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SARDAR PATEL UNIVERSITY

**University Road P. B. 10
Vallabh Vidhyanagar-388120 (Gujarat)
NAAC accredited with Grade 'A'
(10-01-2023 to 09-01-2028)**

Curriculum - Bachelor of Medical Laboratory Science (BMLS)

National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare

Introduction:

Bachelor of Medical Laboratory Science (BMLS) is an undergraduate degree program designed to prepare students for a professional career in clinical laboratory science, which plays a critical role in diagnosing, treating, and monitoring diseases. The course is designed to be of 4 years duration (including one year compulsory internship).

Learning Objectives:

Foundational Knowledge: Understand the normal structure and function of the human body. Explain the pathophysiological basis of disease and how laboratory tests aid diagnosis. Apply knowledge of microbiology, hematology, biochemistry, immunology, and molecular biology to clinical scenarios.

Laboratory Skills: Perform routine and specialized laboratory tests accurately in various disciplines (e.g., hematology, microbiology, clinical chemistry, histopathology). Operate, calibrate, and maintain laboratory instruments and equipment. Collect, handle, and process biological specimens following safety and quality standards.

Quality Assurance & Safety: Implement quality control procedures to ensure accuracy and reliability of test results. Adhere to biosafety and infection control guidelines in all laboratory practices. Identify and troubleshoot pre-analytical, analytical, and post-analytical errors.

Critical Thinking & Problem Solving: Analyze and interpret laboratory data for clinical relevance. Recognize abnormal results and understand their diagnostic implications. Apply logical reasoning to solve technical problems and improve procedures.

Communication & Collaboration: Communicate effectively with healthcare professionals, and laboratory teams. Maintain clear and accurate laboratory records and reports. Demonstrate professional and ethical behavior in a clinical setting.

Research & Lifelong Learning: Understand the principles of scientific research and evidence-based practice. Participate in small-scale research or projects related to laboratory science. Stay updated with current advances in laboratory medicine and emerging technologies.

Professional Development: Demonstrate responsibility, initiative, and time management in professional duties. Understand legal and ethical issues in laboratory practice. Prepare for national certification or licensing exams, if applicable.

Career Opportunities:

Upon successful completion of the course, Graduates can work as:

Medical Laboratory Technologists

Clinical Research Assistants

Clinical Lab Managers

Quality Control Officers

Molecular Lab Technologists

In Hospitals, Diagnostic labs, Blood banks, pharmaceutical companies, public health organizations, Research institutions.

Students also have higher studies options including, Master of Medical Laboratory Science, M.Sc. in disciplines like Microbiology, Biochemistry, or Biotechnology, MBA in Hospital or Healthcare Management.

Program Learning Outcomes (POs):

PO1: Apply scientific knowledge in professional healthcare practice.

PO2: Demonstrate clinical and technical skills to deliver quality healthcare services.

PO3: Collaborate effectively in teams within an interdisciplinary healthcare setting to improve societal health.

PO4: Uphold ethical values and professionalism within the legal framework of society.

PO5: Communicate effectively with healthcare teams and the community.

PO6: Practice evidence-based medicine to ensure high-quality professional performance.

PO7: Engage in continuous learning and adapt to technological advancements for professional growth.

PO8: Exhibit entrepreneurial, leadership, and mentorship skills for independent practice and collaborative work in healthcare.

PO9: Demonstrates an appropriate use of information and communication technology relevant to their field.

PO10: Takes responsibility for personal and professional development and demonstrates an obligation to maintain competency by applying newly acquired knowledge or abilities to patient care.

Program Specific Outcomes (PSO):

PSO-1: Proficiently perform a full range of clinical laboratory tests, develop and evaluate test systems and interpretive algorithms and should be able to work on automated machines.

PSO-2: Manage information to enable effective, timely, accurate, and cost-effective reporting of laboratory-generated information and make specimen-oriented decisions on predetermined criteria, including working knowledge of critical values.

PSO-3: Process information and ensure quality control as appropriate to routine laboratory procedures.

Eligibility for Admission:

The candidate must have passed Higher Secondary (10+2) or equivalent examination recognized by any Indian Board or a duly constituted Board or National Open School.

Admission to Bachelor of Medical Laboratory Science program shall be made on the basis of merit list based on 10+2 marks.

Candidates who have studied abroad and have possess equivalent qualification as determined by the Association of Indian Universities and Equivalence Committee of the NCAHP and fulfil the above criteria shall also be eligible for admission.

Candidates must be 17 years as on December 31 of the year of admission to first year of BMLS course.

Candidates must furnish a certificate of Physical fitness from an Authorized Medical Professional, at the time of application, to ascertain that the candidate does not have any physical disability.

Lateral Entry: Candidates who have obtained Diploma in Medical Laboratory Science from recognised Universities/Institutions will be eligible for direct admission to Second year of BMLS course. Only 10% of sanctioned strength of BMLS course can be allotted to Lateral entry candidates, based on merit.

Duration of the Program:

Duration: 4 years (including 1year compulsory internship).

Total Contact Hours: 4125 hours.

Total Credits: 160 credits.

Medium of Instruction:

English shall be the medium of instruction for all the subjects of study and for examination of the course.

Attendance:

A candidate has to secure minimum:

80% attendance in theoretical

80% in Skills training (practical) for qualifying to appear for the final examination.

No relaxation, whatsoever, will be permissible to this rule under any ground including indisposition etc.

Credit Details:

Lecture / Tutorial: 1 credit = 15 hours

Practical: 1 credit = 30 hours

Clinical Lab postings: 1 credit = 45 hours

BMLS SEMESTER SCHEME OF EXAMINATIONS

BMLS FIRST SEMESTER

CODE	COURSE NAME	L/T	P	C	Hours	IA	ESE	Total
B01MLS01TH	Human Anatomy	4	0	4	60	30	70	100
B01MLS02TH	Human Physiology	4	0	4	60	30	70	100
B01MLS03TH	Fundamentals of the Healthcare System and Medical Laboratory Science (MLS) #	2	0	2	30	15	35	50
B01MLS04TH	Communication and Professionalism #	2	0	2	30	15	35	50
B01MLS05TH	Basic Emergency care and First aid	2	0	2	30	30	70	100
B01MLS06TH	Basics of Computer Application	1	0	1	15	15	35	50
Practical								
B01MLS07PR	Human Anatomy practical	0	4	2	60	30	70	100
B01MLS08PR	Human Physiology practical	0	4	2	60	30	70	100
B01MLS09PR	Basics of Computer Application practical	0	1	1	30	15	35	50
Total		15	9	20	375	210	490	700

Non-University Exams

BMLS SECOND SEMESTER

CODE	COURSE NAME	L/T	P	C	Hours	IA	ESE	Total
B02MLS01TH	Fundamentals of Microbiology	4	0	4	60	30	70	100
B02MLS02TH	Basics of Biochemistry	4	0	4	60	30	70	100
B02MLS03TH	Fundamentals of Haematology	4	0	4	60	30	70	100
B02MLS04TH	Preventive and Social Medicine	2	0	2	30	30	70	100
Practical								
B02MLS05PR	Fundamentals of Microbiology Practical	0	4	2	60	30	70	100
B02MLS06PR	Basics of Biochemistry Practical	0	4	2	60	30	70	100
B02MLS07PR	Fundamentals of Haematology Practical	0	4	2	60	30	70	100
Total		14	12	20	390	210	490	700

BMLS THIRD SEMESTER

CODE	COURSE NAME	L/T	P	C	Hours	IA	ESE	Total
B03MLS01TH	Bacteriology	4	0	4	60	30	70	100
B03MLS02TH	Intermediary Metabolism and Endocrinology	4	0	4	60	30	70	100
B03MLS03TH	Clinical Haematology	4	0	4	60	30	70	100
B03MLS04TH	Basics of Pharmacology	2	0	2	30	30	70	100
Practical								
B03MLS05PR	Bacteriology Practical	0	4	2	60	30	70	100
B03MLS06PR	Intermediary Metabolism and Endocrinology Practical	0	4	2	60	30	70	100
B03MLS07PR	Clinical Haematology- Practical	0	4	2	60	30	70	100
Total		14	12	20	390	210	490	700

BMLS FOURTH SEMESTER

CODE	COURSE NAME	L/T	P	C	Hours	IA	ESE	Total
B04MLS01TH	Virology and Immunology	4	0	4	60	30	70	100
B04MLS02TH	Genetics and Molecular Biology	4	0	4	60	30	70	100
B04MLS03TH	Clinical Pathology	4	0	4	60	30	70	100
B04MLS04TH	Medical Laboratory Management and Quality Control	2	0	2	30	30	70	100
Practical								
B04MLS05PR	Virology and Immunology Practical	0	4	2	60	30	70	100
B04MLS06PR	Genetics and Molecular Biology Practical	0	4	2	60	30	70	100
B04MLS07PR	Clinical Pathology Practical	0	4	2	60	30	70	100
Total		14	12	20	390	210	490	700

BMLS FIFTH SEMESTER

CODE	COURSE NAME	L/T	P	C	Hours	IA	ESE	Total
B05MLS01TH	Mycology & Parasitology	4	0	4	60	30	70	100
B05MLS02TH	Analytical Biochemistry	4	0	4	60	30	70	100
B05MLS03TH	Immunohematology and Transfusion Medicine	4	0	4	60	30	70	100
B05MLS04TH	Medical Law and Ethics	2	0	2	30	30	70	100
Practical								
B05MLS05PR	Mycology & Parasitology Practical	0	4	2	60	30	70	100
B05MLS06PR	Analytical Biochemistry Practical	0	4	2	60	30	70	100
B05MLS07PR	Immunohematology and Transfusion Medicine Practical	0	4	2	60	30	70	100
Total		14	12	20	390	210	490	700

BMLS SIXTH SEMESTER

CODE	COURSE NAME	L/T	P	C	Hours	IA	ESE	Total
B06MLS01TH	Applied Pathobiology	4	0	4	60	30	70	100
B06MLS02TH	Cytology and Histopathology	4	0	4	60	30	70	100
B06MLS03TH	Clinical Biochemistry	4	0	4	60	30	70	100
B06MLS04TH	Biostatistics and Research Methodology	2	0	2	30	30	70	100
Practical								
B06MLS05PR	Cytology and Histopathology Practical	0	4	2	60	30	70	100
B06MLS06PR	Clinical Biochemistry Practical	0	4	2	60	30	70	100
B06MLS07PR	Applied Pathobiology Practical	0	4	2	60	30	70	100
Total		14	12	20	390	210	490	700

BMLS SEVENTH & EIGHTH SEMESTER

CODE	COURSE NAME	L/T	P	C	Hours	IA	ESE	Total
B07MLS01LP	Lab Posting (Logbook and Viva)	0	0	20	900	90	210	300
B08MLS02LP	Lab Posting / Research Dissertation (Thesis / Logbook and Viva)	0	0	20	900	90	210	300
Total		00	00	40	1800	180	420	600

COURSE CONTENT / DETAILED SYLLABUS**SEMESTER I****Course Name: Human Anatomy****Code: B01MLS01TH | Credit: 4 | (60 hours)**

UNIT	TOPIC	HOURS
I	General Anatomy: Introduction to Anatomy, terms and terminology. Regions of Body, Cavities and Systems. Surface anatomy Musculoskeletal, vascular, cardio-pulmonary system. General Embryology.	4
II	Tissues: Classification and description of the basic tissues of the body. Histology: Epithelium, compact bone, muscles, connective tissue, nervous tissue, artery, vein and lymphatic tissue. Connective tissue & its modification, tendons, membranes, and special connective tissue.	4
III	Musculoskeletal system: Bone structure, blood supply, ossification, and classification. Muscle classification, structure, types and functional aspects. Joints-classification, structures of joints, movements, range, blood supply, nerve supply, dislocations	8
IV	Respiratory system: Structure of the upper and lower respiratory tract. Thorax: Pleural cavities & pleura, Lungs and respiratory tree, Heart and great vessels, Diaphragm	6
V	Digestive system: Parts/Structure of digestive system, Abdominal cavity - divisions, Muscles of abdominal wall, Liver, Pancreas, Spleen, Alimentary canal, Gall bladder, Intestine (small & large), and accessory organs of digestion	6

VI	Excretory System: Anatomy of the Kidney. Structure of the kidney, ureter, urinary bladder, male and female urethra. General description of pelvic organs. Lymphatic system- Lymphatic vessels and lymph, lymph nodes, Spleen. Mediastinum - division and contents	6
VII	Cardiovascular system: Circulatory system major arteries and veins of the body, structure of blood vessels, Heart structure, positions, chambers, valves, internal & external features, Blood supply to heart, Conductive system of heart	8
VIII	Nervous system: Classification of the nervous system. Nerve - structure, classification, microscopy with examples. Spinal cord- anatomy, structure and features of Meninges, Ventricles of the brain, CSF circulation	6
IX	Sensory system: Structure of the Visual system, Auditory system, Gustatory system, Olfactory system, Somatosensory system, Skin	6
X	Reproductive system: Structure of male and female reproductive organs. Endocrine system: Pituitary gland, Thyroid, Parathyroid	6

Course Name: Human Physiology

Code: B01MLS02TH | Credit: 4 | (60 hours)

UNIT	TOPIC	HOURS
I	General Physiology: Cell: morphology, structure and function of cell organelles, Structure of cell membrane, Transport across cell membrane, Intercellular communication, Homeostasis	4
II	Blood: Introduction-composition & function of blood, WBC, RBC, Platelets formation & functions, Immunity, Plasma: composition, formation & functions, Plasma Proteins:-types & functions, Blood Groups- types, significance, Haemoglobin, Haemostasis.	4
III	Nervous system and muscle: Organisation of the nervous system. Structure and function of muscle and nerve cells. Functions of the brain, the Spinal cord, the cranial and spinal nerves, and the Motor system. Sensory system. ANS, Synapse, neuromuscular transmission reflex arc, reflex action and reflexes, Cerebrospinal fluid	8
IV	Respiratory System: General organisation, Mechanics of respiration, Regulation of respiration, Gaseous exchange in lungs and tissues, Pulmonary ventilation, volumes and capacities, Effect of exercise on respiration, hypoxia.	6
V	Digestive System: Digestion & absorption of nutrients, Gastrointestinal secretions & their regulation, Functions of Liver, pancreas & stomach, Gastrointestinal tract disorders	6
VI	Renal System: Functions of the kidney, urine formation, Glomerular filtration rate, clearance, Tubular function. Water excretion, concentration of urine-regulation of Na ⁺ , Cl ⁻ , K ⁺ excretion, Physiology of urinary bladder	6
VII	Lymphatic and immunological system: Lymph glands and circulation of lymph, Spleen structure and function, Immunity - Formation of T-cells and B-cells, Antigen, Antibody and Immune response.	6
VIII	Cardiovascular system: Functions of the heart, organisation of the cardiovascular system, structure and properties of cardiac muscles. Cardiac output, cardiac cycle, and conducting system of the heart. Heart sounds,	8

	regulation of heart rate, pulse, blood pressure and its regulation. ECG, cardio-respiratory changes during exercise	
IX	Endocrine system: Physiology of the endocrine glands Pituitary, Pineal Body, Thyroid, Parathyroid, Adrenal, Gonads, Thymus, Pancreas. Hormones secreted by these glands, their classifications, and their functions.	8
X	Male and female reproductive system: Male: functions of testes & penis, pubertal changes in males, testosterone: action & regulations of secretion, ejaculatory mechanism & dysfunction. Female: functions of ovaries and uterus, pubertal changes, menstrual cycle, oestrogens and progesterone action and regulation. Physiological changes during pregnancy, Placenta and placental circulation.	6

Course Name: Fundamentals of the Healthcare System and Medical Laboratory Science

Code: B01MLS03TH | Credit: 2 | (30 hours)

UNIT	TOPIC	HOURS
I	Healthcare delivery system in India: Introduction to healthcare delivery system at primary, secondary and tertiary care, classification of hospitals based on system of medicine, Community participation in healthcare delivery system, National Health Mission, National Health Policy, Issues in Health Care Delivery System in India	6
II	Visit to Clinical laboratories, Introduction to clinical Laboratory, Classification of Laboratory, Introduction to various sections/departments in clinical laboratories, Lab space and designing, Knowledge of lab organisational chart, Role of Laboratory in patient care	8
III	Lab safety measures: Infection control, Universal precautions, PPE, Vaccination, Chemical, physical, electrical and fire safety. Biomedical waste management	4
IV	Records and their importance in a hospital, Records maintained in the Laboratory as per ISO 15189, importance of records and reports, Data entry and management on an electronic health record system	3
V	Medical terminology: Derivation of medical terms, Basic medical terms, form medical terms utilising roots, suffixes, prefixes, and combining roots, Interpret basic medical abbreviations/symbols	6
VI	Regulatory Bodies & Professional Organisations: Roles & Responsibilities Registration - MOHFW, NCAHP, State Council	3

Suggested Readings:

Textbook of Medical laboratory Technology, Mirnali Sant, CBS publishers. 2022

Textbook of Medical laboratory Technology, Ramnik Sood, Jaypee Publishers, 2006

Textbook of Medical laboratory Technology, Godkar PB, Bhalani Publishing House, 2024

Course Name: Communication Skills and Professionalism**Code: B01MLS04TH | Credit: 2 | (30 hours)**

UNIT	TOPIC	HOURS
I	Communication Skills: The Importance of Communication, The Communication Process. Barriers to communication: Physiological, Physical, Cultural, Language, Gender, Interpersonal, Psychological and Emotional barriers	4
II	Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment. Elements of Communication: Introduction, Face-to-Face Communication, Tone of Voice, Body Language (Non-verbal communication), Verbal Communication.	4
III	Developing personal etiquette: personal appearance, importance of grooming, acknowledging and respecting, maintaining professionalism, cubicle etiquette, time management, attending classes, meetings, seminars, etc, table manners, greeting, Netiquette and Telephonic conversation	4
IV	Developing presentation and career skills: Introduction, Importance of Resume and CV, preparing Resume and CV, Interview Skill Tips, FAQ During Interviews, Mock interviews	8
V	Professional values: Integrity, Objectivity, Confidentiality, Professional competence and due care, professional risks, professional responsibility, accountability, professional success	3
VI	Personal Values: Ethical and Moral values, Attitude and behaviour, Personal Hygiene and Mental Health	3

Suggested Readings:

Graham Lock, *Functional English Grammar: Introduction to Second Language Teachers*. Cambridge University Press, New York, 1996.

Gwen Van Servellen. *Communication for Health care professionals: Concepts, practice and evidence*, Jones & Bartlett Publications, USA, 2009

Course Name: Basic Emergency Care and First Aid**Code: B01MLS05TH | Credit: 2 | (30 hours)**

UNIT	TOPIC	HOURS
I	First Aid: Introduction, Aims & objectives of first aid, Priorities of first aid, Golden rules of first aid, Qualities & responsibilities of first aider, Simple first aid measures in selected conditions like Food poisoning, Snake bite, Scorpion bite, Dog bite, foreign bodies in various organs, Burns, Haemorrhage	10
II	Shock: Definition, Types of shock, General Features of shock, Investigations of shock, Initial management & first aid of shock	4
III	Poisoning: Definition, Causes of poisoning, Sources of Poisoning, Symptoms of poisoning, First aid & Management, Antidotes, Common drugs poisoning, Carbon monoxide poisoning	4

IV	Introduction: Chain of survival, team dynamics & multi-rescuer resuscitation. Vital signs of patients- Body temperature, Pulse, Blood Pressure, Respiration	4
V	Basic Life Support (BLS) in adults: Flowchart approach, approach to victim, techniques of CPR, BLS in paediatric Victims: checking pulse in children, chest compressions techniques, Bag mask ventilation technique	8

Suggested Readings:

Manual of first aid, 1st edition, Gupta Abhitabh, 2012, Jaypee Publishers

Emergency medicine, 5th edition, SN Chugh, Ashimachugh 202, CBS publishers

Course Name: Basics of Computer Application

Code: B01MLS06TH | Credit: 1 | (15 hours)

UNIT	TOPIC	HOURS
I	Introduction to Computers: Generations of computers, Applications of computers, Parts of a Computer, I/O devices, computer uses in healthcare	3
II	Basics of Operating System: Introduction to OS, Features of Windows OS, File management, User interface basics	2
III	Microsoft Word and PowerPoint: Introduction to Word, Typing medical documents, formatting, tables, inserting images, Introduction to powerpoint, slide creation	3
IV	Microsoft Excel, Access: Introduction to Excel and Access, Entering data, basic formulas, formatting cells, simple charts	2
V	Internet & Email: Definition, types of network, using browsers, opening email, attaching reports, basic internet safety	2
VI	Computers in Healthcare: Electronic health record, Hospital Information System basics, digital patient records, lab reporting usage	3

Suggested Readings:

V. Rajaramana, *Computer basics and programming*, PHI Learning Pvt. Ltd.

Michael Miller, *Computer Basics and Absolute Beginner's Guide*, Que Publishing

Course Name: Human Anatomy Practical

Code: B01MLS07PR | Credit: 2 | (60 hours)

Study of anatomical plans and positions

Histological study of tissues

Study of Skeletal system

Study of respiratory system

Study of digestive system

Study of urinary system

Study of Cardiovascular system

Study of Nervous system

Study of sensory organs: eye, ear, nose, tongue and skin

Study of reproductive system

Suggested Readings:

Ross and Wilson Anatomy and Physiology in Health and Illness, 11th Ed., Elsevier

Chaurasia B.D. - *Human Anatomy*, 7th Ed., CBS Publishers

Gerard J. Tortora & Bryan H. Derrickson - *Principles of Anatomy and Physiology*, 14th Ed., Wiley

Frank H. Netter - *Atlas of Human Anatomy*, 7th Ed., Elsevier

Frederic H. Martini et al. - *Fundamentals of Anatomy and Physiology*, 9th Ed., Pearson

Gray's Atlas of Anatomy - Richard Drake, Elsevier

Manju Chugani & Preysi Chauhan - *Simplified Anatomy and Physiology for Paramedical Students*, Jaypee

Course Name: Human Physiology Practical

Code: B01MLS08PR | Credit: 2 | (60 hours)

Perform blood collection

Estimation of Hemoglobin

Demonstrate blood cell count - RBC count and WBC count

Prepare blood smear and staining

Measure Blood pressure and Pulse Rate

Demonstration of ECG

Demonstration of EMG

Perform Reflexes testing

Spirometry and PFT (Pulmonary function test)

Suggested Readings:

Guyton & Hall - *Textbook of Medical Physiology*, Elsevier

C.C. Chatterjee - *Human Physiology*, Medical Allied Agency

K. Sembulingam - *Essentials of Medical Physiology*, Jaypee

Gerard J. Tortora & Bryan H. Derrickson - *Principles of Anatomy and Physiology*, 14th Ed., Wiley

Ross and Wilson Anatomy and Physiology in Health and Illness, 11th Ed., Elsevier

Course Name: Basics of Computer Application

Code: B01MLS09TH | Credit: 1 | (30 hours)

Practical (Credit: 1 / 30 hours):

MS Word-Document Creation- Resume, lab report typing, alignment, save & print

MS Word-Formatting & Tables- Medical charts, tables for patient information

MS Excel-Data Entry- Entering blood test reports and patient data

MS Excel - Basic Formulas- Average, sum, and conditional formatting

PowerPoint - Basic Slides- Creating a 5-slide presentation on hospital safety

Internet Browsing & Searching- Using Google for medical topics, downloading forms

Email Usage- Create an email, send a lab report with an attachment

MS Access database creation- Patient database creation

MS Access HTML integration in the database- Patient database creation view HTML webpage

Demonstrate use of Artificial Intelligence tools

SEMESTER II

Course Name: Fundamentals of Microbiology

Code: B02MLS01TH | Credit: 4 | (60 hours)

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	7

	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	
IV	Physiology of Bacteria: generation time of bacteria, bacterial growth curve, bacterial nutrition, bacterial metabolism	6
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

Course Name: Basics of Biochemistry

Code: B02MLS02TH | Credit: 4 | (60 hours)

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
II	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
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
VIII	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

Course Name: Fundamentals of Haematology

Code: B02MLS03TH | Credit: 4 | (60 hours)

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
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	10
V	Normal hemostasis and physiological properties of coagulation factors. Primary, secondary and tertiary hemostasis. Role of the platelets, coagulation factors, coagulation inhibitory system and fibrinolysis.	5
VI	Hematocrit and Erythrocyte Sedimentation Rate: physiological and pathological causes. Automation in Haematology lab: principles and	8

	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	
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

Course Name: Preventive and Social Medicine

Code: B02MLS04TH | Credit: 2 | (30 hours)

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
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	08

	the health team.	
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

Course Name: Fundamentals of Microbiology Practical

Code: B02MLS05PR | Credit: 2 | (60 hours)

Demonstrate the collection of various clinical specimens and their transport and processing.

Demonstrate a safe code of practice in the Microbiology laboratory

Demonstrate cleaning and sterilisation of glassware

Perform microscopy and specimen processing

Operate the autoclave and hot air oven, including its efficacy testing.

Demonstrate the sterilisation of reagents and culture media

Demonstrate sterilisation of media/solution by filtration.

Demonstrate the proper precautions to take when using disinfectants and dilution of commonly used disinfectants.

Demonstrate Simple staining

Demonstrate Gram's staining

Demonstrate Preparation of stains, reagents and culture media, quality control of reagents and media, and sterility check

Identify QC strains used for culture media

Suggested Readings:

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: Basics of Biochemistry Practical

Code: B02MLS06PR | Credit: 2 | (60 hours)

Demonstrate the use of Laboratory Apparatus, Micropipettes, and their uses

Demonstrate cleaning of glassware

Demonstrate the use of a laboratory balance

Prepare and label common Laboratory reagents (Percentage, Molarity, Normality)

Preparation of distilled water, double-distilled water, and deionised water.

Measure pH for laboratory reagents/biological samples

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

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

Perform qualitative analysis of lipids - Solubility test

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 Haematology Practical

Code: B02MLS07PR | Credit: 2 | (60 hours)

Demonstrate laboratory safety and biomedical waste management

Pre-analytical variables in clinical Laboratory: Patient and test request form identification, Patient preparation for phlebotomy, Sources of error in venous blood sample collection

Sample transport, processing, Sample acceptance and rejection criteria

Perform blood collection and demonstrate the order of draw

Estimation of hemoglobin by Drabkin's method

Perform Packed Cell Volume

Perform ESR by the Westergren method

Stain and examine the blood smear using Romanowsky stain

Perform Differential Leucocyte Count

Perform RBC count

Perform WBC count

Perform Absolute Eosinophil count

Perform Platelet count

Calculation of Red Cell Indices

Perform Bleeding Time and Clotting Time

Operate automated cell counters and interpret results

Perform Reticulocyte count

Suggested Readings:

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. ,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

SEMESTER III

Course Name: Bacteriology

Code: B03MLS01TH | Credit: 4 | (60 hours)

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

Course Name: Intermediary Metabolism & Endocrinology

Code: B03MLS02TH | Credit: 4 | (60 hours)

Unit	Topic	Hours
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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

Course Name: Clinical Haematology

Code: B03MLS03TH | Credit: 4 | (60 hours)

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, symptoms, 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

Course Name: Basics of Pharmacology

Code: B03MLS04TH | Credit: 2 | (30 hours)

Unit	Topic	Hours
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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

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

Course Name: Bacteriology Practical

Code: B03MLS05PR | Credit: 2 | (60 hours)

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*).

Apply diagnostic Scheme for Respiratory Tract Infections.

Apply diagnostic Scheme for Urinary Tract Infections.

Apply diagnostic for Gastrointestinal Tract Infections.

Apply diagnostic for Central Nervous System Infections and Bacteraemia.

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)

Demonstrate bacterial identification and antibiotic susceptibility testing using manual /automated methods

Processing of specimens for anaerobic bacteria

Processing of specimens for mycobacteria

Perform serological tests for the diagnosis of bacterial diseases

Identify the quality control used in the manual and automated methods

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: Intermediary Metabolism & Endocrinology- Practical

Code: B03MLS06PR | Credit: 2 | (60 hours)

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

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: Clinical Haematology - Practical Credit : 2 = 60 hours

Code: B03MLS07PR | Credit: 2 | (60 hours)

- Preparation and staining of peripheral smear using Leishman's stain.
- Identification of normal and abnormal morphology of red blood cells, white blood cells, and platelets.
- Peripheral smear study, its correlation with clinical symptoms and comparison of peripheral smear results with complete blood count (CBC).
- Reticulocyte count and its correlation with clinical symptoms

- Demonstration of bone marrow aspiration and smear preparation.
- Staining of bone marrow smears (Pearls 'Prussian blue stain) and its correlation with clinical symptoms
- Preparation of iso-osmotic sucrose solution and performance of sucrose lysis test.
- Identification of tests for hemoglobin variants and thalassemia. Explanation and interpretation of hemoglobin electrophoresis (e.g., sickle cell anaemia, thalassemia).
- Sickling test. Performance and interpretation of the osmotic fragility test
- 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.
- 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

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 hous

SEMESTER IV

Course Name: Virology and Immunology

Code: B04MLS01TH | Credit: 4 | (60 hours)

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

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

Course Name: Genetics & Molecular Biology

Code: B04MLS02TH | Credit: 4 | (60 hours)

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 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	12

Course Name: Clinical Pathology

Code: B04MLS03TH | Credit: 4 | (60 hours)

Unit	Topic	Hours
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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

Course Name: Medical Laboratory Management and Quality Control**Code: B04MLS04TH | Credit: 2 | (30 hours)**

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 – <i>Glucometer, Urine Dipstick, Lateral Flow Immunoassay (LFIA)</i> 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

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: Virology and Immunology Practical

Code: B04MLS05PR | Credit: 2 | (60 hours)

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

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: Genetics & Molecular biology Practical

Code: B04MLS06PR | Credit: 2 | (60 hours)

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, Klinefelter's syndrome / Turner's syndrome)

Course Name: Clinical Pathology Practical

Code: B04MLS07PR | Credit: 2 | (60 hours)

Identify and process clinical specimens (urine, stool, semen, sputum, CSF, pleural, peritoneal, synovial, pericardial fluids)

Perform physical, chemical, and microscopic analysis of urine and stool

Conduct special test in urine -hemoglobin & myoglobin, pregnancy test

Perform Stool analysis – Physical, Chemical and Microscopic Examination

Perform semen analysis- Physical, Chemical and Microscopic Examination

Perform Cerebrospinal Fluid (CSF) examination - Physical, Chemical, and Microscopic Examination

Perform Sputum Analysis- physical, chemical, and microscopic examination

Perform Pleural Fluid examination -physical, chemical, and microscopic examination

Perform Synovial fluid examination- physical, chemical, and microscopic examination

Perform Peritoneal Fluid examination- physical, chemical and microscopic examination

Perform Pericardial Fluid examination- physical, chemical, and microscopic examination

Operate the automation system used in Clinical pathology

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.

SEMESTER-V

Course Name: Mycology & Parasitology

Code: B05MLS01TH | Credit: 4 | (60 hours)

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, Penicilloles, Mucormycosis	15
III	Mycotoxigenesis: Definition of Mycotoxin, Mycetism, 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
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Course Name: Analytical Biochemistry

Code: B05MLS02TH | Credit: 4 | (60 hours)

Unit	Topic	Hours
I	Photometry: Theory of colourimetry, Beer-Lambert's law, Principles and applications of colourimetry, spectrophotometry, atomic absorption Spectroscopy, Fluorimetry and flame photometry in clinical laboratory	10
II	Centrifugation: Basic principles and units of centrifugation, Types of centrifugation and centrifuges, Rotors and tubes, Safety and maintenance, Applications of centrifugation in the laboratory.	4
III	Chromatography: Principles, types, Components and applications of Chromatography – Paper Chromatography, TLC, Ion Exchange, Affinity Gel Filtration, Gas Chromatography and HPLC in the laboratory.	10
IV	Electrophoresis: Principles, Types and applications – Agarose gel, Cellulose acetate and PAGE, and capillary electrophoresis. Electrophoresis of serum and urine protein, lipoprotein and isoenzymes	10
V	Osmometry: Principle and role of osmometry in clinical laboratory	6
VI	Radioactivity: Introduction, properties of alpha, beta and gamma radiations, radioisotopes, measurement of radioactivity, radiation hazards, radiation safety and precaution, Uses of radioisotopes.	6
VII	Types of immunoassays and their principle: Competitive and Non-competitive, immunometric assay and Turbidometry. RIA, ELISA, FIA and ECLIA	8
VIII	Automation: Principle of Automation, Semi-automated and fully automated chemistry analyser used in a clinical laboratory.	6

Course Name: Immunohematology and Transfusion Medicine

Code: B05MLS03TH| Credit: 4 | (60 hours)

Unit	Topic	Hours
I	History of transfusion, Types of blood bags and their advantages and disadvantages, Blood donor selection criteria and donor preparation for collection, Autologous transfusion: Types of autologous blood collection, Hemapheresis: pertaining to Leucocytes, platelets and plasma, Donor adverse reaction and its management	10
II	History and discovery of various blood group systems, Genetics and inheritance of the ABO blood group system, Weak variants of the ABO blood groups, Bombay phenotype, Other phenotypes. Rh blood group system, weak D, Rh null, Rh mod	10
III	Components of blood for transfusion- Packed red cells, washed red cells, frozen Red cells, platelet-rich plasma (PRP), Platelet concentrate and frozen platelets. Fresh plasma (FP), Fresh Frozen Plasma (FFP) and cryoprecipitate, process of component preparation, storage, indications, transfusion dosage, and quality control	12
IV	Transfusion reactions- causes, clinical features, management and laboratory investigation, Pretransfusion tests and their clinical significance. Compatibility test in blood transfusion: Collection of blood for cross-matching from a blood bag, Major cross-matching, Minor cross-matching, use of enzymes in the blood bank, especially Papain	12
V	Transfusion-transmitted diseases and their laboratory investigations. Hemolytic disease of the newborn (HDN) and its investigations	6
VI	HLA Human Leucocytic antigen, Introduction to basic concepts of HLA and clinical applications of HLA testing, Techniques and principles of histocompatibility testing	5
VII	Regulatory agency that governs activities in the blood bank, Total quality management in transfusion service, including premises, personnel, instruments and reagents, Biosafety, external/internal quality control in Transfusion Medicine	5

Course Name: Medical Law and Ethics

Code: B05MLS04TH | Credit: 2 | (30 hours)

Unit	Topic	Hours
I	Comprehend knowledge of medical and bioethics	8
II	Follow good laboratory practice and appropriate ethical guidelines while conducting research on animal and human samples.	10
III	Understand the Indian Legal system, medico legal records, human rights act, disaster management, Human Organ Transplantation Act, mental Health act, professional indemnity insurance policy and IPR	12

Suggested reading:

- Bonnie F. Fremgen – Medical Law and Ethics, Pearson Education

- Jonathan Herring – Medical Law and Ethics, Oxford University Press
- ICMR – Ethical Guidelines for Biomedical Research on Human Participants (2017)
- John D. Angelo-Ethics in Science (2012). Ethical Misconduct in Scientific Research. CRC Press, Taylor & Francis Group
- Hazel Biggs-Healthcare Research Ethics and Law. Regulation, Review & Responsibility. (2010). Cavendish Biomedical Law & Ethics Library
- Graf, C. et al.- Best practice guidelines on publication ethics: a publisher's perspective. (2007). International journal of clinical practice, 61, 1-26
- Gluck et al. Applied ethics in animal research: philosophy, regulation, and laboratory applications, (2002) Purdue University Press

Course Name: Mycology & Parasitology – Practical

Code: B05MLS05PR | Credit: 2 | (60 hours)

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

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

Course Name: Analytical Biochemistry – Practical

Code: B05MLS06PR | Credit: 2 | (60 hours)

Estimation of biochemical parameters using a Semi-automatic analyser

Plasma Glucose

Serum protein

Serum Albumin

Serum Urea

Serum Uric acid

Serum Creatinine

Demonstration of Analytical Techniques

Thin-layer chromatography

Serum protein electrophoresis

ELISA

AAS

HPLC

Paper chromatography and staining techniques

Suggested Readings

Wilson and walker's *Principles and techniques of biochemistry and molecular biology*, Cambridge university press.

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

Textbook of Clinical Chemistry by Teitz

Course Name: Immunohaematology and Transfusion Medicine – Practical

Code: B05MLS07PR | Credit: 2 | (60 hours)

1. Demonstrate the procedure for pooled cell preparation
2. Demonstrate the preparation of 5% cell suspension
3. Demonstrate the preparation of sensitised cells
4. Demonstrate the procedure for cell washing
5. Perform ABO and Rh grouping:
 - a. Direct (preliminary) and indirect (proof) grouping.
 - b. Rh grouping and Du determination.
6. Demonstrate Antibody screening:
 - a. Forward (cell) grouping
 - b. Reverse (serum) grouping
7. Donor Screening and Blood Collection
8. Preservation of blood for transfusion
9. Cross-matching: Major and minor cross-matching.
10. Coombs test: Direct and indirect Coombs test
11. Preparation of blood components

Suggested Reading

- Mamak, N., & Aytekin, İ. (2012). Principles of Blood Transfusion. Blood Cell-An Overview of Studies in Hematology.
- AABB. (2017). Technical manual (19th ed.). AABB.
- Sood, R. (2006). Textbook of medical laboratory technology. Jaypee Brothers Publishers.
- Godkar, P. B., & Godkar, D. P. (2006). Textbook of medical laboratory technology. Bhalani publishing house.
- Klein, H. G., & Anstee, D. J. (2013). Mollison's blood transfusion in clinical medicine. John Wiley & Sons.
- Harmening, D. M. (2018). Modern blood banking & transfusion practices. FA Davis.

BMLS SIXTH SEMESTER

Course Name: Applied Pathobiology

Code: B06MLS01TH | Credit: 4 | (60 hours)

Unit	Topic	Hours
I	Introduction to Pathobiology & Cell Injury: Definition and scope of pathology, Cellular adaptations: hypertrophy, hyperplasia, atrophy, metaplasia, Mechanisms of cell injury: physical, chemical, biological, Morphology of reversible and irreversible injury, Cell death: necrosis (types), apoptosis, Intracellular accumulations – Lipids, cholesterol, proteins, glycogen and pigments; examples, Pathologic calcification – Types and examples.	8
II	Inflammation and Repair: Definition and symptoms, Acute inflammation: signs, vascular and cellular events, Chemical mediators of inflammation, Chronic inflammation and granuloma formation, Healing: Regeneration and fibrosis, wound healing stages, factors affecting wound healing.	12
III	Hemodynamic and Immune Disorders: Edema, hyperemia, haemorrhage, thrombosis, embolism, infarction, Difference between transudate and exudate, Shock: types and pathology, Hypersensitivity reactions (I–IV), autoimmunity: examples (SLE, rheumatoid arthritis), Diabetes, HIV, Tuberculosis	12
IV	Neoplasia: Definitions and nomenclature of tumours, Differences between benign and malignant tumours, Histological features: anaplasia, differentiation, invasion, carcinogenesis: chemical, radiation, and viral, mode of tumour spread, Clinical aspects of neoplasia, grading and stages of tumour, Tumour markers and lab diagnosis (AFP, PSA, CEA, etc.)	16
V	Infectious and Parasitic Diseases: Anthrax, Whooping Cough (Pertussis), Candidiasis, Amoebiasis, Malaria, TORCH Complex, Hepatitis type laboratory diagnosis, Pulmonary tuberculosis and lab diagnosis	12

Course Name: Cytology and Histopathology

Code: B06MLS02TH | Credit: 4 | (60 hours)

Unit	Topic	Hours
I	Introduction to Cytology: Definition of cytology, organisation of cytology laboratory, Types of cytology, Cytological sampling techniques, Sample acceptance and rejection criteria, fixation, reception, processing, and mounting of cytological specimens, Quality control in cytology	5
II	Exfoliative Cytology: Cervical cytology, Fluid cytology-Urinary tract, Respiratory system, CSF, Body fluids. Sex chromatin demonstration and karyotyping, Vital staining for sex chromatin, Aspiration cytology,	10

	Cytology staining techniques- PAP, MGG, Shorr's stain, Aceto-orcein stain	
III	Automation in Cytology: Liquid-based cytology: principles and preparation, Molecular cytology, Cell block technique	5
IV	Introduction to histopathology laboratory: Definition of biopsy and autopsy, Types of tissues received, Storage and documentation, Steps in tissue preparation, Grossing procedures, Handling tiny tissue specimens, Quality assurance	6
V	Fixatives: Definition and classification, Qualities of ideal fixatives, Common fixatives used, Methods of fixation, Methods for removing excess fixative	4
VI	Tissue processing: Definition and methods of decalcification, acid-containing decalcifying fluids, determination of endpoint of decalcification, steps in tissue processing - Dehydration, clearing, impregnation. Embedding moulds and media, Automated tissue processor: parts and working	5
VII	Section cutting: Definition and classification of microtomes, Care and maintenance of microtomes, Microtome knives and sharpening techniques, Automated knife sharpener, Disposable blades, Requirements and process of section cutting, Adhesives preparation, Causes and remedies for improper sections, Frozen section-Importance, Technique, Freezing microtome and cryostat	10
VIII	Routine staining technique: Theories of staining, Definitions: dye, mordents, alum. Classification of haematoxylin, H&E staining and rapid technique, Automated stainer, Mounting media: classification, preparation, purpose. Immunohistochemistry-Tissue preparation and staining, detection of artefacts and remedies	5
IX	Special stains in histopathology- Principle and use of staining procedure Mucosubstances: PAS, Alcian Blue, Colloidal iron, High iron diamine, Mayer's Mucicarmine Connective tissue: Vangieson, Masson's Trichrome Reticulin fibres: Gomori's silver, Gordon and Sweets Elastic fibres: Verhoff's stain Pigments and minerals: Pearls Prussian blue Microorganisms: AFB stain Amyloid: Congo red Lipids and fats: Oil Red O Metachromatic staining: Toluidine blue (frozen section	7
X	Museum Techniques: Specimen mounting steps, fixation of specimens, Museum technique steps	3

Course Name: Clinical Biochemistry

Code: B06MLS03TH | Credit: 4 | (60 hours)

Unit	Topic	Hours
I	GCLP: laboratory safety and Universal precaution, Introduction to Phases in Laboratory, Preanalytical - Specimen collection, processing and handling in clinical laboratory, Sample acceptance and rejection criteria, Sources of error.	3
II	Analytical Phase: SOP, Laboratory equipment- maintenance, lab reagents and kits, calibrators, concept of accuracy, precision, reliability, reproducibility, Quality control (IQC and EQA), Basic statistics (Mean, Median, SD, CV), Westgard rule, LJ graph, Types of error in analytical phase.	3
III	Post Analytical Phase: Report generation, Types of error in post analytical, storage and retention of sample, Documentation of report	3
IV	Laboratory diagnosis of Diabetes mellitus – Plasma glucose (Fasting, Random, Post Prandial, OGTT, glycosylated haemoglobin. Screening test for inborn errors of metabolism- PKU, Alkaptonuria, Fructosuria, galactosemia, hypercholesterolemia.	8
V	Liver Function Test: Indications and classification of LFT, Test based on bile pigment metabolism, classification of jaundice, Test-based serum enzymes	6
VI	Renal Function Test: Indications and classification of RFT. Test based on glomerular filtration, renal plasma flow, and tubular functions. Acid-base balance, including blood gas analysis	6
VII	Gastric Function Test: Indication and classification of GFT, Examination of resting content. Pancreatic Function Test: Indication of Pancreas function test-Lipases and Amylases	6
VIII	Thyroid Function Test: Indications and classification of thyroid function test, tests based on primary function, and blood levels of thyroid hormones.	4
IX	Cardiac Function Test: Indications of Cardiac function test, Cardiac markers, lipid profile, Enzyme pattern in AMI	5
X	Biochemistry of cancer: Properties of cancer cells, morphological and biochemical changes in cancer cells, carcinogenesis, carcinogens, diagnosis of cancer – oncogenic markers (AFP, PFA, CEA, bHCG, Myeloma -Bence Jones protein, M band)	4

Course Name: Biostatistics and Research Methodology

Code: B06MLS04TH | Credit: 2 | (30 hours)

Unit	Topic	Hours
I	Introduction to biostatistics: Concepts, types, significance and scope of statistics, meaning of data, sample and parameter, Types and levels of data and their measurement, Organisation and presentation of data-tabulation of data, Frequency distribution, Graphical and tabular presentation	3
II	Descriptive statistics: Measures of dispersion- Range, Inter-quartile range, Variance, Standard deviation and Coefficient of variation	6
III	Introduction to probability and normal distribution. Normal distribution - characteristics of normal distribution	3

IV	Sampling methods: Need for sampling and the advantages of sampling over complete enumeration, Sampling and non-sampling error, Probability and nonprobability sampling methods	3
V	Measures of relationship: Correlation – need and meaning, Rank order correlation, Scatter plot, Simple linear regression and prediction	4
VI	Testing of significance: Hypothesis, Non-Parametric test- Chi-square, t-test, ANOVA, Mann-Whitney U test. Use of statistical software for data analysis	6
VII	Introduction to research methodology: Research methodology, research design and review of literature, Different methods of data collection and data sources	5

Suggested reading

- S.P. Gupta – Statistical Methods, Sultan Chand & Sons
- B.K. Mahajan – Methods in Biostatistics for Medical Students, Jaypee Brothers Medical Publishers
- Himanshu Tyagi – RPG Biostatistics, CBS Publishers & Distributors
- World Health Organisation (2001) – Health Research Methodology: A Guide for Training in Research Methods, WHO Press

Course Name: Cytology and Histopathology – Practical

Code: B06MLS05PR | Credit: 2 | (60 hours)

1. Demonstrate receiving, handling, and labelling and specimen rejection criteria of cytological specimen.
2. Fine needle aspiration cytology
3. Preparation of fixatives in cytology laboratory and fixation of cytological specimens
4. Demonstrate cytological specimen preservation.
5. Demonstrate specimen processing in cytology – Gynaecological, Urine, Body fluids, Cerebrospinal fluid (CSF), sputum, - Liquid-based cytology.
6. Preparation for Papanicolaou (Pap) stain
7. Demonstrate staining - May-Grunwald Giemsa (MGG) staining, Myeloperoxidase staining, Sudan black B (SBB), Nonspecific esterase, Per Iodic acid Schiff staining (PAS), Neutrophil alkaline phosphatase (NAP), Gabbet's modified Ziehl Neelsen staining.
8. Quality control in a cytology laboratory
9. Demonstrate the preparation of fixatives- 10% Neutral buffered formalin, Formal Saline.
10. Demonstrate preparation of decalcifying fluid - Gooding & Stewart's fluid
11. Perform the tissue processing – fixation, dehydration, clearing, impregnation

12. Demonstrate the procedure for knife sharpening - Honing & stropping
13. Perform section cutting of tissue block using a microtome
14. Haematoxylin and Eosin staining
15. Perform mounting of the stained section
16. Demonstrate staining for carbohydrates, lipids, amyloid collagen, reticulin, elastic fibres, pigments, and Acid-Fast Bacillus (AFB).
17. Demonstrate immunohistochemistry techniques, Enzyme histochemistry-diagnostic applications and the demonstration of phosphates, dehydrogenases, oxidases and peroxidases

Suggested Readings:

- Bancroft, J. D., & Gamble, M. (Eds.). (2008). Theory and practice of histological techniques. Elsevier health sciences.
- Koss, L. G., & Melamed, M. R. (Eds.). (2006). Koss' diagnostic cytology and its histopathologic bases (Vol. 1). Lippincott Williams & Wilkins.
- Ramakrishnan, S., & Sulochana, K. N. (Eds.). (2012). Manual of Medical laboratory techniques. Jaypee Brothers Medical Publishers Pvt. Ltd.
- Lynch, M. J., & Raphael, S. S. . Lynch's Medical laboratory technology.
- Baker, F. J., & Silverton, R. E. (2014). Introduction to medical laboratory technology. Butterworth-Heinemann.
- Koss, L.G. and Melamed, M.R. eds., 2006. Koss' diagnostic cytology and its histopathologic bases (Vol. 1). Lippincott Williams & Wilkins.
- Nayak, R., & Nayak, R. (2023). Review of Postgraduate Pathology (Systemic Pathology): Two Volume Set. JP Medical Ltd.
- Carson, F. L., & Cappellano, C. H. (2009). Histotechnology: A self-instructional text (3rd ed.). ASCP Press.
- Curran, R. C., & Crocker, J. (2000). Curran's atlas of histopathology. (No Title).
- Sadhana Vishwakarma (2017). Edition : 1/e. Techniques in Histopathology and Cytopathology.
- Cibas, E. S., & Ducatman, B. S. (2003). Cytology: Diagnostic principles and clinical correlates. Gulf Professional Publishing.

Course Name: Clinical Biochemistry – Practical

Code: B06MLS06PR | Credit: 2 | (60 hours)

1. Construction of the Levey-Jennings (LJ) graph and interpretation of Westgard rule

2. Oral Glucose Tolerance Test (OGTT) Estimation of following profile test using the kit method
3. Lipid profile
 - a. Triglycerides
 - b. Cholesterol
 - c. HDL
4. Renal Function Test
 - a. Urea
 - b. Uric acid
 - c. Creatinine
5. Liver function test
 - a. Total Protein
 - b. Albumin
 - c. Total Bilirubin
 - d. Direct bilirubin
 - e. SGOT
 - f. SGPT
 - g. Alkaline Phosphatase
 - h. Urinary Bile salt, Bile pigment, urobilinogen
6. Electrolytes
 - a. Sodium
 - b. Potassium
 - c. Chloride Demonstration of the following
7. Glycosylated Hemoglobin (HbA1C)
8. Thyroid Function Test
 - a. T3
 - b. T4
 - c. TSH

Suggested Reading

- 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
- Nader Rifai et al, Tietz Textbook of Clinical Chemistry and Molecular Diagnostics, Saunders/ Elsevier

Course Name: Applied Pathobiology – Practical

Code: B06MLS07PR | Credit: 2 | (60 hours)

1. Basic interpretation of histopathological slides (normal vs diseased tissue)
2. Microscopic Identification of Cellular Changes: (i) Hypertrophy, (ii) atrophy (iii) dystrophy
3. Microscopic pattern recognition in (i) inflammation, (ii) neoplasia, (iii) necrosis
4. Identification of pathological features in gross specimens: (i) liver, (ii) lung, (iii) kidney, (iv) heart, and any other organs
5. Correlation with clinical symptoms and microscopic imaging of disease- case based studies
6. Reporting practice in histopathology and cytology (minimum 15-20 different case studies can be incorporated).

*** If the Institutes are having limitations with biological samples educational slides are readily available which can help them to learn the basic needs of the practical. The remaining hours can be compensated by clinical lab rotations.

Suggested Reading:

- Mohan, H. (2015). Textbook of pathology. Jaypee Brothers Medical Publishers.
- Kumar, V., Abbas, A. and Aster, J. (2020) Robbins and Cotran Pathologic Basis of Diseases. 10th Edition, Elsevier
- MOHAN, Harsh. (2013). Pathology Practical Book. New Delhi: Jaypee Brothers Medical.
- Klatt, E. C. (2014). Robbins and Cotran atlas of pathology. Elsevier Health Sciences.
- Godkar, P. B., & Godkar, D. P. (2006). Textbook of medical laboratory technology. Bhalani publishing house.

SEMESTERS VII & VIII

Course Name: Internship (Clinical Lab Postings / Research Dissertation)

Credits: 40 (20 + 20) | Contact Hours: 1800 hours (900 + 900 hours)

Duration: 1 Year (12 months / 52 weeks) compulsory internship across various clinical laboratory sections.

Posting Sections:

Clinical Biochemistry

Clinical Pathology & Cytology

Hematology & Immunohematology (Blood Bank)

Microbiology, Serology & Parasitology

Histopathology & Molecular Diagnostics

Evaluation Scheme: Continuous logbook evaluation, project presentation, research dissertation assessment, and final Viva-Voce.

Area	Duration (Months)	Competencies
Pathology	2	Sample processing, staining, cryostat handling, FNAC
Hematology & Clinical Pathology	2	Phlebotomy, smear reading, automation, urinalysis
Transfusion Medicine	2	Blood component preparation, donor monitoring, transfusion-transmitted disease screening
Clinical Biochemistry	2	Biochemical analysis, automated system, Quality control
Microbiology	2	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

**SEMESTER VII & SEMESTER VIII (LOG BOOK AND SKILL
ASSESSMENT PAGES**

Cover Page of Log book

University/College logo University/ College Name

**INTRENSHIP LOG BOOK
BMLS (VII/VIII SEMESTER)
(YEAR)**

STUDENT'S RECORD

Name :

Semester:

Enrollment No. :

Session :

.....

Signature of Principal

.....

Signature of Student

DECLARATION BY THE STUDENT

Madam/Sir,

I, Mr/Ms a student of bearing Registration No.
..... declare that I have completed hours of Internship duty, out of the
assigned hours and have performed my duties in the hospital/laboratory as stated in
my logbook

Students Signature

(COLLEGE/UNIVERSITY LOGO)

INSTITUTE/UNIVERSITY/ COLLEGE NAME LOGBOOK CERTIFICATE

This is to certify that the candidate

Mr/Ms..... registration number

..... admitted in the academic year of

*.....college, has satisfactorily completed/ Not completed
all requirements mentioned in this logbook for seventh/ eighth semester of Bachelor of Medical Laboratory
Sciences during the period fromto in the*

... Hospital/Laboratory.

Signature of the Faculty in-Charge (hospital/laboratory) Name

Date

Signature of the Principal/Dean HoD (University/College) Name

Date

SKILL ASSESSMENT SHEET

Hospital/Laboratory: Department:

[illegible]



