SNDT Women's University, Mumbai

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

Bachelor of Science (Clinical Laboratory Science)

B.Sc. In CLS

As Per NEP – 2020

Semester – V & VI

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 and Technological Solutions, Health &	NA

		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

Degree		B.Sc.
Programme		Clinical Laboratory Science
Preamble		BSc CLS is an allied health professional degree program. This program includes clinically oriented subjects such as Microbiology, hematology, immunology, Biochemistry, Anatomy Physiology etc. It covers the diagnosis, treatment and prevention of disease through the use of clinical laboratory tests on body fluids including biochemical, pathological and microscopic analyses. The program also imparts knowledge of sample collection, testing, documentation, and reporting. Clinical laboratory professionals play a crucial role to provide the best care to patients by collecting the information needed. Clinical laboratory professionals have many choices of practice settings or career like Hospitals, clinics, nursing homes and commercial laboratories,
Programme Specific Outcomes(PSOs)		After completing this program, the learners will
	1	be able to apply knowledge and technical skills associated with clinical laboratory technology.
	2	be eligible for the enrollment of Masters and/or Ph.D. programs
	3	get employment at private/municipal/public/semi-government/ government/ State government/ Central government laboratories and Hospitals
	4	be able to get paramedical practice license and can be an entrepreneur
	5	be able to work as a leader in the professional and industrial research zones across the Globe
	6	be able to apply appropriate tools, techniques learnt in the program
	7	be capable to use resources and IT tools in the analysis and synthesis of data (outcome of final year subjects)
Eligibility Criteria for Programme		1. Female candidates with 12^{th} Science in PCB Pass out 2. Female candidates with 3-year full time DMLT course approved by DTE, AICTE and State government are eligible for Direct Second Year admission. (*Note: Admissions will be based on Merit)*
Intake		1. First year – 30 seats 2. Direct Second year – 50% of Intake of First year

Structure with Course Titles

B.Sc. In Clinical Laboratory Science

Semester – V

Sr. No.	Course	Type of Course	Credits	Marks	Int Marks	Ext Marks
	Semester – V					
50134311	Biochemistry-V (Th+Pr) (2+2)	Major (Core)	4	100	50	50
50134312	Molecular Biology and Cytogenetics (Th+Pr) (2+2)	Major (Core)	4	100	50	50
51034311	IKS In Biochemistry (Th)	IKS (Major Specific)	2	50	0	50
50234311	Laboratory Management (Th)	Major (Elective) **(Any One)**	4	100	50	50
50234312	Clinical pathology (Th+Pr)(2+2)					
50334311	Analytical Chemistry (Th)	Minor Stream	4	100	50	50
50634301	Biochemical Analysis and Molecular Laboratory Techniques (Pr)	VSC-4	2	50	50	0
51334301	Community Engagement Projects Such as Blood Donation Camps, Medical Camp Etc. (Pr)	FP	2	50	50	0
			22	**550**	**300**	**250**

Semester – VI

Sr. No.	Course	Type of Course	Credits	Marks	Int Marks	Ext Marks
	Semester - IV					
60134311	Advanced Biochemistry (Th+Pr) (2+2)	Major (Core)	4	100	50	50
60134312	Medical Microbiology (Th+Pr) (2+2)	Major (Core)	4	100	50	50
60234311	Transfusion Medicine and Blood Banking (Th+Pr) (2+2)	Major (Elective) **(Any One)**	4	100	50	50
60234312	Human Physiology (Th+Pr)(2+2)					
60334311	Histopathology (Th)	Minor Stream	2	50	0	50
60334312	Advanced Hematology (Th+Pr) (2+2)	Minor Stream	**4**	100	50	50
61234321	Internship In Hospitals/ Pathological Labs/Multispecialty Clinics (Pr)	OJT	4	100	50	50
			22	**550**	**250**	**300**

Exit with Degree (3-year)

Course Syllabus

Semester – V

.5.1 Major (Core)

Course Titles	**Biochemistry – V (Th+Pr)**
Course Credits	**4 Credit's (2 Th + 2 Pr)**
Course Outcomes	After going through the course, learner will be able to,
	1. Elucidate composition and properties of protein and nucleic acids.
	2. Analyze the structural organization of biomolecules and related structure to function.
	3. Evaluate central Dogma of molecular biology in relation to gene expression.
Module 1 (Credit 1) – Biochemistry of Proteins	
Learning Outcomes	1. Describe the chemistry, classification and properties of protein and amino acids.
	2. Analyze and classify and structure of protein and correlate it with their biological functions.
	3. Interpret lab findings related to protein about amino acids metabolism and associated disorders.
Content Outline	• **Chemistry of proteins:** Definition, importance, structure of proteins, classification of proteins, amino acids present in proteins. • **Important properties** of proteins and amino acids, Structure-function relationship of proteins, various types of proteins, plasma proteins, function of plasma proteins, role of other proteins. • **Digestion and absorption of proteins:** amino acid metabolism, body's amino acid pool sources and utilization, disorder affecting amino acid metabolism. • **Laboratory methods for the determination of amino acids and proteins:** In serum and other body fluids estimation of total protein and albumin and the clinical significance of respective tests.
Module 2 (Credit 1) – Biochemistry Nucleic Acids	
Learning Outcomes	**After learning the module, learner will be able to,**
	1. Explain the structure, types and properties of DNA and RNA forms with the properties of nucleic acids.
	2. Analyze the process of DNA replication, transcription and translation.

	3. Illustrate gene regulation and gene expression mechanism.
	4. Evaluate genetic mutation and DNA repair mechanism with respect to the diseases.
Content Outline	• **Nucleic acids:** Definition, types, chemical and molecular structure and functions. Forms of DNA and Replication of DNA. • **Gene Regulation:** Transcription of DNA to RNA, post-transcriptional modifications and Transcriptional control. • **Genetic Code:** Codon and characteristics, Translation of RNA to protein (protein synthesis). DNA mutations. Mechanism of DNA repair,
Module 3 (Credit 1) – r-DNA Technology	
Learning Outcomes	After learning the module, learner will be able to,
	1. Explain the principle and application of recombinant -DNA technology.
	2. Analyze about different vectors and gene cloning strategies.
	3. Apply various gene transfer technique in experimental setting.
	4. Differentiate and contract about genomic concept and cDNA library.
Content Outline	• **r-DNA technology:** Process and Application. DNA manipulation enzymes, Purification of DNA and RNA. • **Gene cloning:** Restriction endonucleases, vectors: plasmids, cosmides phage vectors, M13 phage vectors, phagemids expression vectors, shuttle vectors, YAC, BAC insertion of DNA and its ligation to carrier DNA, introduction of DNA in cells. • **Gene Transfer Methods:** Transformation Techniques: Preparation of competent cells, chemical methods of transfection: Calcium-phosphate method, liposome mediated method, Physical methods: Electroporation, microinjection, gene gun method • **Gene Library:** Genomic and cDNA libraries
Module 4 (Credit 1) – Laboratory Techniques	
Learning Outcomes	After learning the module, learner will be able to,
	1. Demonstrate DNA extraction and PCR technique.
	2. Perform and analyze blotting techniques.
	3. Evaluate about different experimental techniques used in clinical biochemistry.
Content Outline	• Extraction of DNA from peripheral blood mononuclear cells. • Performing polymerase chain reaction (PCR) of DNA • Isolation of DNA (after PCR)

	• Electrophoretic fractionation of DNA (southern blot technique) • Performing Northern blot technique • Performing western blot technique • Experimental Techniques: Fluorimetry, Radioimmuno assays, ELISA, Chemiluminescence and Bioluminescence, Spectroscopy, Chromatography (HPLC/ GC), Electrophoresis, and Radiotracer techniques.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Assignments on syllabus topics and Group discussion.
- Presentation and Seminar.

References:

1. Harper's Biochemistry, Tata McGraw publishers.
2. Lehninger Principles of Biochemistry, W.H. Freeman Publishers.
3. Text book of Medical Laboratory Technology by Dr. P. B. Godkar.
4. Biotechnology: Expanding horizon. Kalyani Publication. B. D. Singh.
5. Essential of Biotechnology. Ane Books Pvt Ltd. R. C. Sobti and S. S. Pachauri.
6. Biotechnology: Fundamentals and Applications. Student edition. S. S. Purohit.
7. Biotechnology, Himalaya Publishing house. Mohan P Arora.
   Principles of gene manipulation. Blackwell Science. S. B. Primrose.

Semester – V

.5.2 Major (Core)

Course Titles	**Molecular Biology and Cytogenetics (Th+Pr)**
Course Credits	**4 Credit's (2 Th + 2 Pr)**
Course Outcomes	After going through the course, learner will be able to,
	1. Analyze chromosomal abnormalities and correlate them with clinical conditions, including their role in genetic disorders and cancer genetics.
	2. Apply molecular biology techniques for the diagnosis of genetic diseases, including DNA-based methods, polymorphism analysis, and selection of appropriate diagnostic techniques.
	3. Demonstrate understanding of forensic DNA analysis for identity testing and its applications in medical and legal fields.
	4. Illustrate laboratory practices in cytogenetics, including tissue culture techniques, handling of equipment, and preparation of culture media.
Module 1 (Credit 1) - Molecular Biology and Cytogenetics I	
Learning Outcomes	After learning the module, learner will be able to,
	1. Elucidate the principles of cytogenetics, chromosome structure, gene sequencing and karyotype analysis, including modern imaging techniques such as FISH and computer-assisted analysis.
	2. Identify chromosomal abnormalities and relate them to clinical conditions.
	3. Illustrate molecular diagnosis with specific disease examples.
Content Outline	• Cytogenetics, Chromosome structure, Gene Sequencing, Karyotype analysis • FISH (Fluorescence Insitu Hybridization Technique), Computer Assisted Imaging • Chromosome Abnormalities and its clinical application • Cancer Genetics • Next Generation sequencing
Module 2 (Credit 1) - Molecular Biology and Cytogenetics II	
Learning Outcomes	After learning the module, learner will be able to,
	1. Explain and classify various cytogenetic disorders.
	2. Describe molecular diagnostic techniques used for genetic diseases.
	3. Apply the principles and applications of forensic DNA analysis for

	identity testing.
Content Outline	• Cytogenetic disorder • Cell line culture: Definition, preparation and identification of growth on cell line culture • Animal Tissue Culture: primary, secondary cell culture, identification of growth on tissue culture. • Molecular Diagnosis of Genetic Disease, Various Technique under the branch of Molecular Diagnosis, Choice Technique, Various types of Applications, Specific Disease examples, Use of DNA polymorphism and other genetic marker • Forensic Identity test by DNA analysis.
Module 3 (Credit 1) - Molecular Biology and Cytogenetics I Practical	
Learning Outcomes	After learning the module, learner will be able to,
	1. Understand the working principles of laminar airflow, CO_2 incubator, and other laboratory equipment.
	2. Describe the preparation of tissue culture media.
	3. Demonstrate basic tissue culture techniques.
	4. Explain general procedures for tissue culture techniques.
Content Outline	• Observation of working of Laminar flow hood, carbon dioxide incubator, Preparation of tissue culture media. • Observation of general method of preparation of tissue culture. • Demonstration of Animal tissue culture • Observation and demonstration of specific laboratory set-up for human cytogenetics techniques.
Module 4 (Credit 1) - Molecular Biology and Cytogenetics II Practical	
Learning Outcomes	After learning the module, learner will be able to,
	1. Explain the step-by-step procedure of cytogenetic analysis.
	2. Analyse specimen collection, processing, and culture techniques.
	3. Elucidate the FISH technique and its diagnostic applications.
	4. Interpret karyotyping analysis for detecting chromosomal abnormalities.

Content Outline	• Perform and Observe of Basic principle of Cytogenetics procedure
	  ○ Specimen procurement and logging
	  ○ Short term cultures
	  ○ Long term culture
	  ○ Harvesting

	○ Mitotic arrest ○ Hypotonic Treatment ○ Fixation ○ Centrifugation ○ Slide making ○ Slide preparation ○ Microscopy • Demonstration of FISH Technique • Demonstration of determination of Karyotyping analysis

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Seminar Presentation:
  - FISH technique and its applications
  - Role of cytogenetics in cancer diagnosis
- Quizzes on: Chromosome structure, Molecular techniques, Genetic disorders
- Poster presentation on a layout/design of a cytogenetics laboratory setup.
- Mini Project: Prepare a report on DNA fingerprinting in forensic science and its real-life applications.

References:

1. Mark, H. F. L. (2000). Medical cytogenetics. CRC Press.
2. Todd, J. C., Sanford, A. H., Davidsohn, I., & Henry, J. B. (1979). Clinical diagnosis and management by laboratory methods.
3. Liehr, T. (Ed.). (2022). Cytogenetics and molecular cytogenetics. CRC Press.
4. Larramendy, M. L., & Soloneski, S. (Eds.). (2021). Cytogenetics: Classical and Molecular Strategies for Analysing Heredity Material. BoD–Books on Demand.

Semester – V

. 5.3. Indian Knowledge System (IKS) (Major Specific)

Course Titles	**IKS in Biochemistry**
Course Credits	**2 Credit's**
Course Outcomes	After going through the course, learner will be able to,
	1. Describe the nutritional and biochemical significance of ancient Indian dietary concepts.
	2. Apply scientific principles to traditional food preservation techniques and assess their effectiveness.
	3. Explain the biochemical mechanisms of fermentation and distillation in traditional brewing practices.
	4. Identify and classify medicinal plants based on their primary and secondary metabolite composition
Module 1 (Credit 1) - Holistic Nutrition and Medicinal Plants: Ancient Wisdom Meets Modern Science	
Learning Outcomes	After learning the module, learner will be able to,
	1. Analyze the role of nutrient-dense diets in supporting early human brain expansion and evolutionary adaptations for survival.
	2. Compare the six Ayurvedic Rasas by their biochemical effects on digestion, tissue nourishment, and dosha equilibrium.
	3. Explain the scientific mechanisms behind traditional Indian food preservation techniques, such as hurdle technology in pickling and fermentation.
	4. Evaluate the therapeutic contributions of primary and secondary metabolites (e.g., flavonoids, alkaloids) in medicinal plants like Tulsi and Amla.
	5. Apply knowledge of plant antioxidants and pharmacological properties to assess their roles in combating oxidative stress, inflammation, and microbial infections
Content Outline	• **Unit-I: Biochemical Foundations of Early Human Nutrition and Diet Practices** o Role of nutrition in early human survival and development. o Ancient Indian dietary guidelines, Rasa (tastes) and their biochemical significance o Traditional methods of food preservation and their scientific basis o Nutritional and therapeutic role of traditional herbs and plants • **Unit-II Medicinal Plants and Their Biochemical Properties**

	in Ancient Civilizations ○ Importance of medicinal plants in ancient civilizations ○ Primary metabolites: Carbohydrates, proteins, and lipids ○ Secondary metabolites: Alkaloids, flavonoids, tannins, saponins, terpenoids, and phenolics ○ Antioxidant properties of medicinal plants: Biochemical mechanisms and health benefits. Pharmacological activities of medicinal plants Example-Antimicrobial, anti-inflammatory, and anti-cancer properties
Module 2 (Credit 1) - Ancient Indian Brewing and Traditional Cosmetics: Science and Heritage	
Learning Outcomes	After learning the module, learner will be able to, 1. Analyze the historical evolution of brewing techniques from Vedic sura to ritual soma in ancient Indian societies. 2. Compare the biochemical roles of enzymes like amylases in starch breakdown during fermentation of grains, fruits, and tubers. 3. Explain factors affecting fermentation efficiency (pH, temperature, substrate) and the formation of by-products such as glycerol and fusel oils. 4. Evaluate simple versus fractional distillation principles for purifying alcohol and removing impurities like fusel oils. 5. Apply knowledge of plant-based (sandalwood, turmeric) and animal-based (milk, beeswax) ingredients to assess their properties in traditional cosmetic preparations.
Content Outline	• **Unit-I: Biochemical Knowledge in Traditional Brewing and Alcohol Production** ○ Historical evolution of brewing in ancient Indian cultures ○ Cultural significance of traditional alcoholic beverages (e.g., sura, soma, sake), Overview of biochemical processes in fermentation, Carbohydrate sources: Cereal grains (rice, barley, millet), fruits, and tubers, Role of natural enzymes (e.g., amylases, proteases) in raw material breakdown, Factors influencing fermentation efficiency: pH, temperature, substrate concentration, Production of by-products- Glycerol, fusel oils and organic acids. ○ Principles of distillation: Simple vs. fractional distillation. Techniques to remove or reduce impurities (e.g., fusel oils). • **Unit-II Biochemistry in ancient cosmetics and skin care formulation** ○ Importance of cosmetics in ancient civilizations

	○ Plant-Based Ingredients including Sandalwood (Cooling and anti-inflammatory properties), Aloe Vera (Hydration and wound healing) and Turmeric (Antioxidant and antimicrobial activity) ○ Animal-Based Ingredients: Milk and cream- Natural moisturizers (lactic acid as an exfoliant), Beeswax- Emollient properties. Egg whites- Tightening and smoothing effect. ○ Traditional Cosmetic Preparations: Oils and Creams-Herbal oils like sesame, coconut, and almond.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- **Assignments Topics**
  - Ancient Indian diet vs modern diet: A biochemical comparison
  - Scientific basis of fermentation and pickling in traditional Indian foods
  - Role of Rasas in maintaining metabolic and dosha balance
- **Presentation:**
  - Evolution of human diet
  - Rasas and metabolism
  - Medicinal plants in oxidative stress
- **Quiz / Short Test:**
  - Describe Six Ayurvedic Rasas and give one biochemical effect of each
  - Role of nutrition in early human brain development

References:

1. Lad, V. (2012). The Complete Book of Ayurvedic Home Remedies: Based on the Timeless Wisdom of India's 5,000-Year-Old Medical System. Harmony.
2. Nadkarni, K. M., & Nadkarni, A. K. (Eds.). (1996). Dr. KM Nadkarni's Indian Materia Medica: with Ayurvedic, Unani-tibbi, Siddha, allopathic, homeopathic, naturopathic & home remedies, appendices & indexes (Vol. 1). Popular Prakashan.
3. Unuofin, J. O., & Lebelo, S. L. (2020). Antioxidant effects and mechanisms of medicinal plants and their bioactive compounds for the prevention and treatment of type 2 diabetes: an updated review. Oxidative medicine and cellular longevity, 2020(1), 1356893.
4. Chanda, S., & Dave, R. (2009). In vitro models for antioxidant activity evaluation and some medicinal plants possessing antioxidant properties: An overview. African Journal of Microbiology Research, 3(13), 981-996.
5. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2013). Principles of fermentation technology. Elsevier.

Semester – V

.5.4. A. Major (Elective)

Course Titles	**Laboratory Management**
Course Credits	**4 Credit's**
Course Outcomes	1. Demonstrate leadership, human resource management, and decision-making skills in laboratory settings.
	2. Elucidate the principles of laboratory organization, management, and workflow optimization.
	3. Apply laboratory safety measures, waste disposal protocols, and first aid practices effectively.
	4. Demonstrate leadership, human resource management, and decision-making skills in laboratory settings.
	5. Develop and implement SOPs, documentation systems, and understand medico-legal responsibilities.
Module 1 (Credit 1): Basic Concepts and Organization of Laboratory Management	
Learning Outcomes	1. Describe types, organization, and operational structure of clinical laboratories.
	2. Understand leadership roles, human resource management, and performance evaluation systems.
	3. Apply principles of planning, forecasting, decision-making, and mission/vision development.
Content Outline	• General laboratory Management, Basic concepts and Definitions • Organization and operation of a laboratory, various types of laboratories. • Basic laboratory principles and procedures, Laboratory safety, the first Aid measures • The responsibilities of laboratory staff, Waste disposal systems. • Role of managers, providing leadership by example and attitude, Human resource management, building a positive culture, Developing a system for measuring performances, • Forecasting, Planning and Decision making, formulating vision, and mission.
Module 2 (Credit 1): Communication Medico-legal aspects of laboratory practice	
Learning Outcomes	1. Develop and interpret Standard Operating Procedures (SOPs).
	2. Understand medico-legal responsibilities and ethical issues in laboratory practice.
Content Outline	• Importance of effective communication and documentation.

	Writing SOPs, Understanding • Medico-legal aspects of laboratory practice.
Module 3 (Credit 1): Laboratory Communication, Documentation and Legal Aspects	
Learning Outcomes	1. Apply basic financial management concepts including budgeting, cost analysis, and financial statements.
	2. Understand workflow optimization and re-engineering processes.
	3. Evaluate the impact of technological advancements in laboratory operations.
Content Outline	• Introduction to financial management, key concepts like finance management, budgeting, test cost accounting, capital expenditure, expense reports, break-even analysis, understanding balance sheet, profit and loss statement, equity and cash flow. • Re-engineering work flow and technology changes.
Module 4 (Credit 1): Laboratory Documentation and Medico-Legal Practices	
Learning Outcomes	1. Describe principles of Total Quality Management (TQM) and quality systems.
	2. Discuss accreditation requirements and modern quality concepts like Six Sigma.
Content Outline	• Fundamentals of total quality management. Quality systems, Control of design, document, data, purchasing. Process control, control of inspection measuring and testing materials, concept of validation, Control of non-conforming areas. • TQM framework Control of quality records, Internal quality audits. • Current trends in laboratory accreditation. Understanding NABL and ISO regulations. • The six sigma concept

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- **Short Assignment: Topic: Laboratory Organization & Management**
- Prepare a structured note on:
  - Types of laboratories
  - Organizational hierarchy
  - Roles of laboratory personnel
  - Evaluation: Clarity, content accuracy, presentation
- **Case Study Analysis: Topic: Laboratory Safety & Error Management**
  - Scenario-based case (e.g., accidental exposure/spillage)
  - Students must: Identify error and Suggest corrective & preventive actions (CAPA)
  - Evaluation: Analytical thinking, problem-solving.
- **Laboratory Audit Simulation: Activity (Group):**

- Conduct a mock internal audit
- Check:
  - ✓ SOP availability,
  - ✓ Documentation,
  - ✓ Safety compliance
- Submit audit report
- Skill: Accreditation readiness

References:

- World Health Organization. (1991). Basic laboratory methods in medical parasitology. World Health Organization.
- Westgard, J. O. (2016). Useful measures and models for analytical quality management in medical laboratories. Clinical Chemistry and Laboratory Medicine (CCLM), 54(2), 223-233.
- Westgard, J. O., & Westgard, S. A. (2017). Six sigma quality management system and design of risk-based statistical quality control. Clinics in Laboratory Medicine, 37(1), 85-96.
- Berger, D. (1999). A brief history of medical diagnosis and the birth of the clinical laboratory. Part 1--Ancient times through the 19th century. MLO Med Lab Obs, 31(7), 28-30.
- Godkar, P. B., & Godkar, D. P. (2006). Textbook of medical laboratory technology. Bhalani publishing house

Semester – V

.5.4. B. Major (Elective)

Course Titles	**Clinical Pathology (Th+Pr)**
Course Credits	**4 Credit's (2 Th + 2 Pr)**
Course Outcomes	After going through the course, learner will be able to,
	1. Recognize and analyze different clinical specimen in clinical laboratory
	2. Acquainted common tests used for each clinical specimen
	3. Handle various laboratory intrument
	4. Identify the scope relevance of clinical pathology
Module 1 (Credit 1) - Clinical Pathology I	
Learning Outcomes	After learning the module, learner will be able to,
	1. Introduce the clinical pathology section in pathology lab
	2. Understand the brief anatomy of urinary system
	3. Evaluate the physiological role of kidney in Urine formation
	4. Summarize routine examination of urine and it's clinical significance
	5. Demonstrate the routine examination of sputum sample
Content Outline	• Anatomy of Urinary system: Formation of urine, Composition of urine, Hormonal regulation of kidney function and role of kidney in maintaining homeostasis. • Routine urine examination: Physical, Chemical and Microscopic examination of urine and its clinical significance,examination of urine by strip method and chemical method, microscopic examination of urine and its various findings. • Chemical examination of urinary calculi and its clinical significance. • Urine pregnancy test and its clinical significance. • Routine Sputum Examination: Physical and Microscopic examination of sputum and its clinical significance
Module 2 (Credit 1) - Clinical Pathology II	
Learning Outcomes	After learning the module, learner will be able to,
	1. Understand parasitology classification
	2. Acquainted common infections due to parasites
	3. Access the feces and CSF examination and also know it's clinical significance
	4. In detail Understand anatomy of male reproductive system and

	semen formation
	5. Understand the physiology of seminal fluid
	6. Study the pathophysiology of cavity fluids
Content Outline	• Introduction to Parasitology • Classification of human parasite (based on the life cycle) • Protozoal infection and life cycle of E.histolytica and G.lamblia also mention related stool test for the same. • Amoebiasis and Giardiasis related stool test • Life cycle for Helminths, Nemathelminths, Platyhelminths and related stool test for the same. • Routine stool examination: Collection, precaution, preservation, storage, physical, chemical and Microscopic examination (routine and concentration method) of stool sample and related clinical significance. • Routine CSF examination: formation of CSF, normal composition, specimen collection, physical, chemical and microscopic examination of CSF and related clinical significance. • Semen Examination: Physiology of seminal fluid, normal composition of semen, specimen collection and preservation. Physical, chemical and microscopic examination of semen and related clinical significance. • Study of cavity fluids: Peritoneal, Pleural, Pericardial and Synovial fluid: Physiology of cavity fluid, specimen collection and preservation. Physical, chemical and microscopic examination of cavity fluids and related clinical significance.
Module 3 (Credit 1) - Clinical Pathology I Practical	
Learning Outcomes	After learning the module, learner will be able to,
	1. Inspect routine Urine examination and special
	2. Determine routine sputum examination
Content Outline	• Routine urine examination • Physical examination of urine • Chemical examination of urine (chemical method and uristrix method). • Microscopic examination of urine • Determination of urinary stone • Examination of urine pregnancy test (various methods) • Routine Sputum Examination : • Physical Examination of sputum

	• Microscopic Examination of sputum
Module 4 (Credit 1) - Clinical Pathology II Practical	
Learning Outcomes	After learning the module, learner will be able to,
	1. Examine routine faeces specimen
	2. Analyse and investigate CSF, Seminal fluid and Cavity Fluid.
Content Outline	• Gross examination of Faeces: • Physical examination of faeces • Chemical examination of faeces • Microscopic examination of faeces by routine and concentration method. • Gross Examination of CSF: • Physical examination of CSF • Chemical examination of CSF: quantitative determination of glucose, protein and chloride. • Routine Examination of Seminal Fluid: • Physical Examination of seminal fluid. • Determination of quantitative semen fructose. • Microscopic examination of semen. • Cavity Fluids Examination for Pleural, Peritoneal, Pericardial and Synovial Fluid: • Physical Examination for cavity fluids • Chemical Examination for cavity fluids • Microscopic Examination for cavity fluids

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- **Project work:**
  - Interview a clinical pathology technician to understand there daily responsibility and the challenges that they face in their field.
  - Prepare a poster presentation on Urine formation and the laboratory diagnosis carried out for Urine routine examination.
  - Carry out a laboratory survey for various special tests to evaluate male infertility.

- **Seminar Presentation:**
  - Gross CSF Examination.
  - Pathophysiology of Faeces specimen, Synovial fluid and Peritoneal fluid.

References:

1. Dr. Praful Godkar, Medical laboratory technology, 4nd edition, 2024.
2. Kanai L Mukherjee, Medical Laboratory Technology, 4th edition by CBS publishers, 2012.

3. Dr. John Bernard Henry’s, Clinical Diagnosis and Management by laboratory methods, 2001.
4. Shrish M. Kawthalkar, Essestials of Clinical Pathology, 3rd edition, 2023.

Semester – V

.5.5 Minor Stream

Course Titles	**Analytical Chemistry**
Course Credits	**4 Credit's**
Course Outcomes	After going through the course, the learner will be able to
	1. Apply fundamental principles of analytical chemistry, including sampling, chemical calculations, and quantitative analysis, to solve real-world analytical problems.
	2. Perform and interpret volumetric and instrumental analytical techniques for qualitative and quantitative determination of chemical substances.
	3. Utilize separation techniques such as extraction and chromatography for effective isolation and analysis of components in complex mixtures.
	4. Evaluate analytical data using statistical tools and operate basic analytical instruments to obtain accurate, precise, and reliable results.
Module 1 (Credit 1) – Introduction to Analytical Chemistry	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Understand the scope and importance of analytical chemistry.
	2. Apply appropriate sampling methods for solids, liquids, and gases, and perform sample drying and analyte solution preparation accurately.
	3. Perform quantitative chemical calculations, including concentration units, ppm/ppb, dilutions, and stoichiometric analysis.
Content Outline	• **Analytical Basics:** Scope and importance. Functions of analytical chemistry, Steps involved in the analytical process, Methods of sample collection, preservation, and preparation, Sampling techniques for solids, liquids, and gases, Drying of samples, and preparation of analyte solution. • **Chemometrics (Numerical Problems):** Concentration units (mass and volume-based), Calculation of parts per million (ppm) and parts per billion (ppb), Dilution of solutions, Concept of millimole (mmol) and kilogram mole (kgmol), Stoichiometry of chemical reactions, Limiting reagent, Theoretical and practical yield, pH calculations (acids, bases, and buffers), Formation and stability constants.
Module 2 (Credit 1) – Analytical Techniques	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Understand the principles and procedures of volumetric analysis.

	2. Differentiate and apply various titrations.
	3. Interpret titration curves and accurately determine equivalence points using suitable indicators.
	4. Explain the fundamental principles of spectroscopic techniques.
Content Outline	• Volumetric Methods of Analysis: Introduction to volumetric analysis, Calibration of volumetric apparatus, Primary and secondary standards, Principles of titration. • Types of Titrations: o Acid–base titrations, o Redox titrations, o Titration curves and endpoint determination. • Selection and suitability of indicators. • Introduction to instrumental analysis by spectroscopic methods: o UV–Visible spectroscopy, o Infrared (IR) spectroscopy, o Proton Magnetic Resonance Spectroscopy (1H-NMR).
Module 3 (Credit 1) - Separation Techniques	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Understand and apply solvent extraction and solid phase extraction techniques.
	2. Explain and perform planar chromatographic methods and quantitative detection techniques like Densitometric and Fluorimetric methods.
Content Outline	• **Separation Methods:** o **Solvent Extraction:** Principle and efficiency, Selectivity of extraction, Extraction systems and methods, Applications. o **Solid Phase Extraction (SPE):** Principle, Procedure, Applications. o **Planar Chromatography:** Basic principles, Classification of chromatographic techniques, Paper chromatography: technique and applications, Thin Layer Chromatography (TLC): technique and applications. o **High Performance Thin Layer Chromatography (HPTLC):** Conversion of TLC to quantitative analysis, Densitometric detection methods, Fluorimetric detection methods.
Module 4 (Credit 1) – Analytical Statistics	
Learning	After learning the module, the learner will be able to,

Outcomes	1. Evaluate and interpret analytical data using statistical concepts. 2. Understand, operate, and maintain key analytical instruments for accurate and reliable measurements.
Content Outline	• **Statistics in Analytical Chemistry:** Evaluation of analytical data, Accuracy and precision, Types of errors, Normal distribution curve, Standard deviation, Confidence limits, Graphical presentation of results, Method of averaging, Method of least squares (linear), Significant figures, Correlation analysis, Statistical hypothesis testing: o t-test, o F-test, o Chi-square test. • **Introduction To Analytical Instruments:** o **pH meter:** components, use, maintenance, applications. o **Analytical balance** – Types, operation, and construction, Errors in weighing, and care of an analytical balance. o **Spectrophotometer:** Principle, type, components, uses, application.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Applications of Chromatography in Food or Pharmaceutical Analysis
- Principles and Uses of Spectroscopic Techniques
- Role of Analytical Chemistry in Environmental Monitoring
- Study of Analytical Instruments (e.g., Spectrophotometer)

Reference Books:

1. Textbook of Medical Laboratory Technology by Dr. P. B. Godkar, 4th edition, 2024.
2. Seamus P.J. Higson: Analytical Chemistry.
3. Douglas A. Skoog and Donald M. West: Fundamentals of Analytical Chemistry.
4. Adion A. Gordus: Schaum's Outline of Analytical Chemistry, Tata McGraw-Hill.
5. Gary D. Christian: Analytical Chemistry.
6. Freifelder and Kealy: Analytical Chemistry.

Semester – V

.5.6 Vocational Skill Courses (VSC-4)

Course Titles	**Biochemical Analysis and Molecular Laboratory Techniques**
Course Credits	**2 Credit's**
Course Outcomes	After going through the course, learner will be able to,
	1. Execute protein precipitation tests (heat/acetic acid, Heller's, alkali, alcohol, isoelectric) and color reactions (Ninhydrin, Nitroprusside, Xanthoproteic, Millon, Sakaguchi) to identify proteins and amino acids.
	2. Operate colorimeter and spectrophotometer for accurate quantification of biochemical assays.
	3. Quantify total protein (Biuret), urea (urease), uric acid (uricase), and creatinine (picric acid) using colorimetric methods.
	4. Extract genomic DNA, quantify DNA (spectrophotometry/DPA) and RNA (Orcinol), and perform agarose gel electrophoresis.
Module 1 (Credit 1) – Biochemistry Practical-I	
Learning Outcomes	After learning the module, learner will be able to,
	1. Perform protein precipitation tests (heat/acetic acid, Heller's, alkali, alcohol, isoelectric) and color reactions (Ninhydrin, Nitroprusside, Xanthoproteic, Millon, Sakaguchi) to detect proteins and amino acids.
	2. Operate colorimeter/spectrophotometer and quantify total protein (Biuret), urea (urease), uric acid (uricase), creatinine (picric acid) via colorimetric methods.
Content Outline	• **Perform qualitative analysis of protein and amino acids:** • Precipitation test: Heat and acetic acid Test, Heller's test, alkali, alcohol, Isoelectric point precipitation. • Color reaction: Ninhydrin, Nitroprusside test, Xanthoproteic test, Million test, Sakaguchi test. • Operate the colorimeter and spectrophotometer. • Estimation of Total Protein by Biuret Method Estimation of Urea by Urease method. • Estimation of Uric acid by uricase method. • Estimation of creatinine by picric acid method.
Module 2 (Credit 1) – Biochemistry Practical-II	
Learning Outcomes	After learning the module, learner will be able to,
	1. Extract genomic DNA, quantify by spectrophotometer (A260/A280 purity check), and perform agarose gel

	electrophoresis for size separation.
	2. Estimate DNA concentration using DPA (diphenylamine) method and RNA using Orcinol method via colorimetric reactions.
Content Outline	• Extraction of genomic DNA. • Quantification of DNA by spectrophotometer. • Agarose gel electrophoresis of DNA. • Estimation of DNA by DPA method. • Estimation of RNA by Orcinol method.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Assignments on syllabus topics and Group discussion.
- Presentation and Seminar.

References:

1. Harper's Biochemistry, 28th edition, Robert K Murray, Tata McGraw publishers.
2. Lehinger Principle of Biochemistry, David L Nelson, 7th edition, WH Freeman Publishers.
3. Text book of Medical Laboratory Technology by Dr. P. B. Godkar.
4. Biotechnology: Expanding horizon. Kalyani Publication. B D Singh.
5. Essential of Biotechnology. Ane Books Pvt Ltd. R C Sobti and S S Pachauri.
6. Biotechnology: Fundamentals and Applications. Student edition. S S Purohit.
7. Biotechnology, Himalaya Publishing house. Mohan P Arora.
8. Principles of gene manipulation. Blackwell Science. S B Primrose.

Course Syllabus

Semester – VI

.6.1 Major (Core)

Course Titles	**Advance Biochemistry (Th+Pr)**
Course Credits	**4 Credit's (2 th+ 2 Pr)**
Course Outcomes	After going through the course, learner will be able to,
	1. Recognize and analyze different types of cancers.
	2. Able to know about Therapeutic drug monitoring and chemical aspects of toxicology.
	3. Identify the scope and relevance of cancer biochemistry.
	4. Identify and explain the significance of common biochemical markers used in diagnostics and monitoring of disease.
Module 1 (Credit 1) – Cancer Biochemistry	
Learning Outcomes	After learning the module, learner will be able to,
	1. Introduce about Cancer.
	2. To understand characteristics of Cancer cell.
	3. To understand about drug metabolisms and its excretion.
	4. Evaluate various methods of laboratory determinations of tumor markers, hormones and vitamin.
	5. Understand about endocrine hormones and nerve biochemistry.
	6. Determine role of hormone in human pregnancy.
Content Outline	• **Biochemistry of cancer:** Definitions, concepts, and scope of cancer epidemiology, Cancer classification, Risk factors: genetic, environmental, lifestyle, occupational. Properties of cancer cells, morphological and biochemical changes in cancer cells and Characteristic of growing tumor cells. • **Cancer and Tumor markers:** Carcinogenesis, Carcinogens, Tumor / oncogenic markers and its classification (AFP, PFA, CEA, bHCG, Myeloma -Bence Jones protein, M band), Potential uses of tumor markers. oncogenic viruses, activation of protooncogenes to oncogenes, oncogenes, mechanism of action of oncogenes, Importance of growth factors. • **Diagnosis of cancer:** Chromosomal translocation, gene amplification, Point mutation, Antioncogenes, Tumor markers and laboratory determinations: Marker detection - PSA, β-hCG, AFP, CEA, CA15-3, CA 125, CA 19-9. • **Therapeutic drug monitoring and chemical aspects of toxicology:** Therapeutic drugs: Definition, Mechanism of action, Absorption, Distribution, Biotransformation, Metabolism and Excretion of drugs, and Clinical utility. Relation between plasma

	concentrations of drugs and their cellular effects. • **Monitoring individual drug concentration:** Digoxin, Phenytoin Cyclosporin, Lithium, Paracetamol, Salicylates, Ethanol and Methanol.
Module 2 (Credit 1) – Hormones, Vitamin and Nerve Biochemistry	
Learning Outcomes	After learning the module, learner will be able to, 1. Understand about endocrine hormones. 2. Determine role of hormone in human pregnancy. 3. Understand nerve biochemistry.
Content Outline	• **Hormones of Endocrine system:** Hormones of pituitary gland & hypothalamus, Hormones of adrenal gland, Hormones of the gonads, the menstrual cycle, Human chorionic gonadotropin. • **Clinical Chemistry of Pregnancy:** Human pregnancy, Role of various hormones conception, embryo, fetus, amniotic fluid, functional development of fetus, complications of pregnancy. • **Vitamins and Trace Elements:** Definition, Nutritional assessment and classification: Oil soluble vitamins, Water-soluble vitamins and related pathophysiology. Trace elements. • **Muscle and Nerve Biochemistry:** Introduction, Biomedical importance, Muscle as major biochemical transducer, Functional unit of muscle, Thick filaments, Roles of Actin and Myosin. Events occurring at the neuromuscular junction.
Module 3 (Credit 1) – Practical	
Learning Outcomes	After learning the module, learner will be able to, 1. To Understand about Diagnostic Kits. 2. To prepare and standardize reagents.
Content Outline	• Use of diagnostic kits. • Preparation and standardization of reagents. • Calibration of instruments in the biochemistry laboratory. • Standardization of a biochemistry method. • Demonstration of HCG. • Demonstration of Prolactin. • Determination of Acid phosphatase. • Determination of Prostate-Specific Antigen (PSA). • Demonstration of drug determination (any one as mentioned in theory).
Module 4 (Credit 1) – Endocrine Function Test	
Learning	After learning the module, learner will be able to,

Outcomes	1. To introduce endocrine system.
	2. To understand disorders of endocrine system.
	3. To learn and understand about endocrine disorders.
Content Outline	• **Overview of disorders of:** Hypothalamus, pituitary, thyroid, adrenal cortex, pancreas, placental, testes, ovaries. • **Analysis of hormones:** Thyroid profile and Fertility profile. • **T3, T4, TSH, FT3, FT4, anti- TPO, Prolactin, Testosterone, Chorionic gonadotropin (BHCG), FSH, LH, Estradiol, progesterone, Insulin, ACTH, Cortisol.**

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Assignments and Group discussion.
- Research and present on different types of endocrine hormones.
- Arrange a visit to a clinical laboratory to observe the process of Thyroid and fertility profile test.

References:

1. Harper's Biochemistry, 28th edition, Robert K Murray, Tata McGraw publishers.
2. Lehinger Principle of Biochemistry, David L Nelson, 7th edition, WH Freeman Publishers.
3. Text book of Medical Laboratory Technology by Dr. P. B. Godkar.

Semester – VI

.6.2. Major (Core)

Course Titles	**Medical Microbiology (Th+Pr)**
Course Credits	**4 Credit's (2 Th + 2 Pr)**
Course Outcomes	After going through the course, learner will be able to,
	1. Evaluate the role of normal microbial flora in human body.
	2. Acquainted clinical specimen collection, transportation and lab diagnosis.
	3. Categorize different bacterial, viral, fungal and protozoal diseases depending upon its causative agents and clinical features.
	4. Demonstrate variety of Antimicrobial agents.
	5. Evaluate the scope and clinical relevance of medical microbiology.
Module 1 (Credit 1) - Medical Microbiology I	
Learning Outcomes	After learning the module, 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 collection, transportation, and processing of clinical specimens.
	4. Evaluate the quality and suitability of specimens for laboratory diagnosis.
Content Outline	1. **Introduction to normal microbial flora:** Normal microflora of the human body: Importance of normal microflora of skin, throat, gastrointestinal tract and urogenital tract. 2. **Host pathogen interaction:** o Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity. o Carriers and their types, Opportunistic infections, Nosocomial infections and Transmission of infection. o Collection, Transportation and Examination of following Specimen: Revision of Urine and Blood o CSF o Ear Specimen o Eye Discharge o Pus from Abscess material, wound

	○ Burn and sinuses ○ Skin and Soft Tissue ○ Feces
Module 2 (Credit 1) - Medical Microbiology II	
Learning Outcomes	After learning the module, learner will be able to,
	1. Explain and analyze the pathogenesis of bacterial, viral, fungal, and protozoal infections.
	2. Interpret laboratory diagnostic methods for infectious diseases.
	3. Evaluate the epidemiology and laboratory diagnosis of viral infections.
	4. Explain and apply principles of vaccination in disease prevention.
	5. Analyze laboratory diagnosis of fungal and protozoal infections.
Content Outline	• **Bacterial Diseases: Its causative agent and its Clinical Relevance:** ○ Respiratory Tract Infections ○ Gastrointestinal Infections ○ Skin and Soft Tissue Infections ○ Sexually Transmitted Diseases (STDs) ○ Nervous System Infections ○ Urinary tract infection • **Clinical Mycology:** General Consideration, Terms applies to fungi: Basic morphological classification, Parasitic fungi, Laboratory Diagnosis of mycotic infection • **Viral Diseases,** Pathogenies its laboratory diagnosis: Hepatitis Viruses: Clinical features of HAV, HBV, HCV, HDV, HEV Replication of hepatitis B virus, Pathology, Nomenclature and definitions of Hepatitis viruses, Clinical findings, Epidemiology of HAV, HBV, HCV, HDV, HEV Laboratory features **of Infective Hepatitis and related laboratory tests** • **Herpesviruses:** Introduction, Structure and composition, Classification, Replication, Related diseases, Pathogenesis and Pathology, Laboratory diagnosis • **Paramyxoviruses and Rubella Virus:** Introduction, Structure and composition, Classification, Replication, Related diseases, Pathogenesis and Pathology, Laboratory diagnosis • **Orthomyxoviruses**: Introduction, Structure and composition, Classification, Replication, Related diseases, Pathogenesis and Pathology, Laboratory diagnosis

	• **Vaccines** • **Coccidian Protozoan Infections:** Toxoplasma gondii, Morphology and Identification, Culture, Pathology and Clinical findings, Diagnostic Laboratory Test
Module 3 (Credit 1) - Medical Microbiology I (Practical)	
Learning Outcomes	After learning the module, 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 (Vesatreak), Biotek, and Mini API systems.
	3. Apply principles of quality control and biosafety in microbiology laboratories.

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

Module 4 (Credit 1) - Medical Microbiology II (Practical)	
Learning Outcomes	After learning the module, learner will be able to,
	1. Perform serological tests for detection of antibodies
	2. Conduct routine examination of body cavity fluids
	3. Interpret results of immunological assays used in infectious disease diagnosis.
Content Outline	• Determination of Toxoplasma antibodies in serum • Determination of Rubella antibodies in serum • Determination of CMV antibodies in serum • Determination of Varicella Zoster antibodies in serum • Routine examination of cavity fluids: Pleural, Pericardial, Peritoneal and Synovial fluid

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Seminar Presentation:
  - Host and Pathogen interaction
  - Viral and fungal Diseases
- Quizzes on Recent and Advance 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 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

Semester – VI

.6.3. A. Major (Elective)

Course Titles	**Transfusion Medicine and Blood Banking (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. 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 a blood bank.
Module 1 (Credit 1) – Transfusion Medicine and Blood Banking Theory - I	
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.
Content 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.
Module 2 (Credit 1) – Transfusion Medicine and Blood Banking Theory -II	
Learning Outcomes	After learning the module, the learner will be able to
	1. Understand Hemapheresis and its working.
	2. They will be able to know about the different blood transfusion reactions.
Content Outline	• **Special Situations:** Apheresis, Hemolytic Diseases of Newborns, Exchange Transfusion, Autologous Transfusion. • Pretransfusion Testin**g:** General Considerations, Selection of Unit, Compatibility Testing, Antibody Screening, Coombs Testing. • **Infusion of Blood and its Components:** Proper Identification, Conditions Affecting During Infusion of Blood or Blood

	Components, and 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. • **Cord Blood Banking**
Module 3 (Credit 1) – Transfusion Medicine and Blood Banking Practical - I	
Learning Outcomes	After learning the module, the learner will be able to
	1. Importance of blood grouping and antibody screening.
	2. Understand the preparation of Antisera and pooled cells.
Content 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 Du Variants • Quality Check of Antisera
Module 4 (Credit 1) – Transfusion Medicine and Blood Banking Practical - II	
Learning Outcomes	After learning the module, the learner will be able to
	1. Information about different tests to avoid transfusion reaction.
	2. Understand the waste management in the blood bank
Content Outline	• Coomb's Test or Antiglobulin Testing • Compatibility Testing or Cross-Matching • Transfusion Transmitted Disease Testing • Investigation of Transfusion Reaction • Quality Management • Waste Management

Assessment/ Workshop

- 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 McPherson and

Pincus, 23rd edition, 2016

Semester – VI

.6.3. B. Major (Elective)

Course Titles	**Human Physiology (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 basic structure and functions of the human body
	2. Acquainted with common diseases/disorders of each system
Module 1 (Credit 1) - Human Physiology I	
Learning Outcomes	After learning the module, learners will be able to
	1. Introduce students to basic terminology
	2. Understand the basic structure of the human body
	3. Understand the functioning of cardio cardiovascular, respiratory, gastrointestinal
	4. Brief knowledge about common diseases affecting each system.
	5. To create awareness about interdependence and coordination between different systems of the body for normal functioning.
Content Outline	• Introduction o General terms- anatomy, physiology, symmetrical arrangement, anatomical position. Median plane / lateral plane, internal/ external, superficial /deep, superior/ inferior, anterior/posterior. o Basic human tissues. Introduction to the human skeleton. Structure of bone and cartilage. o Classification of various types of muscle. • **Blood And Lymphatic System** o Physical characteristics of blood o Blood volume, composition of plasma, and functions of plasma proteins o RBC formation and functions. Information about anemia and thalassemia. o Blood groups, their importance, and Rh-incompatibility. o WBC- types, functions, importance of CBC o Platelets and the mechanism of coagulation o Lymph and lymphatic system, spleen, and its functions. • **Heart** o Its structure and circulation of blood.

	○ Cardiac cycle ○ Information about hypertension & ischemic heart disease • **Respiratory System** ○ Respiratory organs-nose, sinuses, larynx, trachea, bronchi, lung, brief structure and functions. Mechanism of respiration, factors affecting the efficacy of respiration. Various lung volumes and capacities. ○ Common diseases- TB, asthma, bronchitis, cough, pneumonia, sinusitis • **Gastro-Intestinal System** ○ Oral cavity, tonsils, pharynx, esophagus, stomach, small and large intestine - brief structure and functions. Liver, gall bladder, and pancreas structure and functions. ○ Common disorders – dental caries, vomiting, diarrhea, constipation, Hyperacidity, and diabetes.
Module 2 (Credit 1) - Human Physiology II	
Learning Outcomes	After learning the module, learners will be able to
	1. Understand the functioning of the excretory system and brief knowledge about Common diseases affecting this system.
	2. Know more about the Nervous System and the Endocrine System
	3. Know the reproductive system and the importance of the reproductive system health
Content Outline	• **Excretory System** ○ Structure and function of organs of the urinary system (in brief). ○ Mechanism of urine formation ○ Common diseases- urinary tract infection and renal stones. ○ Structure and function of skin ○ Regulation of body temperature ○ Common disorders - acne, dandruff, and burns. • **Nervous System** ○ Classification of the nervous system ○ Structure and functions of different parts of the brain, spinal cord, and reflex action. ○ Eye - structure and mechanism of vision ○ Common problems - conjunctivitis, cataract. ○ Ear - structure and mechanism of hearing

	○ Common problems - deafness, vertigo, motion sickness • **Endocrine System** ○ Listing of endocrine glands and their location ○ Functions of the pituitary, thyroid, parathyroid, and adrenal. • **Reproductive System** ○ **Female Reproductive System** ✓ Structure ✓ Menstrual cycle ✓ Fertilization ✓ Breast- Structure, function, importance of breast hygiene, and breastfeeding ✓ Physiological changes in pregnancy and the Importance of antenatal care. ○ **Male Reproductive System** ✓ Structure ✓ Sex education ✓ Contraception and infertility ✓ Sexually transmitted diseases- syphilis, gonorrhea, AIDS
Module 3 (Credit 1) - Human Physiology I Practical	
Learning Outcomes	After learning the module, learners will be able to
	1. Introduce the students to the human skeleton and enable them to identify various bones in the body
	2. Perform simple clinical tests like estimation of hemoglobin and blood group, and blood pressure
Content Outline	• Study of the human skeleton and identification of bones. • Estimation of hemoglobin • Estimation of blood groups, • Demonstration of peripheral blood smears. Importance of complete blood count. • Measurement of pulse rate and blood pressure. • Discussion of normal components of urine. Test for abnormal components like sugar, albumin, and acetone, and discuss diseases in which they are found.
Module 4 (Credit 1) - Human Physiology II Practical	
Learning Outcomes	After learning the module, learners will be able to
	1. Utilize the knowledge learnt to administer first aid for common

	emergencies.
	2. Acquaint the students with the basic principles of home nursing.
Content Outline	• First Aid o Definition, aims, qualities of the first aider, contents of the first aid box. o Different types of bandages and bandaging techniques. • Wounds o Classification, dressing, and management of hemorrhage - basic principles and discussion about bleeding from various parts of the body.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Case Study Assignment:
- Write a short report on common blood disorders such as anemia, thalassemia, hypertension, asthma, or diabetes covering causes, symptoms, diagnosis, and prevention.
- Group Presentation/Seminar:
- Present on one body system (cardiovascular, respiratory, gastrointestinal) explaining structure, function, and common diseases.
- Case-Based Learning:
- Analyze case studies related to UTI, kidney stones, cataract, diabetes, thyroid disorders, infertility, or hypertension.

Reference

1. Shaw, P. (2014). Ross and Wilson Anatomy and Physiology in Health and Illness. Nursing Standard, 28(49), 32.
2. Tortora, G. J., & Derrickson, B. H. (2018). Principles of anatomy and physiology. John wiley & sons.
3. Patton, K. T., Bell, F. B., Thompson, T., & Williamson, P. L. (2022). Anatomy & physiology with brief atlas of the human body and quick guide to the language of science and medicine-e-book: Anatomy & physiology with brief atlas of the human body and quick guide to the language of science and medicine-e-book. Elsevier Health Sciences.
4. Patton, K. T., & Thibodeau, G. A. (2018). Anthony's Textbook of Anatomy & Physiology-E-Book: Anthony's Textbook of Anatomy & Physiology-E-Book. Elsevier Health Sciences.

Semester – VI

.6.4 Minor Stream

Course Titles	**Histopathology**
Course Credits	**2 Credit's**
Course Outcomes	1. Explain the fundamental principles of histopathology and cytological techniques.
	2. Analyse 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 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 principles and procedure of immunohistochemistry.
	4. Analyse 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.

Semester – VI

.6.5 Minor Stream

Course Titles	**Advance Hematology (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. Introduction to major hematological disorders.
	2. Understand the importance of quality control in hematology
	3. Explain the structure and functioning of the immune system and its components.
	4. Interpret the significance of cytokines, adhesion molecules, and immune mediators in immune responses.
	5. Apply knowledge of complement fixation and serological tests in diagnostic immunology.
Module 1 (Credit 1) – Hematology Theory - I	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Understand the diagnosis of thalassemia and sickle cell anemia.
	2. Introduction to leukaemia and blood parasite.
Content Outline	• Sickle cell anemia: Introduction, Clinical features, Pathophysiology, Laboratory diagnosis, Special tests. • Thalassemia: Introduction, Clinical features, Major and Minor Thalassemia (Alpha and Beta Thalassemia), Pathophysiology, Laboratory diagnosis, Special test. • Introduction to Leukemia: FAB and WHO classification, Cytochemistry, Laboratory diagnosis. • Pathophysiology and Laboratory diagnosis: • Acute Myeloid Leukemia & Chronic Myeloid Leukemia • Acute Lymphoid Leukemia& Chronic Lymphoid Leukemia. • Polycythemia: Introduction, Classification, Pathophysiology, Laboratory Diagnosis. • Plasma Cell Neoplasm: Multiple Myeloma • Introduction to Bleeding and Coagulation Disorders: • Pathophysiology and Laboratory Diagnosis: • Immune Thrombocytopenic Purpura (ITP), • Thrombotic Thrombocytopenic Purpura (TTP), • Disseminated Intravascular Coagulation (DIC)

	• Hemophilia A and B • Introduction to Blood Parasite: Malaria and Leishmaniosis • Flow Cytometry and CD marker • Quality Control in Hematology
Module 2 (Credit 1) – Immunology Theory – I	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Explain the involvement of complement in rheumatologically, renal, and neurological diseases.
	2. Describe the genetics, structure, and inheritance of MHC (Class I and II molecules).
	3. Analyze the role of HLA in immune recognition and disease susceptibility
	4. Evaluate immunological aspects of transplantation, including compatibility testing and cross-matching.
Content Outline	• Complement in disease states: Rheumatological disease, renal disease, and Neurological Disease. Complement fixation test: Applicability in serological tests such as VDRL and Wassermann tests. • Kinin and Kinin- generating system • Cytokines and Adhesion molecules: Interleukin, Transforming Growth Factor, Tumor Necrosis Factor, Interferon - Gamma, Cell Adhesion molecules- Integrins and selectins. • Human Leukocyte Antigen (HLA): The Major Histocompatibility complex of man. Composition of MHC, Genetics of MHC genes, Inheritance of Class-I and Class-II Molecules. • Tissue/ Organ Transplantation: Genetic basis of Transplantation, histocompatibility matching, serum screening test, Donor-specific cross-match, indirect cross-matching, Auto-antibodies and B- cell antibodies.
Module 3 (Credit 1) - Hematology Practical – I	
Learning Outcomes	After learning the module, the learner will be able to,
	1. Special laboratory test for sickle cell anemia.
	2. Importance of peripheral blood smear and special test.

Content Outline	• **Laboratory investigation for:**
	  ○ Sickle Cell anemia
	  ○ Thalassemia
	• Hb Electrophoresis
	• Sickling Test and Solubility Test

	• Osmotic fragility test
	• Heinz Bodies Preparation
	• Alkali Denaturation Test
	• Determination of Glucose-6-Phosphate Dehydrogenase G6PD
	• Quantitative Abnormalities of WBCs
	• **Study of the blood picture of:**
	  ○ Chronic Myeloid Leukemia
	  ○ Chronic Lymphoid Leukemia
	  ○ Acute Myeloid Leukemia
	  ○ Acute Lymphoid Leukemia
	• Cytochemistry in Leukemia
	• Preparation of Thick Smear for Blood Parasite
	• Fibrin Degradation Products
	• D - Dimer
	• Detection of the Malaria Parasite and Leishmaniosis

Module 4 (Credit 1) - Immunology Practical – I	
Learning Outcomes	After learning the module, the learner will be able to, 1. Perform and interpret routine serological tests such as Widal and HBsAg detection 2. Estimate immunoglobulins (IgA, IgE, IgG, IgM) using standard laboratory methods 3. Explain the principle and procedure of the Western blot technique for HIV confirmation 4. Understand the working principles of automated systems like AxSym and Immulite.
Content Outline	• Revision for all the serological tests from sem IV, particularly Widal and HbsAg Surface Antigen. • Determination of IgA • Determination of IgE • Determination of IgG • Determination of IgM • Determination of HIV-I and HIV-II by Screening method • Detection of Human Anti- HIV-I by Western Blotting Technique • Study of Working of AxSym and Immulite System.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- **Assessment/ Workshop**: 10 Marks Presentation/ Assignment (Related to Syllabus)
- **Short Essay Assignment**
  - Explain the complement system pathways with a diagram.
  - Role of complement in disease conditions.
- **Synopsis:**
  - ELISA plate
  - Western blot strip
  - Immunoassay analyzer (AxSym/Immulite)

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
5. Todd, J. C., Sanford, A. H., Davidsohn, I., & Henry, J. B. (1979). Clinical diagnosis and management by laboratory methods.
6. McPherson, R. A., & Pincus, M. R. (2021). Henry's clinical diagnosis and management by laboratory methods E-book. Elsevier Health Sciences.
7. Gell, P. G. H., & Coombs, R. R. A. (1963). Clinical aspects of immunology.