SNDT Women's University, Mumbai

Bachelor Of Science
(Clinical Laboratory Science)

B.Sc. In Clinical Laboratory Science

As Per NEP – 2020

Semester – III & IV

Syllabus

(WEF. 2025-2026)

Structure with Course Titles

SN	Courses	Type of Course	Credits	Marks	Int	Ext
	Semester III					
30134311	BIOCHEMISTRY-III (THEORY + PRACTICAL)	Major (Core)	4	100	50	50
30134312	HAEMATOLOGY-I (THEORY + PRACTICAL)	Major (Core)	4	100	50	50
30134313	DESIGN THINKING AND INNOVATION IN MICROBIOLOGY (THEORY)	Major (Core)	4	100	50	50
30334311	GENERAL CHEMISTRY (THEORY)	Minor Stream	2	50	0	50
30434311	STUDY OF CELLS AND TISSUES	OEC	2	50	0	50
		AEC (Modern Indian Language)	2	50	50	0
31334301	FIELD PROJECT IN PATHOLOGY LABS /HOSPITALS / CLINICS	FP	2	50	50	0
		CC	2	50	50	0
			22	**550**	**300**	**250**

	Semester IV					
40134311	BIOCHEMISTRY-IV (THEORY + PRACTICAL)	Major (Core)	4	100	50	50
40134312	MICROBIOLOGY- II (THEORY + PRACTICAL)	Major (Core)	4	100	50	50
40134313	HAEMATOLOGY-II (THEORY + PRACTICAL)	Major (Core)	4	100	50	50
40434311	BLOOD BANK AND RELATED TECHNIQUE'S	OEC	2	50	0	50
40734311	HISTOPATHOLOGY II PRACTICAL	SEC	2	50	0	50
		AEC (Modern Indian Language)	2	50	0	50
41534301	Community engagement of any kind	CE	2	50	50	0
		CC	2	50	50	0
			22	**550**	**250**	**300**

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

SEMESTER III

3.1 Major Core (4 Credits)

Course Title	**Biochemistry-III (Theory + Practical)**
Course Credits	4
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-enery 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 Outcomes	After learning the module, learners will be able to -
	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 flame photometry. ● 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
    - Types of thermodynamics
    - 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

3.2 Major Core (4 Credits)

Course Title	**Hematology-I (Theory + Practical)**
Course Credits	4 (2+2)
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
CourseOutline	▪ **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.
CourseOutline	▪ **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 impendence 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 Outcome	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.
CourseOutline	▪ 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 of hemoglobin. ▪ 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 Outcome	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 satin 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

3.3 Major (Core) (4 Credits)

Course Title	**Design Thinking and Innovation in Microbiology (Theory)**
Course Credits	2 (1+1)
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 healthcare/ 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.

5. 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* – foundational microbiology
4. Madigan, Martinko, et al. *Brock Biology of Microorganisms*

Articles/Online:

1. IDEO U: https://www.ideou.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*

3.4 Minor Stream (2 Credits)

Course Title	**GENERAL CHEMISTRY (THEORY)**
Course Credits	4
Course Out comes	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	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	Define and identify the structures of various molecules or ions, types of bonds
Content Outline	**1. 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 **2. 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 **3. 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:
	Classify electrolytes/ elements and elaborate their physiological role
Content Outline	**1.** Major physiological ions (Role and condition related to change in concentration of following ions: chloride, phosphate, bicarbonate, sodium, potassium, calcium, magnesium) **2.** Electrolytes used in replacement therapy: Sodium replacement (sodium chloride), potassium replacement (potassium chloride), calcium replacement (calcium chloride, calcium gluconate) **3.** 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) **4.** 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 Ansyln 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.
3) Modern Inorganic Pharmaceutical Chemistry, Clarence A. Discher. Wiley, New York.
4) Remington: the science and practice of pharmacy, Beringer, P. Lippincott Williams & Wilkins.
5) Inorganic Pharmaceutical Chemistry, Bothara, K. G., Nirali Prakashan. 6) Inorganic Pharmaceutical Chemistry, A. S. Dhake, H. P. Tipnis, Career Publication.

3.5 OEC (2 Credits)

Course Title	**Study of Cells and Tissues**
Credit	**2**
Course Outcomes	After going through the course, learners will be able to -
	1.Identify and describe the microscopic stucture 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 histopathologuical 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 structure
	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
	1. Examine different types of procedure methods 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 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,explainingprocessess 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

3.7 FP (2 Credits)

SOP for evaluation of FP:

1. Training Officer Assessment	**Evaluation criterion**	**Total Marks 20**
	1. Log Book (Documenting the field work)	5 Marks
	2. Initiative	5 Marks
	3. Trainee's Commitment towards work	5 Marks
	4. Viva- voce	5 Marks
2. Attendance	Punctuality	**Total Marks 10**
3. Presentation on the field project		**Total Marks 20**
	1. Quality of content [10m]	**10 Marks**
	a. Accuracy and relevance of the information	2 Marks
	b. Depth of Analysis: Does it go beyond surface-level facts and show understanding?	2 Marks
	c. Structure: Is the information logically organized? (eg. Intro, body, conclusion)	2 Marks
	d. Delivery: Voice and clarity, speed of delivery	2 Marks
	e. Confidence: maintaining eye contact, body language and audience engagement	2 Marks
	2. Visual Aids	**5 Marks**
	a. Quality of Slides: Are they neat, readable, and visually engaging?	2 Marks
	b. Use of Media: Are videos, images, or charts used effectively?	2 Marks
	c. Relevance: Do visuals enhance understanding or distract from the topic?	1 Marks
	3. Time Management	**3 Marks**
	a. Presentation should be in a required time frame	2 Marks
	b. All the section (introduction, body, conclusion) should be given equal time	1 Marks
	4. Q & A Handling: Are they able to answer questions clearly and correctly	**2 Marks**

SEMESTER IV

4.1 Major Core (4 Credits)

Course Title	**Biochemistry-IV(Theory+Practical)**
Credit	**4**
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 cholestrol and triglycerrides 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, characteristicof major apoproteins. Important enzymes in lipoprotein metabolism , • Cholesterol catabolism, Dyslipidemia, Criteria for diagnosis ofhyperlipidemia, Primary and secondary dislipidemias • 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,boneremolding
	3.Analyzefree 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, Cardic injury panel tests, • Biochemical cardiac markers. • Mineral & Bone metabolism, Calcium and bone metabolism, Role of hormonesand 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 abiut 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,Microalbuminurea. • Determination of Apolipoprotein A1, Lp(a) and Determination of Apoliprotein 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, PO_2 ,PCO_2, and plasma bicarbonate. • Determination of Thyroid profile tests: T_3, T_4, TSH, free T_3, free T_4, Thymoglobulin, TBGand 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.
4. Biochemistry: U. Satyanarayana Published 2005, reprinted 2010 Publisher Anurabha Sen.
5. Biochemistry for Medical Laboratory Technology Students by Harbans Lal and Ashuma Sachdeva 3rd edition 2024

4.2 Major Core (4 Credits)

Course Title	**Microbiology II (Theory + Practical)**
Course Credits	4 (2+2)
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 Outcome	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, Corynebacteriumdiphtheriae • Demonstration of culture of anaerobic bacteria in an anaerobic atmosphere • Staining of sputum smear for the defection 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 Outcome	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. Lipincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
5. Dr. Ananthanarayan Paniker. (2024). 13th edition
6. Textbook of Medical laboratory technology P.B. Godkar

7. Jawetz, Melnick and Adelberg’s Medical Microbiology

4.3 Major Core (4 Credits)

Course Title	**Hematology-II (Theory + Practical)**
Course Credits	4 (2+2)
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 tests performed in the 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 blood group 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 Outcome	After learning the module, the learner will be able to,
	1. Understanding the different coagulation testing.
	2. Perform ABO blood grouping.
CourseOutline	▪ 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 Outcome	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

4.4 OEC (2 Credits)

Course Title	**Blood Bank and Related Technique's (Theory + Practical)**
Course Credits	**2 (1+1)**
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'sTesting. ▪ **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 aboutdifferent testing to avoid transfusion reaction.
CourseOutline	▪ 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'sTestor Antiglobulin Testing ▪ Compatibility Testingor Cross-Matching ▪ Transfusion Transmitted Disease Testing ▪ Investigation of Transfusion Reaction

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Blood bank drive
2. 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

4.5 SEC (2 Credits)

Course Title	**Histopathology (Theory and Practical)**
Course Credits	2 (1+1)
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 - I	
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.
CourseOutline	▪ **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 Outcome	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):

1. 10 Marks Presentation (Related to Syllabus)
2. 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