DIPLOMA IN MEDICAL LABORATORY SCIENCE (DMLS) SESSION 2025					
Course code	**Course Title**	**Course Type**	**L+T+P**	**Total Credits/Week**	**Weightage Theory/ Practical**
Semester-I (OLD)					
DMLT-BIC.201	Chemistry of Carbohydrates & Lipids	Core	3+0+2	3	30+70=100T 10+40=50P
DMLT-PAT.202	Fundamentals of Histopathology/ Histotechnology & Cytology	Core	3+1+2	4	30+70=100T 10+40=50P
DMLT-MIC.203	General Microbiology	Core	2+0+2	2	30+70=100T 10+40=50P
ECO.250	English/Communication skills	Elective	2+0+0	2	NC
		Total Credits	**10+1+9**	**20**	**225+225=450**
Semester-II (NEW)					
DMLS.204	Fundamentals of Microbiology	Core	4+0+2	6	30+70=100T 30+70=100P
DMLS.205	Basics of Biochemistry	Core	4+0+2	6	30+70=100T 30+70=100P
DMLS.206	Fundamentals of Haematology	Core	4+0+2	6	30+70=100T 30+70=100P
DMLS.207	Preventive and Social Medicine	Elective	2+0+0	2	30+70=100
COM.250	Basics of Computer Application	Elective	1+0+1	2	NC
		Total Credits	**15+0+7**	22	**210+490=700**
Semester-III					
DMLS.301	Bacteriology	Core	4+0+2	4	30+70=100T 30+70=100P
DMLS.302	Intermediary Metabolism and Endocrinology	Core	4+0+2	4	30+70=100T 30+70=100P
DMLS.303	Clinical Haematology	Core	4+0+2	4	30+70=100T 30+70=100P
DMLS.304	Basics of Pharmacology	Core	2+0+0	2	30+70=100
		Total Credits	**14+0+6**	**20**	**210+490=700**
Semester-IV					
DMLS.305	Virology and Immunology	Core	4+0+2	6	30+70=100T 30+70=100P
DMLS.306	Genetics and Molecular Biology	Core	4+0+2	6	30+70=100T 30+70=100P
DMLS.307	Clinical Pathology	Core	4+0+2	6	30+70=100T 30+70=100P
DMLS.308	Medical Laboratory Management and Quality Control	Core	2+0+0	2	30+70=100T
		Total Credits	**14+0+6**	**20**	**210+490=700**
Semester-V (Internship six month) INTERNSHIP (clinical lab posting/research dissertation)					
DMLS.408	Biochemistry Laboratory	Core	0+0+15	15	30+70=100
DMLS.409	Microbiology Laboratory	Core	0+0+15	15	30+70=100
DMLS.410	Pathology Laboratory	Core	0+0+10	10	30+70=100
		Total Credits	**0+0+40**	**40**	**90+210=300**

Course Structure for the Diploma MLT (CODE-BMLT.1.2) SESSION 2024

Course code	Course Title	Course Type	L+T+P	Total Credits/Week	Weightage Theory/ Practical
Semester-I					
DMLT-BIC.201	Chemistry of Carbohydrates & Lipids	Core	3+0+2	5	50+50=100T 50P
DMLT-PAT.202	Fundamentals of Histopathology/ Histotechnology & Cytology	Core	3+1+2	6	50+50=100T 50P
DMLT-MIC.203	General Microbiology	Core	2+0+2	4	50+50=100T 50P
ECO.250	English/Communication skills	Elective	2+0+0	2	NC
DMLT.250	Clinical Rotations	Core	0+0+3	3	-
		Total Credits	**10+1+9**	**20**	**450**
Semester-II					
DMLT-BIC.204	Heme, Porphyria & Biophysical biochemistry	Core	2+1+2	5	50+50=100T 50P
DMLT-PAT.205	Basic Techniques in Haematology & Clinical Pathology	Core	3+1+2	6	50+50=100T 50P
DMLT-MIC.206	Systemic Microbiology	Core	2+1+2	5	50+50=100T 50P
COM.250	Computer applications	Elective	2+0+0	2	NC
DMLT.250	Clinical Rotations	Core	0+0+3	3	-
		Total Credits	**9+3+9**	**21**	**300/150=450**
Semester-III					
DMLT-BIC.307	Carbohydrates, lipids & protein Metabolism	Core	2+1+2	5	50+50=100T 50P
DMLT-PAT.308	Histopathology & Cellular Pathology	Core	2+1+2	5	50+50=100T 50P
DMLT.309	Immunology	Core	2+0+2	4	50+50=100T 50P
HVE.350	Human Values & Ethics	Elective	3+0+0	3	NC
DMLT.250	Clinical Rotations	Core	0+0+3	3	-
		Total Credits	**9+2+9**	**20**	**300/150=450**
Semester-IV (NEW)					
DMLT-PAT.310	Clinical Pathology	Core	4+0+2	6	30+70=100T 10+40=50P
DMLT-BIC.311	Medical Laboratory Management and Quality Control	Core	2+0+0	**2**	30+70=100T
DMLT-MIC.312	Mycology & Parasitology & Virology	Core	4+0+2	6	30+70=100T 10+40=50P
DMLT.301	Genetics and Molecular Biology	Elective	4+0+2	6	30+70=100T 10+40=50P
		Total Credits	**14+0+6**	**20**	**400/150=550**

SEMESTER-I		
Name of the Course	**Chemistry of Carbohydrates & Lipids**	
Course Code	**DMLT-BIC.201**	
Credit hours	**03**	
Teaching Objective		
Learning Outcomes		
Unit No.	**Content**	**Lectures**
1.	**Biomolecules:** Definition**,** Characteristics and properties.	10
2.	**Carbohydrates chemistry:** Classification, Digestion & Absorption, Chemistry and properties Glycoproteins, isomerism, mucopolysaccharides	16
3.	**Lipids:** Classification, Digestion & Absorption, Chemistry and properties & metabolism, Cholesterol structure and Metabolism, Prostaglandins.	16
	Total	42
PRACTICALS (BMLT-BIC.225)		
1.	Introduction to biochemistry: Definition, Importance of Biochemistry, SI Units and their use, Volumetric apparatus and their calibration.	12
2.	Safety measures and first aid and emergency treatment.	10
3.	Handling and maintenance of general laboratory glassware, equipment's (Balance, Centrifuge, Colorimeter etc.)	10
	TOTAL	**32**

SEMESTER II

Course Name: Fundamentals of Haematology **Credit = 4 (60 hours)**

Course Rationale: Students will be made aware of the composition of blood and methods of estimating different components of blood. Students will learn the basic concepts of Hematology and routine clinical investigations of the Haematology laboratory.

Learning Objective: At the end of the course, students should be able to

- Understand the composition of blood and the function of blood cells.
- Identify the normal and abnormal blood cells \, viz erythrocytes, leucocytes and thrombocytes.
- Comprehend the process of hemostasis and its physiological properties
- Demonstrate knowledge of haematological techniques used to analyse basic parameters in the Laboratory

Unit	Topic	Hours
I	Introduction to blood, composition and function of normal cellular components. Haematopoiesis: Site of haematopoiesis, Bone marrow and Bone marrow collection; Cellular ratio, bone marrow biopsy and aspiration techniques and their indications for collection	10
II	Erythrocytes: Normal Structure, Function, and Fate of Erythrocytes along with Clinical Indications of Jaundice, Normal Range. Abnormal Red Blood Cells: Anisocytes, Poikilocytes, and their clinical significance Hemoglobin: Structure, composition and function, synthesis and regulation of hemoglobin, oxygen association and dissociation curve Various types of hemoglobin with clinical significance - Fetal hemoglobin, Meth-hemoglobin, Sulf-haemoglobin, Carboxyhemoglobin, Sickle hemoglobin, Glycosylated hemoglobin, different methods of estimation	10

Unit	Topic	Hours
III	Leucocytes: Structure, functions, normal range, lifespan of normal White Blood Cells. Quantitative and qualitative disorders of White Blood Cells: physiological and pathological causes	**10**
IV	Thrombocytes: Structure, functions, normal range, lifespan of normal Platelets. Quantitative disorder of Platelets: physiological and pathological causes Normal hemostasis and physiological properties of coagulation factors. Primary, secondary and tertiary hemostasis. Role of the platelets, coagulation factors, coagulation inhibitory system and fibrinolysis.	**10**
V	Hematocrit and Erythrocyte Sedimentation Rate: **p**hysiological and pathological causes	**5**
VI	Automation in Haematology lab: principles and analysis Quality assurance in Haematology, Internal and external quality control, including reference preparation, Routine quality assurance protocol, Statistical analysis, i.e. Standard deviation, Coefficient of variation, accuracy and precision	**8**
VII	Anticoagulants: types, mode of action and preference of anticoagulants for different haematological studies. Different types of blood collection, including the preservation of blood samples for various haematological investigations. Principles of Romonowsky stain with examples and its applications	**7**
	Total	**60**

Course Name: Fundamentals of Haematology practical Credit: 2 (60 hours)

Course Rationale: Students will acquire comprehensive knowledge and skills in fundamental laboratory techniques and patient safety. They will understand and apply knowledge regarding sample collection, transport, storage, and preservation. Perform laboratory investigations using appropriate methods and instruments, while adhering to safety protocols and equipment care.

1. Demonstrate laboratory safety and biomedical waste management
2. Pre-analytical variables in clinical Laboratory: Patient and test request form identification, Patient preparation for phlebotomy, Sources of error in venous blood sample collection
3. Sample transport, processing, Sample acceptance and rejection criteria
4. Perform blood collection and demonstrate the order of draw
5. Estimation of hemoglobin by Drabkin's method
6. Perform Packed Cell Volume
7. Perform ESR by the Westergren method
8. Stain and examine the blood smear using Romanowsky stain
9. Perform Differential Leucocyte Count
10. Perform RBC count
11. Perform WBC count
12. Perform Absolute Eosinophil count
13. Perform Platelet count
14. Calculation of Red Cell Indices
15. Perform Bleeding Time and Clotting Time

16. Operate automated cell counters and interpret results
17. Perform Reticulocyte count

***Clinical Laboratory rotation/observation can be incorporated wherever possible**

Suggested books

- Godkar, P. B., & Godkar, D. P. (2006). *Textbook of medical laboratory technology*. Bhalani publishing house.
- Dacie, J. V. (2006). *Dacie and Lewis practical haematology*. Elsevier Health Sciences.
- Firkin, F., Chesterman, C., Rush, B., & Pennigton, D. (2008). *De Gruchy's Clinical haematology in medical Practice*. John Wiley & Sons.
- McPherson, Richard A.. (2022). *Henry's clinical diagnosis and management by laboratory methods, 24th ed.* (24). : Elsevier.
- M.D., H, T., M.D, H, D. (2004). Color Atlas of Hematology Practical Microscopic and Clinical Diagnosis. New York: Thieme.
- Greer, J. P., Arber, D. A., Glader, B., & List, A. F. (2018). Wintrobe's clinical hematology (14th ed.). Wolters Kluwer.
- Kanai, L Mukherjee, (2010). Medical Laboratory Technology, CBS publishers

Course Name: Basics of Biochemistry **Credit =4 (60 hours)**

Course Rationale: Students will learn the basic concepts of Biochemistry, chemistry of carbohydrates, proteins, lipids, nucleic acids, enzymes, vitamins, minerals and nutritional requirements.

Learning Objective: At the end of the course, students should be able to

- Describe the structure and function of key biomolecules, including carbohydrates, proteins, lipids, and nucleic acids.
- Explain the fundamental principles of enzyme action, including enzyme kinetics, inhibition, and regulation.
- Demonstrate knowledge of biochemical techniques used to analyse biomolecules.

Unit	Topic	Hours
I.	**Introduction to Biochemistry:** Units of weight and volume, Preparation of solutions (percentage, Molarity, Normality), Basic concepts of acids, bases, and buffers, their application in the Laboratory. Definition and determination of pH. Preparation of distilled water, double-distilled water, and deionised water. Fundamental concepts on biophysical phenomena like osmosis, dialysis, colloidal state, viscosity, adsorption, osmotic pressure, and surface tension.	**4**
11	**Chemistry of Carbohydrates**: Introduction to carbohydrates, biological importance of carbohydrates, classification, physical and chemical properties	**7**
III	**Chemistry of lipids:** Introduction to lipids, biological importance of lipids, Classification of lipids, Physical and chemical properties, Cholesterol and lipoproteins	**7**
IV	**Chemistry of Amino acids & Proteins:** Introduction to amino acids, biological importance of Amino acids, classification of amino acids. Introduction to proteins, the biological importance of proteins. Classification of proteins, Structural organisation of Proteins, Physical and chemical properties of Proteins and Amino acids	**10**

Unit	Topic	Hours
V	**Chemistry of Nucleic acids**: Introduction to Nucleic acids, nucleotides, nucleosides, biological importance of Nucleic acids, Structure of DNA and RNA, Difference between DNA and RNA	**8**
VI	**Chemistry of Enzymes:** Introduction of enzymes, classification of enzymes, Coenzymes and Cofactors, Active site, Mechanism of action, Factors influencing enzyme action, Enzyme inhibition and regulation.	**8**
VII	**Vitamins & Minerals:** Introduction to vitamins, Classification, RDA, Chemistry and biochemical function, deficiencies and toxic manifestations Introduction to minerals, Classification, RDA, Chemistry and biochemical function, deficiencies and toxic manifestations, Special references to calcium, phosphorus, magnesium, iron, zinc and copper	**12**
VII1	**Nutrition:** Calorie Requirements, SDA and BMR, Respiratory Quotient, Glycemic Index, Balanced Diet and Energy Calculations, Formulation of diet and dietary fibre, Starvation, obesity, and Protein Energy Malnutrition	**4**

	Total	**60**

Course Name: Basics of Biochemistry- Practical Credit =2 (60 hours)

Course rationale: Students will learn the essential laboratory practices, which include the Preparation of Lab reagents and qualitative analysis of carbohydrates, proteins and lipids.

1. Demonstrate the use of Laboratory Apparatus, Micropipettes, and their uses
2. Demonstrate cleaning of glassware
3. Demonstrate the use of a laboratory balance
4. Prepare and label common Laboratory reagents (Percentage, Molarity, Normality)
5. Preparation of distilled water, double-distilled water, and deionised water.
6. Measure pH for laboratory reagents/ biological samples
7. Perform qualitative analysis of carbohydrate and identification of unknown carbohydrate- Molisch test, Benedict test, Modified Bareford test, Seliwanoff test, Bial test, Mucic acid test, Iodine test, Foulger's test, osazone test
8. Perform qualitative analysis of protein and amino acids- Precipitation test - Heat and acetic acid Test, Heller's test, alkali, alcohol, Isoelectric point precipitation. Colour reaction – Ninhydrin, Nitroprusside test, Xanthoproteic test, Million test, Sakaguchi test
9. Perform qualitative analysis of lipids – Solubility test

***Clinical laboratory rotation/observation can be incorporated wherever possible**

Suggested Readings:

- U. Sathyanarayana – *Biochemistry*, Elsevier
- Robert K. Murray et al. – *Harper's Illustrated Biochemistry*, Tata McGraw-Hill
- M.N. Chatterjee & Rana Shinde – *Textbook of Medical Biochemistry*, Jaypee
- Alan Gowenlock – *Varley's Practical Clinical Biochemistry*, CBS
- David L. Nelson & Michael M. Cox – *Lehninger Principles of Biochemistry*, W.H. Freeman
- D.M. Vasudevan – *Textbook of Biochemistry*, Jaypee
- A.C. Deb – *Fundamentals of Biochemistry*, New Central Book Agency
- Y.K. Joshi – *Basics of Clinical nutrition*, Jaypee publishers

Course Name: Fundamentals of Microbiology **Credit : 4= 60 hours**

Course Rationale: Students will acquire knowledge on the Historical Development of Microbiology, various types of microscopes, bacterial anatomy and staining methods, sterilisation methods, culture media, culture methods, biochemical tests and antibiotic susceptibility tests, and understand the underlying concepts of bacterial genetics and its applications in recombinant DNA technology.

Learning Objective: At the end of the course, students should be able to

- Comprehend knowledge of Microscopes, their types and applications
- Explain microbial structure, physiology, growth, and reproduction.
- Identify common methods used in the control and prevention of microbial growth and infection.
- Demonstrate knowledge of aseptic techniques and basic microbiological laboratory procedures.

Unit	Topic	Hours
I	Historical Development of Microbiology: Infection and Contagion, Discovery of Microorganisms, Conflict over Spontaneous Generation, Role of Microorganisms in Diseases, Scientific Development of Microbiology - Louis Pasteur, Joseph Lister, Robert Koch, Paul Ehrlich, Edward Jenner, Ignaz Semmelweis, Antony van Leeuwenhoek.	3
II	Microscopy: Light Microscopy, Bright-field microscopy, Dark- ground microscopy, Phase-contrast microscopy, Fluorescence microscopy, Electron microscopy	7
III	Morphology of Bacteria: Comparison of Prokaryotic Cells– Eukaryotic cells, size of bacteria, arrangement of bacterial cells, Anatomy of the bacterial cell- the structure, function, and clinical significance of - Cell wall, Cell membrane, Cell surface appendages, Bacterial Capsule, Cell organelles, plasmid, Spore. Principles of staining - Simple staining, Negative staining, Differential staining, Gram's and acid-fast staining, Albert's, Flagella staining, Capsule staining, Endospore staining	7
IV	Physiology of Bacteria: generation time of bacteria, bacterial growth curve, bacterial nutrition, bacterial metabolism	6

Unit	Topic	Hours
V	Bacterial Genetics: Different gene transfer methods: Transformation, Transduction, Lysogenic conversion, Conjugation.	5
VI	Sterilisation and Disinfection: Classify sterilisation methods - Dry heat sterilisation, Moist heat sterilisation, Radiation, Filtration. Disinfection- Classify disinfectants, general features of disinfectants - Alcohols and aldehydes, Dyes, halogens and phenols - Gases, surface active agents and metallic salts, Testing of disinfectants - Rideal Walker method, Chick Martin test, Disinfectant kill time test, Kelsey- Sykes test, In-use test, Advanced techniques in Sterilisation of Heat- Sensitive Articles.	7
VII	Culture Media and Methods: Culture Media- common ingredients of culture media, classification of media. Culture Methods- Methods of bacterial culture, aerobic culture, anaerobic culture, methods of anaerobiosis, methods of isolating pure cultures.	5
VIII	Identification of Bacteria: Methods used to identify bacteria, phenotypic characteristics, genomic characterisation, Bacterial Taxonomy- Taxonomy, Identification, classification systems, Identification of Bacteria by biochemical tests and automated systems: - Bac T alert and BACTEC systems, -VITEK and Phoenix systems - RTPCR, MALDI-TOF	8
IX	Antibiotic susceptibility testing (AST): A. Diffusion methods 1. Kirby–Bauer disk diffusion method 2. Stokes disk diffusion method B. Dilution methods 1. Broth dilution method 2. Agar dilution method. Epsilometer or E-test, Minimum inhibitory concentration (MIC) and Minimum bactericidal concentration (MBC) of antibiotics,	6
X	Human Normal Microbial Flora and Microbiome: Microbial Infections- Microorganisms and Host, Infection and Infectious Disease, Classification of Infections, Sources and Modes of Transmission of Infection, Epidemiological Terminologies	6
Total		60

Course Name: Fundamentals of Microbiology Practical Credit: 2= 60 hours

Course Rationale: Students will acquire knowledge to demonstrate and perform basic microbiological tests in the identification of microorganisms.

1. Demonstrate the collection of various clinical specimens and their transport and processing.
2. Demonstrate a safe code of practice in the Microbiology laboratory
3. Demonstrate cleaning and sterilisation of glassware
4. Perform microscopy and specimen processing
5. Operate the autoclave and hot air oven, including its efficacy testing.
6. Demonstrate the sterilisation of reagents and culture media
7. Demonstrate sterilisation of media/solution by filtration.
8. Demonstrate the proper precautions to take when using disinfectants and dilution of commonly used disinfectants.
9. Demonstrate Simple staining
10. Demonstrate Gram's staining
11. Demonstrate Preparation of stains, reagents and culture media, quality control of reagents and media, and sterility check
12. Identify QC strains used for culture media

***Clinical laboratory rotation/observation can be incorporated wherever possible**

Suggested reading

- Mackie & McCartney – *Practical Medical Microbiology*, Elsevier
- Bailey & Scott – *Diagnostic Microbiology*, Elsevier
- R. Ananthanarayan & C.K. Jayaram Paniker – *Textbook of Microbiology*, Universities Press
- Surinder Kumar – *Essentials of Microbiology*, Jaypee Brothers Medical Publishers
- Subhash Chandra Parija – *Textbook of Microbiology and Immunology*, Elsevier
- Lansing M. Prescott – *Microbiology*, McGraw-Hill
- Apurba Sankar Sastry & Sandhya Bhat K – *Essentials in Medical Microbiology*, Jaypee Brothers Medical Publishers
- Praful B. Godkar & Darshan P. Godkar – *Textbook of Medical Laboratory Technology*, Bhalani Publishing

Course Name: Preventive and Social Medicine **Credit: 2 = 30 hours**

Course Rationale: Through this course, students learn the principles of primary health care, the significance of health programs, and the role of communication and education in behaviour change. The inclusion of first aid and patient care in communicable diseases prepares allied health professionals to actively contribute to health promotion and disease prevention at all levels of healthcare delivery.

Learning Outcome: At the end of the course, students will be able to

- Describe the epidemiology, prevention, and control of communicable and non-communicable diseases
- Understand the concepts and principles of public health, disease prevention, and health promotion.
- Identify the determinants of health and disease, including environmental, social, economic, and behavioural factors.

Unit	Topic	Hours
I.	**Basic Epidemiology:** Epidemiological Triad, Carrier, Reservoir, Host for infection and diseases, Various methods of disinfection used at each level of healthcare, Incubation period, Nosocomial Infections	03
II.	**Primary Health Care:** Principles, Elements, Health Programmes - Maternal and Child Health, Nutrition, Environment, older adults, Central Government Health Schemes, Occupational Health, Voluntary Health Agencies, Role of NGOs in the Health Team.	07
III	**Demography and Family Welfare:** Definition, Demographic cycle, Population Explosion, Factors influencing population growth, death rate, birth rate, and methods of contraception. Family Welfare – Definition, Objectives of Family Planning. Types: Temporary and Permanent methods, Follow-up of contraceptive methods, Family planning counselling.	03
IV	**Environmental Health:** Air Pollution, Noise Pollution, Water Pollution, with the causes, effects, and preventive measures. Solid Waste Management - Swachh Bharat Abhiyan, Nirmal Bharat Abhiyan. Biomedical Waste Management Rules 2016 - colour coding and disposal into correctly colour-coded bags. Disease Elimination and Disease Eradication: Examples.	07

Unit	Topic	Hours
V	**Communication and Health Education:** Health education–definition, principles, objectives, purpose, types, and AV aids. Communication–definition, process, and types. Behavioural change communication. IEC (Information, education, and communication): aims, scope, concept, and approaches. First-aid–Definition, Principles, Golden rules, and bandages. First-aid for fracture, bleeding, drowning, Convulsions, Foreign Bodies, poisoning, Shock, and Cardio- Pulmonary Resuscitation. Role and skill of health professional in Health Education; Interpersonal relationship: coordination and cooperation in health education with other members of the health team.	08
VI	**Patient care in Communicable Diseases:** Care of patients with communicable diseases, Isolation methods, Standard safety measures (Universal precautions). Role and skill of the Health professional in the management of patients with communicable diseases.	02
Total		**30**

Suggested Readings

- Textbook of Preventive and Social Medicine – J.E.Park
- Manual for Laboratory Technician – 1985. DGHS, Ministry of Health, Govt of India

SEMESTER III

Course Name: Intermediary Metabolism & Endocrinology Credit = 4 (60 hours) Course Rationale: To familiarise the students with the metabolism of carbohydrates, lipids, proteins, nucleic acids, haemoglobin and minerals. Students will also gain knowledge of the basics of endocrinology.

Learning Objective: At the end of the course, students should be able to

- Explain the fundamental principles of metabolism, including anabolic and catabolic pathways.
- Describe the key metabolic pathways such as glycolysis, the citric acid cycle (TCA cycle), oxidative phosphorylation, and beta-oxidation.
- Understand the regulation of metabolic pathways and the role of enzymes, cofactors, and hormones in metabolic control.

Unit	Topic	Hours
I	**Metabolism of carbohydrates**: Digestion and absorption, Glycolysis, TCA cycle, Gluconeogenesis, Glycogenesis and Glycogenolysis, Significance of HMP shunt and uronic acid pathway. Regulation of blood glucose. Disorders of Carbohydrate metabolism: Diabetes mellitus, glycosuria, glycogen storage diseases, galactosemia, pentosuria, fructosuria.	9
11	**Biological oxidation and Electron transport chain:** Redox potentials, Biological oxidation and high-energy compounds, organisation of electron transport chain, Chemiosmotic theory, ATP synthase, inhibitors of ATP synthase, uncouplers of oxidative phosphorylation.	6
111	**Metabolism of lipid:** Digestion and absorption, Beta-oxidation of fatty acids, Synthesis and breakdown of cholesterol, lipoproteins, and ketogenesis. Disorders of lipid metabolism: Hyperlipidemia, hyperlipoproteinemias, Atherosclerosis, fatty liver	8
1V	**Metabolism of protein and amino acid:** Digestion and absorption, transamination, Oxidative and non-oxidative deamination, Urea cycle, Creatine synthesis and degradation, Metabolism of aromatic amino acids. Disorders of Protein metabolism and amino acid metabolism: Inherited disorders associated with the urea cycle, Phenylketonuria, Alkaptonuria	9
V	**Integration of Metabolism**: Metabolism in a well-fed state and starvation. **Mineral metabolism:** Regulation of the blood level of calcium, phosphorus and iron. **Water and electrolyte balance:** Distribution of fluids in the body, water metabolism, factors influencing the distribution of body water, thirst mechanism, intake and loss of body water, electrolyte distribution, function and regulation, and dehydration.	6
VI	**Purine and Pyrimidine metabolism**: Biosynthesis of purines, pyrimidines, Breakdown of purine and pyrimidines	8
V11	**Haemoglobin metabolism**: Oxygen dissociation curves and abnormal haemoglobin, formation and breakdown of hemoglobin.	6

VIII	**Hormones:** Introduction, Classification, Major endocrine glands and their hormones, Hypothalamus, Pituitary, Thyroid, Parathyroid, Adrenal cortex, Pancreas and gonads. Mechanism of action of hormones.	8
	Total	60

Course Name: Intermediary Metabolism & Endocrinology -Practical Credit =2 (60 hours)

Course Rationale: Students will be taught a relevant diagnostic test and gain hands-on experience in estimating biochemical parameters using standard kit methods used in laboratories.

1. Operate the colourimeter and spectrophotometer
2. Estimation of Plasma Glucose by GOD - POD method
3. Estimation of Total Protein by Biuret Method
4. Estimation of Albumin by the BCG method. Calculation of A/G ratio
5. Estimation of Cholesterol by modified CHOD-POD method
6. Estimation of Urea by Urease method
7. Estimation of Uric acid by uricase method
8. Estimation of creatinine by picric acid method
9. Demonstration of serum electrolytes
10. Estimation of Calcium
11. Perform qualitative urine analysis - 5-hydroxy indole acetic acid (HIAA), total porphyrins, Coproporphyrin

***Clinical laboratory rotation/observation can be incorporated wherever possible**

Suggested Readings:

- U. Sathyanarayana – *Biochemistry*, Elsevier
- Robert K. Murray et al. – *Harper's Illustrated Biochemistry*, Tata McGraw-Hill
- M.N. Chatterjee & Rana Shinde – *Textbook of Medical Biochemistry*, Jaypee
- Alan Gowenlock – *Varley's Practical Clinical Biochemistry*, CBS
- David L. Nelson & Michael M. Cox – *Lehninger Principles of Biochemistry*, W.H. Freeman
- D.M. Vasudevan – *Textbook of Biochemistry*, Jaypee
- A.C. Deb – *Fundamentals of Biochemistry*, New Central Book Agency
- Y.K. Joshi – *Basics of Clinical nutrition*, Jaypee publishers
- Nader Rifai et al, *Tietz Textbook of Clinical Chemistry and Molecular Diagnostics,* Saunders / Elsevier

Course Name: Bacteriology **Credit : 4= 60 hours**

Course outcomes: Students will identify medically important bacteria, understand their pathogenic mechanisms, and apply diagnostic methods for bacterial infections and hospital-acquired infections.

Learning outcome: At the end of the course, students should be able to

- Identify clinically significant bacteria that cause human disease.
- Describe the pathogenesis, clinical features, and modes of transmission of common infectious diseases.
- Demonstrate proper techniques for specimen collection, handling, and processing in a clinical bacteriology laboratory.

Unit	Topic	Hours
I	Gram-positive bacteria: Staphylococcus species, Streptococcus species, Corynebacterium diphtheriae, Bacillus species	8
II	Mycobacteria: Classification and morphology	4
III	Anaerobes: Non-spore-forming anaerobes. Classify anaerobes, infections caused, and laboratory diagnosis of non-sporing anaerobes	5
IV	Spore-forming anaerobes: Classify Clostridia species: Clostridium perfringens, Clostridium tetani, Clostridium botulinum, Clostridium difficile	5
V	Gram Negative Cocci: Neisseria meningitidis, Neisseria gonorrhoeae	5
VI	Enterobacteriaceae: Escherichia coli, Klebsiella species, Proteus species, Salmonella species, Shigella species	10
VII	Vibrio species, Pseudomonas and Burkholderia. Spirochetes: Classification of Spirochetes - Treponema pallidum, Leptospira, Borrelia	8
VIII	Mycoplasma, Actinomycetes and Nocardia, Candida	5
IX	Types of infections & diagnosis - Skin and soft tissue infections, Respiratory tract infections, Cardiovascular System & Central Nervous System infections, Otitis media, Gastrointestinal tract infections, Urinary tract infections, Genital tract Infections	6
X	Nosocomial Infection - Hospital Acquired Infections (HAI), risk factors, sources and route. Investigation, prevention and control of hospital-acquired infections. Bacteriology of air, food, water and milk	4
	TOTAL	60

Course Name: Bacteriology Practical **Credit: 2= 60 hours**

Course outcomes: Students will demonstrate and perform bacterial culture, identification, and antibiotic susceptibility testing using manual and automated methods.

1. Perform pure culture study of common pathogens. (*Staphylococcus aureus, Staphylococcus pyogenes, Enterococcus species, Corynebacterium diphtheriae, E. coli, Salmonella spp, Shigella spp, Pseudomonas, Proteus spp, K. pneumoniae, Vibrio cholerae, Pseudomonas aeruginosa, C. albicans).*
2. Apply diagnostic Scheme for Respiratory Tract Infections.
3. Apply diagnostic Scheme for Urinary Tract Infections.
4. Apply diagnostic for Gastrointestinal Tract Infections.
5. Apply diagnostic for Central Nervous System Infections and Bacteraemia.
6. Apply diagnostic for Skin Infections.
    - (demonstrate specimen processing by manual method, including specimen receiving, Specimen inoculation into appropriate culture media, using appropriate staining method, biochemical reactions, and serological grouping for aerobic bacteria)
7. Demonstrate bacterial identification and antibiotic susceptibility testing using manual /automated methods
8. Processing of specimens for anaerobic bacteria
9. Processing of specimens for mycobacteria
10. Perform serological tests for the diagnosis of bacterial diseases
11. Identify the quality control used in the manual and automated methods

***Clinical laboratory rotation/observation can be incorporated wherever possible**

Suggested Reading

- R. Ananthanarayan & C.K. Jayaram Paniker – *Textbook of Microbiology*, Universities Press
- C.P. Baveja – *Textbook of Microbiology*, Arya Publications
- Subhash Chandra Parija – *Textbook of Microbiology and Immunology*, Elsevier
- Dubey R.C. – *A Textbook of Microbiology*, S. Chand Publishers
- Arora D.R. – *Textbook of Microbiology,* CBS Publishers
- Apurba Sankar Sastry & Sandhya Bhat K – Essentials in Medical Microbiology, Jaypee Brothers Medical Publishers
- Mackie & McCartney – *Practical Medical Microbiology*, Elsevier
- Henry D. Isenberg – *Clinical Microbiology Procedures Handbook*, ASM Press
- Bailey & Scott – *Diagnostic Microbiology*, Elsevier
- Koneman et al. – *Colour Atlas and Textbook of Diagnostic Microbiology*, Lippincott

Course Name: Clinical Haematology **Credit : 4 = 60 hours**

Course Rationale: Students will understand the pathophysiology and laboratory diagnosis of haematological disorders, including anaemia, leukocyte abnormalities, coagulation defects, and related morphological changes in blood cells.

Learning outcome: At the end of the course, students should be able to

- Comprehend knowledge of Qualitative and Quantitative disorders of Erythrocytes, leucocytes and thrombocytes
- Describe the pathophysiology and clinical features of common pathological diseases
- Demonstrate the proper techniques for specimen collection, handling, and diagnosis of the pathological diseases

Unit	Topic	Hours
I.	Red cell indices: Definition, normal range, and calculations with their application in diagnosing anaemia	**5**
II.	Anaemia - Morphological and etiological classification: Signs, symptoms, aetiology, pathophysiology, and laboratory findings associated with Iron deficiency anaemia, Megaloblastic anaemia, Aplastic anaemia, Hemolytic anaemia, Thalassemia, Sickle cell anaemia, Hereditary spherocytosis, Paroxysmal nocturnal hemoglobinuria. Recent advances in laboratory diagnosis of anaemia	**16**
III	Leukaemia: Leukaemia: Leukemoid reaction- Definition and clinical implications, Leukaemia- Classification, definition and clinical implications, Pathophysiology, signs, ymptoms, and laboratory diagnosis of Acute lymphoid leukaemia (ALL), Acute myeloid leukaemia (AML), Chronic lymphoid leukaemia (CLL), Chronic myeloid leukaemia (CML). Pathophysiology, signs, symptoms, and laboratory diagnosis of Polycythemia vera, Multiple Myeloma. Recent advances in laboratory diagnosis of leukaemia	**16**
IV	Haemostasis Disorders: Coagulation pathways- Extrinsic and Intrinsic Cell-Based Model of Coagulation. Coagulation Tests and Interpretation of Prothrombin, PT/INR, Activated Partial Thromboplastin Time (APTT), Thrombin Time (TT), Fibrinogen, Platelet, D-dimer test, Mixing study, and factor assay Pathophysiology, signs, symptoms, and laboratory diagnosis of common bleeding / clotting disorders - Haemophilia A & B, Von-Willebrand disease, Bernard-Soulier syndrome, Glanzman's thrombasthenia, Disseminated intravascular coagulation (DIC), Immune Thrombocytopenic Purpura (ITP). Recent advances in laboratory diagnosis of coagulation disorders	**16**
V	Cytogenetics, Karyotyping, FISH, chromosome analysis for interpretation of malignancies	**4**
VI	Basics of Flow Cytometry with CD markers	**3**
IV	Haemostasis Disorders: Coagulation pathways- Extrinsic and Intrinsic	**16**

	Cell-Based Model of Coagulation. Coagulation Tests and Interpretation of Prothrombin, PT/INR, Activated Partial Thromboplastin Time (APTT), Thrombin Time (TT), Fibrinogen, Platelet, D-dimer test, Mixing study, and factor assay Pathophysiology, signs, symptoms, and laboratory diagnosis of common bleeding / clotting disorders - Haemophilia A & B, Von-Willebrand disease, Bernard-Soulier syndrome, Glanzman's thrombasthenia, Disseminated intravascular coagulation (DIC), Immune Thrombocytopenic Purpura (ITP). Recent advances in laboratory diagnosis of coagulation disorders	
V	Cytogenetics, Karyotyping, FISH, chromosome analysis for interpretation of malignancies	**4**
VI	Basics of Flow Cytometry with CD markers	**3**
	Total	**60**

Course Name: Clinical Haematology - Practical **Credit : 2 = 60 hours**

Course Rationale: Students will gain practical skills necessary for various laboratory investigations required for the diagnosis of haematological disorders and compare them with normal values and clinical conditions.

1. Preparation and staining of peripheral smear using Leishman's stain.
2. Identification of normal and abnormal morphology of red blood cells, white blood cells, and platelets.
3. Peripheral smear study, its correlation with clinical symptoms and comparison of peripheral smear results with complete blood count (CBC).
4. Reticulocyte count and its correlation with clinical symptoms
5. Demonstration of bone marrow aspiration and smear preparation.
6. Staining of bone marrow smears (Pearls 'Prussian blue stain) and its correlation with clinical symptoms
7. Preparation of iso-osmotic sucrose solution and performance of sucrose lysis test.
8. Identification of tests for hemoglobin variants and thalassemia. Explanation and interpretation of hemoglobin electrophoresis (e.g., sickle cell anaemia, thalassemia).
9. Sickling test. Performance and interpretation of the osmotic fragility test
10. Bleeding time, Clotting time, Prothrombin time (PT), Activated partial thromboplastin time (aPTT). Thrombin time, Platelet count, Fibrinogen count, and interpretation of first-line hemostasis tests. Blood collection procedures related to coagulation testing. Performance and interpretation of: Clot retraction, Inhibitor assays. Platelet function tests.
11. Identify the tests to detect hereditary haemolytic anaemia. Prepare reagents for the osmotic fragility test. Perform the osmotic fragility test and interpret the results. Integrate clinical symptoms and laboratory investigations to identify haematological disorders

***Clinical laboratory rotation/observation can be incorporated wherever possible**

Suggested Readings:

- Sood, R. (2009). *Medical Laboratory Technology, Vol-1 : Methods of Interpretation* (6th). India: Jaypee Brothers.
- Dacie, J. V. (2006). *Dacie and Lewis practical haematology*. Elsevier Health Sciences.
- McKenzie, S. B., Williams, J. L., & Landis-Piwowar, K. (2004). *Clinical laboratory hematology* (Vol. 1). Pearson education.
- Ramakrishnan, S., & Sulochana, K. N. (Eds.). (2012). *Manual of Medical laboratory techniques*. Jaypee Brothers Medical Publishers Pvt. Ltd.
- Godkar, P. B., & Godkar, D. P. (2006). *Textbook of medical laboratory technology*. Bhalani publishing house.

Course Name: Basics of Pharmacology **Credit: 2 = 30 hours**

Course Rationale: Students will gain foundational knowledge in pharmacokinetics and pharmacodynamics, adverse drug effects, commonly used drugs in infectious and metabolic disorders, and the pharmacology relevant to laboratory diagnostics and interpretation.

Learning outcome: At the end of the course, students should be able to

- Explain fundamental concepts of pharmacology
- Identify major classes of drugs, their therapeutic uses, mechanisms of action, and common side effects.
- Recognise signs and symptoms of common drug toxicities and the role of the laboratory in monitoring drug therapy.

Unit	Topic	Hours
I	General Pharmacology: Branches of Pharmacology, Routes of Drug Administration, Pharmacokinetics (Absorption, Distribution, Metabolism, Excretion), Pharmacodynamics, Adverse Drug Reactions, Overview of Clinical Trials and Phases, Essential Drug Concepts for Laboratory Professionals (e.g., drug half-life, therapeutic drug monitoring)	8
II	Antimicrobial Chemotherapy: Classification of Antibacterial Drugs, Mechanism of Action and Resistance, Sulfonamides, Trimethoprim, Beta-lactams: Penicillin, Cephalosporins. Protein Synthesis Inhibitors: Aminoglycosides, Tetracyclines, Macrolides, Antitubercular and Antileprotic Drugs, Antifungals and Antivirals, Relevance of Antibiotic Sensitivity Testing, Laboratory Role in Monitoring Antimicrobial Therapy	12
III	Drugs Related to Hormonal and Metabolic Disorders: Insulin and Oral Hypoglycemic Agents, Thyroid and Antithyroid Drugs, Corticosteroids (overview and lab monitoring), Drugs affecting Calcium Balance, Antidiuretics, Relevance of Drug-induced Metabolic Changes in Lab Tests	6
IV	Drugs Acting on Blood and Blood-forming Organs: Hematinics and Use in Anaemia, Coagulants and Anticoagulants, Blood Products and Plasma Expanders, Overview of Anticoagulant Therapy and Its Relevance to Laboratory Monitoring (e.g., PT, INR, aPTT), Effects of Drugs on Haematological Parameters	4
	Total hours	30

Suggested Reading

- K.D. Tripathi – Essentials of Medical Pharmacology, Jaypee
- Padmaja Udaykumar – Pharmacology for Nurses
- Satoskar et al. – Pharmacology and Pharmacotherapeutics
- Relevant Laboratory Manuals/Drug Interaction Charts for Lab Technicians

SEMESTER IV

Course Name: Clinical Pathology **Credit: 4 (60 hours)**

Course Rationale: Students will understand the principles and procedures for analysing urine, faeces, semen, sputum, and body fluids. They will learn to differentiate normal from abnormal findings and apply analytical techniques in clinical diagnosis.

Learning outcome: At the end of the course, students should be able to

- Comprehend knowledge of formation, composition and function of body fluids
- Demonstrate proper technique for specimen collection, handling, and processing in a clinical Pathology laboratory.
- Apply standard laboratory techniques for the identification of the aetiology of infection.

Unit	Topic	Hours
I	**Urine analysis:** Formation and Normal Composition of urine, Indication of urine analysis, collection of urine, preservatives used for urine sample, examination of urine – Manual methods, dipstick method, urine analysers • Physical examination of urine and interpret the result - Volume, colour, odour, specific gravity, pH, turbidity • Chemical examination of urine and interpret the result for - Glucose - Protein - Blood - Ketones - Bile salt - Bile pigment • Examination for hemosiderin, chyluria, fat globules, and myoglobin detection in urine • Microscopic examination of urine- cells, casts, crystals, organisms, others • Characteristics of a normal and abnormal urine sample. List advanced techniques used in the field of diagnosis, Sources of errors, and Clinical conditions using laboratory results of urine analysis	**12**
II	**Faecal analysis:** Formation and Normal composition of stool, specimen collection, scotch tape preparation, Preservatives of stool specimen, Physical, chemical and microscopic faecal analysis • Physical examination-Volume, colour, consistency, odour, Blood, Mucus and Adult parasites • Test for occult blood • Saline and Iodine wet preparation, Concentration method, floatation method, and methylene blue stain	**10**
III	**Semen analysis:** Formation of semen, method of collection**,** importance and method of semen analysis - Normal and abnormal morphology of sperms Physical and chemical characteristics, sperm count, and Medico-legal aspects of specimen analysis	**8**
IV	Sputum Analysis: Formation of Sputum, Collection of Sputum, Analysis of Sputum	6

V	**Body fluids:** Different body fluids and methods of aspiration, characteristics of normal and abnormal body fluids, physical, chemical, and microscopic analysis of body fluids, procedure of cell count, clinical conditions - CSF, peritoneal, pericardial, pleural and synovial fluid **Other body fluids:** Function, volume and chemical composition, specimen collection, handling of amniotic fluid, examination of amniotic fluid, special tests performed in amniotic fluid Examination of bronchoalveolar Lavage, saliva, sweat, and tears.	**15**
VI	Recent advances in clinical pathology that have led to the use of special stains in clinical pathology, and outline sample processing using automation in clinical pathology	4
	Total	**60**

Course Name: Clinical Pathology Practical **Credit: 2 (60 hours)**

Course Rationale: Students will demonstrate and perform physical, chemical, and microscopic examinations of clinical specimens using manual and automated methods.

Preanalytical: Proper method of sample identification for inpatients and Outpatients, Sample transport and processing, Sample acceptance and rejection criteria

1. Identify and process clinical specimens (urine, stool, semen, sputum, CSF, pleural, peritoneal, synovial, pericardial fluids)
2. Perform physical, chemical, and microscopic analysis of urine and stool
3. Conduct special test in urine -hemoglobin & myoglobin, pregnancy test
4. Perform Stool analysis – Physical, Chemical and Microscopic Examination
5. Perform semen analysis- Physical, Chemical and Microscopic Examination
6. Perform Cerebrospinal Fluid (CSF) examination - Physical, Chemical, and Microscopic Examination
7. Perform Sputum Analysis- physical, chemical, and microscopic examination
8. Perform Pleural Fluid examination -physical, chemical, and microscopic examination
9. Perform Synovial fluid examination- physical, chemical, and microscopic examination
10. Perform Peritoneal Fluid examination- physical, chemical and microscopic examination
11. Perform Pericardial Fluid examination- physical, chemical, and microscopic examination
12. Operate the automation system used in Clinical pathology

***Clinical Laboratory rotation/observation can be incorporated wherever possible**

Suggested Readings

- Godkar, P. B., & Godkar, D. P. (2006). *Textbook of medical laboratory technology*. Bhalani publishing house.
- Sood, R. (2006). *Textbook of medical laboratory technology*. Jaypee Brothers Publishers.
- Mundt, L., & Shanahan, K. (2020). *Graff's textbook of urinalysis and body fluids*. Jones & Bartlett Learning.
- Strasinger, S. K., & Di Lorenzo, M. S. (2014). *Urinalysis and body fluids*. FA Davis.

Course Name: Genetics & Molecular Biology **Credit= 4(60 hours)**

Course Rationale: Students will learn the fundamentals of Genetics and molecular biology in order to understand the molecular basis of disease, perform and interpret basic molecular diagnostic tests.

Learning Outcome: At the end of the course, students will be able to

- Explain how genetic information is copied, transferred, and used in cells
- Describe how genes are inherited and how traits are passed through generations.
- Identify common laboratory techniques used to study genes

Unit	Topic	Hours
I	**Introduction to Genetics:** Mendelian genetics –Principle of dominance, Principle of segregation, Principle of Independent Assortment, Genotype & phenotype; homozygous & heterozygous; dominant& recessive; gene & allele, Trait Inheritance – ABO blood groups in human; Polygenic Inheritance –Kernel colour in Maize, skin colour in man, Sex-linked Inheritance – haemophilia and colour blindness in man, Non- Mendelian Inheritance-Maternal inheritance	8
II	**Chromosomal basis of Inheritance:** Chromosome morphology- size and shape; Euchromatin and Heterochromatin- constitutive and facultative heterochromatin Chromosomes: Packaging of DNA in to Chromosomes, structure (centromere and telomere), karyotype, Structural chromosomal aberrations - duplications, deletions, inversions & translocations with examples, Genetic consequences, Numerical chromosomal aberrations – aneuploidy, euploidy auto-polyploidy and allo-polyploidy, Genetic consequences	12
III	**Cell division and chromosome segregation:** Mitosis – Stages in mitotic cell division- significance of mitosis. Meiosis – Formation of Synaptonemal complex, crossing over, chiasma formation, significance of meiosis. stages of mitosis, meiosis I&II& fertilization	6
IV	**Molecular basis of Inheritance** Structure of DNA and RNA, DNA replication, Mutations: types of mutations- transition, transversion, frame shift, silent, missense and nonsense	10
V	**Gene expression and regulation** Structure of eukaryotic gene, Transcriptional machinery in eukaryotes (RNA polymerases) and their structural and functional features; Genetic code, Transcription, translation	12
VI	**Molecular Diagnostics** ● Spectroscopy – principle, instrumentation, ultraviolet and visible light spectroscopy, and its applications ● Chromatography– types of chromatographic techniques (paper, ion exchange, chromatography, size exclusion chromatography)-principle & applications ● Centrifugation–principle and applications ● Electrophoretic techniques- types (Agarose gel electrophoresis, SDS PAGE), principle & applications	12

	• Microscopy- principle & applications of Phase contrast microscope and bright field and fluorescence microscopy • PCR - principles and applications • Quantitative Real Time PCR– principle and applications. • DNA Sequencing – principle and applications. • Microarray- DNA and protein arrays - principle and applications. • Blotting techniques- Southern blot, Northern blot and Western blot- principle and applications. Fluorescence &Chemiluminescence Imaging- principle and applications	
	TOTAL	60

Course Name: Genetics &Molecular biology Practical Credit: 2 = 60 hours

Course Rationale: Students will demonstrate and perform diagnostic tests widely used in molecular biology labs

1. Extraction of genomic DNA
2. Quantification of DNA by spectrophotometer
3. Agarose gel electrophoresis of DNA
4. Estimation of DNA by DPA method
5. Estimation of RNA by orcinol method
6. Estimation of Protein by BSA method
7. Western blotting
8. Karyotyping (normal male/normal female)
9. Identification of chromosome anomalies using Idiograms– Autosomal disorders (Down Syndrome / Edward's syndrome, Klienefelter's syndrome / Turner's syndrome)

***Clinical Laboratory rotation/observation can be incorporated wherever possible**

Suggested Reading

- Molecular Cell Biology 6th edition (2007) Harvey F Lodish
- Techniques for molecular biology, D.Tagu C. Moussard, CRC Press
- Molecular diagnostics: for the clinical laboratorian by William B. Coleman and Gregory J. Tsongalis. Publisher: Humana Press

Course Name: Virology & Immunology **Credit= 4(60 hours)**

Course Rationale: Students will understand the morphology and general features of viruses and gain comprehensive knowledge of the immune system, immune response, and diagnostic immunological techniques.

Learning Outcome: At the end of the course, students will be able to

- Identify clinically significant viruses that cause human disease and understand immunology
- Describe the pathogenesis, clinical features, and modes of transmission of common infectious diseases.
- Demonstrate proper techniques for specimen collection, handling, and processing in a clinical laboratory.

Unit	Topic	Hours
I	Introduction to virology: History of viruses, Viral taxonomy, Virus replication, Viral pathogenesis, Viral factors, Viral Growth Curve, Viral Growth Cycle. Host response, Environmental factors	5
II	Cultivation of Viruses, Detection of Virus Growth in Cell Culture, Different methods of cultivation of viruses, animal inoculations, egg inoculation, cell culture, Viral Assay, Viral Genetics, Classification of Viruses	5
III	Laboratory Diagnosis of Viral Infections:(1) direct detection of viruses/viral antigens, (2) demonstration of virus-induced cytopathic effects (CPEs) in the cells, (3) virus isolation, (4) viral assays, (5) detection of viral proteins and other enzymes, (6) detection of the viral genome and (7) viral serology	7
IV	Classify medically important viruses, Morphology, cultural characteristics, pathogenesis, lab diagnosis and treatment of Herpes virus, Poxviruses, Rhabdovirus, Orthomyxoviruses, Paramyxoviruses, Polio virus, Hepatitis virus, HIV, Oncogenic viruses, Arboviruses	15
IV	Prevention and Precautions in Virology: Safety precautions in the virology laboratory, Antiviral drugs	3
V	Immunology: The Immune Response, Innate immunity, adaptive immunity, acquired immunity- active and passive immunity	3
VI	Immune system: components of the immune system, immune cells and their functions, organs of the immune system - primary and secondary immune organs	3
VII	Antigen and antibody: Types of antigens and determinants of antigenicity, Structure and functions of different immunoglobulins, Properties and functions of antibodies- monoclonal and polyclonal antibodies. Antigen-Antibody reactions- Definition, Classification, General features, and mechanisms, applications of various antigen-antibody reactions	5
	Immune response: Classify immune response- Primary &Secondary Basic concept of humoral and cell-mediated immunity, Cytokines- define, classify, properties and functions	3

Unit	Topic	Hours
VII	Complement system: definition, components and activation pathways. Hypersensitivity- definition, types of hypersensitivity reactions	5
VIII	Autoimmune diseases: Primary and secondary immune deficiency disorders. Autoimmunity: Basic concepts of autoimmunity, risk factors and mechanisms of autoimmunity	4
IX	Immunisation/Vaccination: Active and passive immunisation, classification of vaccines, and immunisation schedule in India. Brief knowledge about the extended programme of immunisation (EPI) in India	2
	Total	**60**

Course Name: Virology & Immunology Practical Credit : 2 = 60 hours

Course Rationale: Students will demonstrate and perform diagnostic tests for viral infections and immunological disorders using serological and molecular techniques.

1. Collection, transport and processing of various clinical specimens for Virology
2. Identify the tests used for the diagnosis of viral infections
3. Integrate knowledge in the diagnosis of given clinical cases
4. Identify viruses and their replication using charts.
5. Perform Staining- Giemsa stain, Seller's stain, immunofluorescent staining procedures for the diagnosis of viral infections.
6. Demonstrate various inoculation routes in a fertilised hen egg
7. Perform serological tests, i.e. Widal, Brucella Tube Agglutination, VDRL (including Antigen Preparation), ASO Anti-Streptolysin O, C-Reactive Protein (Latex agglutination), Rheumatoid factor (RF) Latex agglutination, Rose Waaler test, RPR
8. Demonstrate ELISA, immunodiffusion, immunofluorescence, and Western blotting.

***Clinical Laboratory rotation/observation can be incorporated wherever possible**

Suggested Reading

- R. Ananthanarayan & C.K. Jayaram Paniker – *Textbook of Microbiology*, Universities Press
- Apurba Sankar Sastry & Sandhya Bhat K – *Essentials in Medical Microbiology*, Jaypee Brothers Medical Publishers
- Surinder Kumar – *Essentials of Microbiology*, Jaypee Brothers Medical Publishers
- Subhash Chandra Parija – *Textbook of Microbiology and Immunology*, Elsevier
- Fields Virology – Editors: David M. Knipe & Peter M. Howley, Published by Lippincott Williams & Wilkins
- P. Daniel Fudenberg, H. Hugh Fudenberg & John Stites – *Basic & Clinical Immunology*, Lange Medical Books
- Kuby Immunology – Authors: Jenni Punt, Sharon Stranford, Patricia Jones & Judy Owen, Published by W.H. Freeman
- S.K. Gupta – *Essentials of Immunology*, Jaypee Brothers Medical Publishers

Course Name: Medical Laboratory Management and Quality Control Credit = 2 (30 hours)

Course Rationale: Students are introduced to medical laboratories, quality management, laboratory information management systems applied in diagnostic laboratories, laboratory automation and point of care testing

Learning Outcome: At the end of the course, students will be able to

- Explain the principles of effective laboratory organisation, administration, and workflow planning
- Demonstrate knowledge of quality assurance (QA) and quality control (QC) practices in laboratory settings.
- Understand laboratory accreditation standards and regulatory requirements

Unit	Topic	Hours
I	Total quality management of clinical laboratories: Define a quality management system, the three phases of the laboratory testing process, laboratory error, and quality indicators. List the quality indicators in the preanalytical phase and the sources of errors in the preanalytical, analytical, and postanalytical phases. Define the Root Cause Analysis (RCA) process. Define corrective actions and preventive actions (CAPA), CAPA for the control and prevention of errors in the clinical laboratory. Classify quality control: Internal quality control method, formulating quality control charts, Levey- Jenning charts, and Interpretation of Westgard rules. Explain external quality control method, the proficiency testing method in the clinical laboratory, and illustrate good laboratory practice	6
II	Accreditation and certification of laboratories: Define accreditation, certification and accreditation bodies. Explain the National Accreditation Board for Testing and Calibration Laboratories (NABL) and the International Organisation for Standardisation (ISO). Summarise the benefits of accreditation. Audit in a Medical Laboratory - Introduction and Importance, Responsibility, Planning, Horizontal, Vertical and Test audit, Frequency of audit, Documentation, Procurement of equipment and Inventory Control	4
III	Automation in Laboratory Workflow: Definition, Automation in Preanalytical, Analytical, and Post-analytical Phases. Types of Analyzers: Continuous Flow, Discrete and Dry Chemistry Analyzers. Automation in Immunology, Microbiology, Histopathology, Haematology, Biochemistry, Clinical Pathology. Total Laboratory Automation (TLA)- Robotic Process Automation (RPA), Laboratory Information Management System (LIMS), AI & Machine Learning – Predictive diagnostics and image analysis, Point-of-Care Testing (POCT) – Portable diagnostic devices, Automated Storage and Retrieval Systems (ASRS) – Efficient sample archiving. Point-of-Care Testing (POCT): Definition, types, goal, advantages and disadvantages. Working Principles of POCT Devices – *Glucometer, Urine Dipstick, Lateral Flow Immunoassay (LFIA)* Explain Waived vs. Non-Waived Tests, Calibration and Validation, Essential for quality assurance, regulatory compliance, and patient safety.	12

IV	Introduction to Laboratory information system (LIS), Laboratory Information Management Systems (LIMS). Operations: sample management, Instrument and application integration, electronic data exchange. Languages of Informatics and LIS, LIMS, and Middleware. Document Control, Data Mining Methods, Security, LIS Validation, components and working of LIS, applications of LIS	4
V	Sustainability of Clinical Laboratories: Waste Management, Energy Efficiency, Water Conservation, Green Procurement, Digitalisation. Introduction and awareness of financial management in a clinical laboratory	4
	TOTAL	30

Suggested Readings:

- Mirnali Sant, *Textbook of Medical laboratory Technology*, CBS publishers
- Godkar PB, *Textbook of Medical laboratory Technology,* Bhalani publishing house
- Paszko Christine, Turner Elizabeth (2001*) Laboratory Information Management Systems* (2nd edition) CRC Press Inc
- Douglas Shawn (2023). *The Complete Guide to LIMS and Laboratory Informatics* (1st edition) LabLynx Press

Course Name: Mycology & Parasitology Credit = 4 (60 hours)

Course Rationale: Students will gain comprehensive knowledge of medically important fungi and parasites, including their classification, morphology, pathogenesis, and laboratory diagnosis.
Learning Outcome: At the end of the course, students will be able to

- Identify clinically significant fungi and parasites that cause human disease
- Describe the pathogenesis, clinical features, and modes of transmission of common infectious diseases.
- Demonstrate proper techniques for specimen collection, handling, and processing in a clinical laboratory.

Unit	Topic	Hours
I	Introduction to Mycology: Taxonomy and classification of various medically important fungi, Characteristic features of fungi, reproductive methods of fungi, Normal fungal flora. Classification of mycoses.	4

II	Superficial mycoses- general characteristics of superficial mycoses Morphology, pathogenesis, laboratory diagnosis, and treatment of Piedra, Malassezia, Dermatophytoses, and Subcutaneous mycoses are the general characteristics of subcutaneous mycoses. Morphology, cultural characteristics, pathogenesis and lab diagnosis and treatment of Mycotic mycetoma, Sporotrichosis, Chromoblastomycoses, Subcutaneous phycomycosis, Rhinosporidiosis, Lobomycosis Systemic Mycoses -general characteristics of opportunistic systemic mycoses- Histoplasmosis, Blastomycosis, Coccidioidomycosis, Paracoccidioidomycosis General characteristics of opportunistic systemic mycoses- Morphology, cultural characteristics, pathogenesis and lab diagnosis and treatment of Candidiasis, Cryptococcosis, Aspergillosis, Penicillosis, Mucormycosis	15
III	Mycotoxicosis: Definition of Mycotoxin, Mycetismus, Method of Mycotoxins, preventive measures and treatment.	4
IV	Common fungal laboratory contaminants, Culture media used in mycology, Direct microscopy examination of fungi, Processing of clinical samples for diagnosis of fungal infections i.e. Skin, nail, hair, pus, sputum, CSF and other body fluids, Techniques used for isolation and identification of medically important fungi, Antifungal susceptibility tests, preservation of fungal cultures, Routine myco- serological tests and skin tests	7
V	Introduction of arthropods: Define and classify the arthropods of importance in public health. The sources and modes of transmission of infections are contaminated soil and water, foods, and vectors. Role of arthropods in the transmission of diseases Insects of medical importance: Morphology, life cycle, disease transmitted and control of Mosquitoes, Tse-tse fly, Fleas, Ticks, Housefly, Sand fly, Types of animal association- parasitism, commensalism, symbiosis	4
VI	Protozoology/ Protozoal parasites: General characteristics of protozoa. Geographical distribution, Habitat, Morphology, life cycle, Mode of infection, laboratory diagnosis, treatment and prevention of ● Amoebae (Entamoeba histolytica, non-pathogenic amoebae), ● Flagellates (Trichomonas, Giardia lamblia, Trypanosoma, Leishmania), Sporozoa (Plasmodium species, Toxoplasma species)	6
VII	Helminthology/ Helminthic parasites: Platyhelminthes: General characters of Platyhelminths. Geographical distribution, Habitat, Morphology, life cycle, Mode of infection, laboratory diagnosis, treatment and prevention of Cestodes (Diphyllobothrium, Taenia, Echinococcus, Hymenolepis) - Trematodes (Schistosoma, Fasciola, Fasciolopsis, Clonorchis and Paragonimus)	7
VIII	Nemathelminthes: General characters of Nemathelminthes, Geographical distribution, Habitat, Morphology, life cycle, Mode of infection, laboratory diagnosis, treatment and prevention of Nematodes (Ascaris lumbricoides, Ancylostoma duodenale, Strongyloides stercoralis, Trichinella spiralis, Enterobius vermicularis, Trichuris trichura, Wuchereria bancrofti and Dracunculus medinensis)	8

IX	Laboratory diagnosis of parasitic diseases: Collection, preparation of specimens for the diagnosis of parasitic infection- Stool, Blood, Urine, sputum, Cerebrospinal fluid (CSF), Tissue and aspirates, Genital specimens Examination of Stool for parasites - intestinal protozoal infections, Macroscopic and microscopic examination of stool samples, Staining methods, i.e. Iodine staining and permanent staining, Concentration methods- Principles and applications, Chemical examination of stool, Occult blood, Bile pigment Examination of blood for parasites- Staining, examination of thin and thick blood film Immunology and Serology Tests- Skin Test, Animal Xenodiagnosis, Inoculation, Imaging and Haematology	5
	Total	**60**

Course Name: Mycology & Parasitology Practical Credit : 2 = 60 hours

Course Rationale: Students would be able to identify various fungal strains and parasites. Students will also be correlated with the diseases associated with them.

1. Collection, transport and processing of various clinical specimens for fungal culture - Skin, nail, hair, pus, sputum, CSF and other body fluids and secretions
2. Prepare culture media, reagents and stains used for fungal analysis
3. Perform KOH preparation, Gram stain, Potassium Hydroxide - Calcofluor White method, India Ink preparation, Modified Kinyoun Acid Fast Stain for Nocardia, Lactophenol Cotton Blue preparation
4. Identification of pathogenic fungi - yeast, moulds, dimorphism in fungi
5. Perform stool examination for the detection of intestinal parasites with concentration methods- sedimentation and floatation methods
6. Identify adult worms, ova, and hemoparasites from slides or models
7. Examination of blood smears for hemoparasites.

***Clinical laboratory rotation/observation can be incorporated wherever possible**

Suggested Reading

- Jagdish Chander – *Textbook of Medical Mycology*, Jaypee Brothers Medical Publishers
- George S. Fischer – *Fundamentals of Diagnostic Mycology*
- C.K. Jayaram Paniker, *Paniker's Textbook of Medical Parasitology*, Jaypee Brothers Medical Publishers
- D.R. Arora & B. Arora – *Medical Parasitology*, CBS Publishers & Distributors
- P. Chakraborty – *Textbook of Medical Parasitology*, New Central Book Agency
- Lynne Shore Garcia – *Diagnostic Medical Parasitology*, ASM Press
- K.D. Chatterjee – *Parasitology in Relation to Clinical Medicine*, CBS Publishers & Distributors
- J.G. Collee, A.G. Fraser, B.P. Marmion, A. Simmons – *Mackie & McCartney Practical Medical Microbiology*, Elsevier
- Praful B. Godkar – *Textbook of Medical Microbiology and Parasitology*, Bhalani Publishing House
- K. Park – *Park's Textbook of Preventive and Social Medicine*, Banarsidas Bhanot Publishers

SEMESTER V

Course Name: Internship Credit: 20 (840 hours)

Course Rationale: The internship provides a structured transition from theoretical understanding to practical competency in medical laboratory sciences. It supports the development of technical skills, ethical responsibility, and professional identity, preparing students to function independently and collaboratively in clinical laboratories and research settings.

By rotating through specialized disciplines, students deepen their understanding of diagnostic procedures, automation, specimen handling, and healthcare workflows. This experience fosters critical thinking, interdisciplinary collaboration, and readiness for national/global healthcare environments.

Internship Duration: Six months (Semester V)

Schedule: 42 hours/week (6 hours/day, 6 days/week)

Learning Outcome

- Preanalytical phase - Safely collect, identify, and manage clinical specimens, follow proper safety precautions
- Conduct clinical investigations and interpret findings
- Perform equipment quality control and resolve technical issues
- Manage documentation, communication, ethics, and teamwork
- Demonstrate leadership and entrepreneurship in lab environments
- Write and critique scientific literature reviews

Internship Rotation Structure & Competencies

Area	Duration (Months)	Competencies
Pathology	1	Sample processing, staining, cryostat handling, FNAC
Hematology & Clinical Pathology	1	Phlebotomy, smear reading, automation, urinalysis
Clinical Biochemistry	1	Biochemical analysis, automated system, Quality control
Microbiology	1	Culturing, antimicrobial susceptibility testing, media preparation, QC strains
Research (Individual/group projects can be included)	2	Literature review, topic formulation, manuscript drafting

Internship Rotation Plan

- **Posting Guidelines**: Each student completes all rotations with documented competent acquisition.

- **Attendance & Conduct**: Minimum 90% attendance and adherence to institutional guidelines required.
- **Assessment**: Non-CGPA contributing; qualitative evaluations are documented.
- **Certification**: Granted upon satisfactory completion, verified by HOD/Coordinator and HOI.

Competency Domains for Alignment

Domain	Representative Competencies
Cognitive & Technical	Clinical reasoning, diagnostic accuracy, QC protocols
Affective & Ethical	Professionalism, patient safety, lab ethics
Psychomotor	Skill-based performance, automation handling, specimen processing
Communication & Collaboration	Documentation, interdisciplinary teamwork
Research & Innovation	Literature review, evidence synthesis, scientific writing
Leadership & Entrepreneurship	Initiative, mentorship, resource management

Internship Logbooks

- **Daily Tracking**: Structured entries with dates, tasks, and supervisor validation
- **Weekly Goals**: Intern sets rotation-specific targets
- **Competency Checklist**: Per module, includes skill validation (e.g., staining, cryostat handling)
- **Supervisor Feedback**: 5-point scale on independence, safety, and professional behavior

Formative Assessment

- Objective Structured Practical Examination (OSPE)
- Mini Clinical Evaluation Exercise (Mini-CEX)
- Reflective Portfolios
- Supervisor Evaluations
- Peer-Reviewed Research Logs
- Recorded Demonstrations

Certification: Internship completion certificate includes:

- Clinical rotation postings and total hours
- Externship and research details
- Authenticated by HOD/Coordinator and HOI
- **Note**: Degree awarded only upon validated internship completion