2017
4. Histopathology Techniques and Its Management by Ramdas Nayak, 1st Edition 2017.
5. Histopathology (For Paramedical Students) by Poonam Bacceti and Arun Singh, 2nd edition 2018

Course Syllabus

.3.7 Major (Core)

Course Titles	Medical Microbiology – I (Th+Pr)
Course Credits	2 (1 + 1)
Course Outcome	After going through the course, the learner will be able to
	1. Evaluate the role of normal microbial flora in the human body.
	2. Be acquainted with clinical specimen collection, transportation, and lab diagnosis.
Module 1 (Credit 1) - Medical Microbiology Theory	
Learning Outcomes	After learning the module, the learner will be able to
	1. Explain normal microbial flora and its medical importance.
	2. Explain and analyze host–pathogen interactions, including virulence factors and transmission.
	3. Apply appropriate methods for the collection, transportation, and processing of clinical specimens.
	4. Evaluate the quality and suitability of specimens for laboratory diagnosis.
Content Outline	Introduction to normal microbial flora: - Normal microflora of the human body: Importance of normal microflora of the skin, throat, gastrointestinal tract, and urogenital tract. Host-pathogen interaction: - Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity. - Carriers and their types, Opportunistic infections, Nosocomial infections, and Transmission of infection. - Collection, Transportation, and Examination of the following Specimens: CSF, Ear Specimen, Eye Discharge, Pus from Abscess material, wound, Burn and sinuses, Skin and Soft Tissue, Feces and Revision of Urine and Blood
Module 2 (Credit 1) - Medical Microbiology Practical	
Learning Outcomes	After learning the module, the learner will be able to
	1. Demonstrate handling and processing of clinical samples in laboratory conditions.
	2. Explain the working principles of automated systems like VITEK (Vesatrek), Biotek, and Mini API systems.
	3. Apply principles of quality control and biosafety in microbiology laboratories.

Content Outline	• Examination of the following specimens: - Blood - CSF - Ear Specimen - Eye Specimen - Pus from abscess material from wounds, burns, and sinuses - Feces • Study of the working of the Vesatreak system and the Biotek system • Study of the working of the mini-API System • Preparation and quality control of staining solutions, nutrient agar, culture plates, agar slant, blood agar, and Quality control
------------------------	---

Assignments/ Activities towards Comprehensive Continuous Evaluation (CCE):

Seminar Presentation:

- Host and Pathogen interaction
- Viral and fungal Diseases
- Quizzes on Recent and Advanced laboratory diagnosis for bacteriological Specimen
- **Assignment:** Collection, transport, and processing of clinical specimens. Task: Prepare a comparative table for all specimens (urine, blood, CSF, pus, feces, etc.), including: Collection method, Transport medium, and Diagnostic importance
- **Short Assignment Topic:** Host-virus interaction and immune response
- Demonstrate antibacterial sensitivity by the Kirby-Bauer method

Reference

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Sharma, K. (2007). Manual of Microbiology. Ane Books Pvt Ltd.
6. Al-Kobaisi, M. F. (2007). Jawetz, Melnick & Adelberg's Medical Microbiology. Sultan Qaboos University Medical Journal, 7(3), 273

Course Syllabus

Semester – IV

.4.1 Major (Core)

Course Titles	Biochemistry - IV (Th+Pr)
Course Credits	4 Credit's (2 Th + 2 Pr)
Course Outcomes	After going through the course, learners will be able to -
	1. Understand the diverse structure of lipids.
	2. Describe the functions of lipids
	3. Analyze cholesterol and triglycerides in blood
	4. Describe the organic and inorganic components of bone.
	5. Apply various analytical techniques to study bone composition and structure.
Module 1 (Credit 1): Chemistry of Lipids-Part 2	
Learning Outcomes	After learning the module, learners will be able to -
	1. Explain lipid metabolism with involvement of various enzymes
	2. Describe the methods used to analyze lipids
	3. Express Fredrikson's Classification of lipoproteins.
Content Outline	● Lipoprotein metabolisms, metabolism of VLDL, LDL , HDL, characteristic of major apoproteins. Important enzymes in lipoprotein metabolism , ● Cholesterol catabolism, Dyslipidemia, Criteria for diagnosis of hyperlipidemia, Primary and secondary dyslipidemias ● Fredrikson's Classification of lipoproteins.
Module 2 (Credit 1): Cardiac Profile Tests And Chemistry of Bone	
Learning Outcomes	After learning the module, learners will be able to -
	1. Understand risk of heart diseases
	2. Understand the different types of bone cells, bone remodeling
	3. Analyze free calcium ions..
Content Outline	● Blood supply of heart, the cardiac cycle, electrical changes in the heart, Ischemic ● Heart disease ,Atherosclerosis, Risk factors, The response to injury hypothesis, ● Cardiac profile tests, Cardiac injury panel tests, ● Biochemical cardiac markers. ● Mineral & Bone metabolism, Calcium and bone metabolism, Role

	of hormones and vitamins. ● Metabolic bone disorders, bone profile tests. Spot test for urinary ● Calcium. Iron selective technology for the determination of free calcium ions.
Module 3 (Credit 1): Lipid Panel	
Learning Outcomes	After learning the module, learners will be able to -
	1. Identify abnormal lipid levels
	2. Learn about the structure and functions of apolipoprotein
	3. Evaluate bone health and diagnosis bone diseases
Content Outline	● Lipid profile tests: S. total cholesterol, HDL. Cholesterol, LDL-Cholesterol ● VLDL-cholesterol, T.cholesterol /HDL Cholesterol ratio. ● Special Diabetic profile tests: Determination of Glycosylated hemoglobin, Microalbuminuria. ● Determination of Apolipoprotein A1, Lp(a) and Determination of Apolipoprotein B ● Determination of serum calcium, inorganic phosphorus and S. alkaline phosphatase as a part of bone profile tests
Module 4 (Credit 1): Cardiac Injury Panel Test	
Learning Outcomes	After learning the module, learners will be able to -
	1. Explain the role of troponin in the heart muscle cells
	2. Understand the normal blood pH range
	3. Describe the mechanism regulating blood pH
	4. Identify conditions causing blood pH imbalances.
Content Outline	● Determination of cardiac injury panel tests: CK-T, CK-MB, SGOT, LDH and SHBD ● Determination of Troponin T and Troponin-I ● Determination of blood pH, PO₂, PCO₂, and plasma bicarbonate. ● Determination of Thyroid profile tests: T₃, T₄, TSH, free T₃, free T₄, Thymoglobulin, TBG and TRH

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Research and present on different types of cardiac enzymes
2. Arrange a visit to a clinical laboratory to observe the process of lipid profile test
3. Assignments given to present the chemistry behind bone formation and breakdown
4. Organize a community outreach event to educate the public about the importance of healthy cholesterol levels and bone health

References:

1. Text book of Biochemistry (For Medical Students) by Dr. Prasad R. Manjeshwar, 7th edition 2024.
2. Textbook of medical laboratory technology: Dr. P. B. Godkar, 3rd edition, Published 2018.
3. Biochemistry: U. Satyanarayana Published 2005, reprinted 2010 Publisher Anurabha Sen.
4. Biochemistry for Medical Laboratory Technology Students by Harbans Lal and Ashuma Sachdeva 3rd edition 2024

Semester – IV**.4.2 Major (Core)**

Course Titles	Microbiology - II (Th+Pr)
Course Credits	4 Credit's (2 Th + 2 Pr)
Course Outcomes	After going through the course, learner will be able to,
	1. Understand the basic concept of Lab safety and waste management
	2. Summarize the characteristic, pathogenesis and lab diagnosis for Gram positive and Gram Negative Bacteria
	3. Evaluate the characteristic features for spore forming and non spore forming bacteria
	4. In-depth evaluate immune system and related concept
	5. Analyze and understand the diagnostic serology and immunology
Module 1 (Credit 1): Microbiology - II	
Learning Outcomes	After learning the module, learner will be able to,
	1. Understand Microbial laboratory safety measures and waste disposal methods
	2. Recognize and analyze different Collection, examination and transportation methods for variety of microbial specimen
	3. Evaluate pathophysiological variations between spore and non spore forming bacteria
	4. Identify the scope and relevance of Serological Diagnosis
Content Outline	● Safety in microbiology laboratory and waste disposal ● Study of Gram positive Bacteria, The Streptococci and Staphylococci ● Non-spore forming Gram-positive Bacilli: Corynebacterium diphtheriae ● Study of Spore-forming Gram –positive bacilli: Clostridium species ● Study of Mycobacterium: Mycobacterium tuberculosis and Mycobacterium leprae ● Revision of study of Gram-negative bacteria: E.coli, Salmonella, Shigella spp., Vibrio spp. ● Diagnostic serology: ● Introduction, The immune system, Immunological reaction and related Terms, Antibodies- IgA, IgD, IgE, IgG, IgM. Immunity – natural acquired Passive immunity, Antigen antibody interaction

	Origin of immune cells, T-cell and B-cell, Complement system. ● Serological tests: VDRL and Widal test
Module 2 (Credit 1): Microbiology - II	
Learning Outcomes	After learning the module, learner will be able to,
	1. In-depth understand the study of spirochetes
	2. Evaluate pathophysiological variations between Chlamydia, Rickettsia and mycoplasma
	3. Recognize and analyze different Collection, examination and transportation methods for variety of microbial specimen
	4. In detail understand Virology and related concepts
	5. Acquaint different types of viruses and its pathophysiology
Content Outline	● Study of spirochetes: Morphology, Identification, Pathogenesis, Pathology ● Clinical findings and related laboratory tests. ● Study of Chlamydia, Rickettsia and Mycoplasma: Morphology, Identification, Pathogenesis, Pathology, Clinical findings and laboratory tests ● Collection, Transport and Examination of Specimens – ● Urine, Urogenital Specimens, Throat and mouth specimens, Sputum and Blood ● Viruses (Part –I) Introduction, Useful definitions, Classification, Structure and properties, Infection of host cells, General transmittance routes, Host response ● Overview of DNA and RNA containing viruses, Important viruses and related diseases. Viruses of medical Importance ● Lentiviruses and AIDS: ● Introduction, Important properties of Lentiviruses, Major gene products of HIV ● Pathogenesis and pathology, Prevention of HIV, Transmission of HIV, ● Clinical findings in HIV, Laboratory diagnosis. ● Poxviruses: Introduction, Structure and composition, Classification replication, related diseases, pathogenesis and pathology, Laboratory diagnosis

	Picornaviruses: Introduction, Structure and composition, Classification, replication, related diseases, pathogenesis and pathology, Laboratory diagnosis.
Module 3 (Credit 1): Microbiology - II (Practical)	
Learning Outcomes	After learning the module, learner will be able to,
	1. Inspect cultural characteristic for Gram negative and Gram positive bacteria in pure culture
	2. Demonstrate culture for anaerobic bacteria
	3. Perform staining technique for Mycobacterium spp.
	4. Perform serological tests
Course Outline	- Study of following Gram negative bacteria in pure culture: E. coli, Salmonella sp., - Study of following Gram positive bacteria in pure culture: Streptococcus pyogenes, Streptococcus pneumoniae, Streptococcus aureus, Corynebacterium diphtheriae - Demonstration of culture of anaerobic bacteria in an anaerobic atmosphere - Staining of sputum smear for the detection of Mycobacterium tuberculosis by Ziehl -Neelsen (Hot stain) Method for Mycobacterium leprae - Performing following serology tests of serum: - Antigen antibody reactions - Preparation of serial dilutions of serum - Study of Prozone effect - Study of flocculation test: VDRL test - Study of slide agglutination test: Widal test - Study of Tube agglutination test: Widal test
Module 4 (Credit 1): Microbiology - II (Practical)	
Learning Outcomes	After learning the module, learner will be able to,
	1. Examine routine examination for different biological specimen
	2. Understand fully automated microbiological analyzers
	3. Analyse and investigate HIV and HbsAg markers.
Course Outline	- Examination of following biological specimen: - Urine - Urogenital specimens.

	○ Throat and mouth specimens. ○ Sputum. ○ Blood ● Use of Versatrek system or Bacteck system ● Use of Fully automated API system. ● Mycobacterium culture (LJ method) ● Determination of hepatitis markers ● Detection of HIV-1 and HIV-II by screening methods ● Detection of Human Anti HIV-1 by Immunoblotting technique.
--	---

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Prepare laboratory reports on experiments of bacteriology
2. Research paper on the topic of Immunology and Sero diagnosis
3. Quizzes based on multiple choice questions on sexually transmitted diseases
4. Group discussion on fully automated analyzers in microbiology department
5. Project on Important viruses and related diseases. Viruses of medical Importance

References:

1. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th edition. Pearson.
2. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Dr. Ananthanarayan Paniker. (2024). 13th edition.
5. Textbook of Medical Laboratory Technology, P.B. Godkar.
6. Jawetz, Melnick and Adelberg's Medical Microbiology.

Semester – IV

.4.3 Major (Core)

Course Titles	Hematology - II (Th+Pr)
Course Credits	4 Credit's (2 Th + 2 Pr)
Course Outcomes	After going through the course, the learner will be able to
	1. Recognize and analyze different types of blood cells and their function
	2. Common tests used for each blood sample
Module 1 (Credit 1): Hematology Theory - I	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Recognise the normal hemostasis
	2. Understand the different types of anaemia.
	3. Information about bone marrow.
Course Outline	● Clinical significance of complete blood count: Absolute Eosinophil count, Reticulocyte count, and Platelet count. ● Introduction to hemostasis: Mechanism of coagulation: The intrinsic and extrinsic pathways. The final common pathway of blood coagulation. ● Revision of Anemia and Classification of anemia. ● Bone marrow examination: structure of bone marrow, sites of bone marrow aspirate, evaluation of bone marrow aspiration, various cells, bone marrow biopsy. Assessment of iron stores. ● Hemolytic anemia: Red cell destruction: Intravascular and extravascular, laboratory findings Clinical manifestations, compensatory mechanism. ● Iron deficiency anemia (IDA): Introduction, Prevalence of IDA in India, Iron metabolism, Iron balance, causes of iron deficiency, Bone marrow features, Differential diagnosis using histograms.
Module 2 (Credit 1): Hematology Theory- II	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Understand the different hematology laboratory.
	2. Brief introduction about blood grouping.
Course Outline	● Megaloblastic anaemia: Folate deficiency, Vitamin B12 deficiency, Pathogenesis, Clinical features, Peripheral blood findings, Bone marrow picture, and Pernicious anaemia.

	● Aplastic anaemia: Pathogenesis, Hematological findings, Clinical features, Course of the disease, Associated Laboratory findings. ● Routine coagulation tests and clinical significance: Bleeding time, Coagulation time, Clot retraction and clot lyses time, Prothrombin Time, Plasma recalcification time, Partial thromboplastin time, Activated partial thromboplastin time, Thrombin time, Thromboplastin generation test, Protamine sulfate test, Platelet aggregation test. ● Introduction to the Immunohematology ○ Human blood group systems: ABO antibodies. Inheritance of the ABO blood groups and formation of A, B, and H antigens. ○ Rhesus bloodgroup system, Rh antigen, Rh and Pregnancy. Other blood group systems ○ Revision of Automation in hematology: Cell counting by impedance technique, General measurement parameters, Determination of RBC, WBC, and platelet histograms. Fixed and automatic discriminators, Differential Methods, Laser technology, ○ Importance of RDW-CV, study of histograms.
Module 3 (Credit 1): Hematology Practical -1	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Understanding the different coagulation testing.
	2. Perform ABO blood grouping.
Course Outline	● Orientation to Phlebotomy & revision of study of blood smears ● Determination of absolute eosinophil count ● Determination of platelet count ● Determination of bleeding time and clotting time. ● Determination of clot retraction and lysis time. ● Determination of prothrombin time. ● Determination of plasma recalcification time. ● Determination of partial thromboplastin time (PTT). ● Determination of activated partial thromboplastin time (APTT). ● Determination of plasma hemoglobin.

	● Sucrose lysis test. ● Qualitative test for ABO grouping with antisera. ● Determination of ABO grouping by tube method.
Module 4 (Credit 1): Hematology Practical – II	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Calculation of red cell indices.
	2. Understand the histogram.
Course Outline	● Determination of D (Rho) antigen on human red blood cells. ● Indirect antiglobulin (Coomb's) test. ● The compatibility test. ● Study of blood smears and histograms related to iron deficiency anemia. ● Determining hemoglobin, MCV, MCH, MCHC, and RDW by autoanalyzer. ● Determination of RBC count and related histogram by autoanalyzer. ● Study of blood smears and histograms related to megaloblastic anemia. ● Study of histograms related to aplastic anemia

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

10 Marks Presentation Assignment (Related to Syllabus)

Reference Books:

1. Textbook of Medical Laboratory Technology by Dr. P. B. Godkar, 4th edition, 2024.
2. Textbook of Hematology by Dr. Tejinder Singh, 3rd edition, 2017
3. Textbook of Dacie and Lewis Practical Hematology, 11th edition, 2011
4. Essential in hematology and clinical pathology by Dr. Ramdas Nayak, 2nd edition, 2017

Semester – IV

.4.4 Open Elective Courses/ Generic (OEC)

Course Titles	Blood Bank and Related Technique's (Th)
Course Credits	2 Credit's
Course Outcomes	After going through the course, the learner will be able to
	1. Comprehend the different types of blood donors and donation.
	2. Information about adverse reaction.
	3. They will be able to know the importance of blood transfusion.
	4. Information about blood components and separation techniques.
	5. Importance of quality control and waste management in blood bank.
Module 1 (Credit 1): Transfusion Medicine (Theory)	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Introduce the blood bank and its importance.
	2. Information about blood grouping and understanding the importance of compatibility testing.
	3. Understand Hemapheresis and its working.
	4. They will be able to know about the different blood transfusion reactions.
Course Outline	● Blood Collection: Donor Registration, Selection of Blood Donor, Medical History and Physical Assessment, Rejection Criteria, Phlebotomy, Adverse Donor Reaction. ● Blood Processing: ABO Blood Grouping and Rh Typing, Antibody Screening, Transfusion Transmitted Disease Testing. ● Blood Preservation:Anticoagulant and RBCs Additives, Biochemical Changes in Stored Blood, Storage of Frozen RBCs. ● Blood Components:Preparation and Selection of Blood Components and Derivates, Temperature and Storage of Blood Components. ● Special Situations:Apheresis, Hemolytic Diseases of Newborns, Exchange Transfusion, Autologous Transfusion. ● Pretransfusion Testing:General Consideration, Selection of Unit, Compatibility Testing, Antibody Screening, Coomb's Testing. ● Infusion of Blood and its Components: Proper Identification, Conditions Affecting While Infusion of Blood or Blood Components, Monitoring the Patients.

	● Transfusion Reaction: Hemolytic And Nonhemolytic Transfusion Reaction, Investigation of Transfusion Reaction, Transfusion Transmitted Diseases, Graft Versus Host Diseases (GVHD), Transfusion Induces Immunosuppression. ● Quality Management ● Waste Management
Module 2 (Credit 1): Transfusion Medicine (Practical)	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Importance of blood grouping and antibody screening.
	2. Information about different testing to avoid transfusion reaction.
Course Outline	● Collection of Blood from Donor ● Preparation And Storage of Blood Components ● Preparation of Pooled Red Cells ● ABO Blood Grouping and Rh Typing ● Antibody Screening ● Test for Weak D or DuVariants ● Quality Check of Antisera ● Coomb's Test or Antiglobulin Testing ● Compatibility Testing or Cross-Matching ● Transfusion Transmitted Disease Testing ● Investigation of Transfusion Reaction

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Blood bank drive
- 10 Marks Presentation and Assessment

Reference Books:

1. Textbook of Medical Laboratory Technology by Dr. P. B. Godkar, 4th edition, 2024
2. Essential in hematology and clinical pathology by Dr. Ramdas Nayak, 2nd edition, 2017
3. Henry's Clinical Diagnosis & Management by Laboratory methods by Mc Pherson and Pincus, 23rd edition, 2016

Semester – IV

.4.5 Skill Enhancement Courses (SEC)

Course Titles	Histopathology - I (Pr)
Course Credits	2 Credit's
Course Outcomes	After going through the course, the learner will be able to
	1. Understand the importance of the Histopathology and Cytology Department.
	2. Classify tumors based on their histopathological characteristics.
	3. Demonstrating ethical handling of patient samples while adhering to safety protocol.
	4. They will be able to design and execute a sequence for processing of tissue for histological examination.
Module 1 (Credit 1): Histopathology (Theory)	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Introduction to the Histopathology and Cytology section
	2. Understand the brief introduction about the frozen section.
Course Outline	● Introduction & Orientation: Histopathology and Cytological Technique, Cell division, Basic steps in tissue processing. ● Basic Histopathology techniques: Methods of examination of tissues & cells, Smear technique. ● Tissue Preparation: Methods, Preparation of paraffin sections, Embedding, Preparation of frozen section. ● Fixation: Various Types of Fixatives and Reagents, Fixation of Tissue ● Decalcification: Gross Examination, technique for decalcification, various types of decalcifying fluids.
Module 2 (Credit 1): Histopathology (Practical)	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Evaluate the effectiveness of different staining procedures and their application.
	2. Importance of different types of staining.
	3. Understand waste management and automation.
Course Outline	● Tissue processing: Manual Methods, Use of Automatic Tissue Processor, Types of Cryostats, Paraffin Section Cutting.

	● Staining: Theory of staining techniques, Impregnation, and Mountants and Mounting procedures. ● Frozen Section Techniques: Celloidin Section, Cutting Technique ● Exfoliative Cytology Techniques: Clinical significance, Specimen Collection, Preparation of Smear& Fixation, Various staining Techniques & Papanicolaou Method. ● Automation in Histopathology ● Waste Management
--	--

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- 10 Marks Presentation (Related to Syllabus)
- 10 Marks Assignment

Reference Books:

1. Textbook of Medical Laboratory Technology by Dr. P. B. Godkar, 4th edition, 2024
2. Histological Techniques Practical Manual by K Lakshminarayanan, 3rd edition, 2020

Semester – IV**.4.7 Minor Stream**

Course Titles	Immunohistochemistry + Cytology (Th)
Course Credits	2 Credits
Course Outcomes	1. Explain the fundamental principles of histopathology and cytological techniques.
	2. Analyze basic tissue processing, fixation, and staining procedures.
	3. Demonstrate skills in section cutting and slide preparation.
	4. Illustrate advanced histopathological and cytological techniques in diagnosis.
Module 1 (Credit 1): Histopathology & Cytological Techniques	
Learning Outcomes	1. Explain the basic concepts and scope of histopathology and cytological techniques.
	2. Describe cell structure, cell division, and the colloidal nature of tissues.
	3. Demonstrate procedures for gross examination of organs.
	4. Describe and apply decalcification techniques and select suitable decalcifying agents.
	5. Demonstrate manual tissue processing methods.
Content Outline	• Introduction & orientation to Histopathology and cytological Techniques • The cell- i) Structure ii) cell division iii) Colloidal conception of tissue. • Methods of examination of tissues and cells. • Gross examination of organs. • Fixation - Introduction, aim of fixation. • Fixatives – Reagents used, advantages, disadvantages. • Gross fixation of different organs. • Decalcification – Technique, different types of fluids used. • Processing of tissue by manual methods. • Processing of tissue by using an automatic tissue processor.
Module 2 (Credit 1): Section Cutting, Staining and Advanced Histopathological Techniques	
Learning Outcomes	1. Explain the working and applications of different types of cryostats.

	2. Describe the theory and principles of staining techniques.
	3. Elucidate the principles and procedure of immunohistochemistry.
	4. Analyze electron microscopy techniques and recent advances in histopathology.
Content Outline	• Paraffin section cutting. • Different types of cryostats. • Theory of staining. • Mountants, basic staining and mounting procedures. • Routine staining procedures and frozen section techniques. • Special staining techniques. • Exfoliative cytology techniques. • Museum techniques. • Immuno-histochemistry, introduction & technique. • Electron microscopic techniques & recent advances.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

• Assignments

- Objective: Assess understanding and analytical skills
- Activities:
 - ✓ Short notes (e.g., fixation, decalcification, staining principles)
 - ✓ Diagram-based questions (cell structure, tissue processing steps)
 - ✓ Case-based questions (effect of poor fixation on tissue morphology)

• Seminar / Presentation

- Objective: Assess higher-order thinking and communication
- Suggested Topics:
 - ✓ Immunohistochemistry in diagnosis
 - ✓ Advances in histopathology
 - ✓ Electron microscopy

References:

1. O'Dowd, G., Bell, S., & Wright, S. (2023). Wheater's Functional Histology, E-Book: A Text and Colour Atlas. Elsevier Health Sciences.
2. Lowe, J. S., Anderson, P. G., & Anderson, S. I. (2023). Stevens & Lowe's Human Histology-E-Book: Stevens & Lowe's Human Histology-E-Book. Elsevier Health Sciences.
3. Gartner, L. P. (2020). Textbook of histology e-book: Textbook of histology e-book. Elsevier Health Sciences.
4. Krstic, R. V. (2013). Human microscopic anatomy: an atlas for students of medicine and biology. Springer Science & Business Media.