B. Voc. Medical Laboratory Sciences

(B. Voc. - MLS)

Syllabus

w. e. f. Academic Session 2025-26

DDU KAUSHAL KENDRA

Jamia Millia Islamia

New Delhi-110025

6.3.25
Hony Director
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New Delhi-110025

B.VOC. Medical Laboratory Science (B.VOC. MLS)
Duration: Three Years (6 semesters)

Sem.	S. N.	Paper Code	Paper Name	Total Hrs.	Credit	IE	SE	Total
1	1	MLS 101	Fundamentals of Human Anatomy	48	4	25	75	100
	2	MLS 102	Fundamentals of Human Physiology	48	4	25	75	100
	3	MLS 103	Basic Biochemistry	48	4	25	75	100
	4	MLS 104	Cell Biology & Medical Genetics	48	4	25	75	100
	Skill Components							
	5	MLS 105	Fundamental of Computer & IT	48	4	25	75	100
	6	MLS 106	English-I	48	4	25	75	100
	7	MLS 107P	Practical I (MLS 101, MLS 102)	84	6	25	75	100
	8	MLS 108P	Practical II (MLS 103, MLS 104)	84	6	25	75	100
			Total	**456**	**36**	**200**	**600**	**800**
2	**S. N.**	**Paper Code**	**Paper Name**	**Total Hrs.**	**Credit**	**IE**	**SE**	**Total**
	1	MLS 201	General and Systemic & Clinical Pathology	56	4	25	75	100
	2	MLS 202	Clinical Biochemistry - I	48	4	25	75	100
	3	MLS 203	Instruments & Reagents	48	4	25	75	100
	4	MLS 204	General Microbiology	48	4	25	75	100
	5	MLS 205	Haematology & Haemoglobinopathies	56	4	25	75	100
	Skill Components							
	6	MLS 206	English-II	48	4	25	75	100
	7	MLS 207P	Practical III (MLS 201, MLS 205)	98	8	50	150	200
	8	MLS 208P	Practical IV (MLS 202, MLS 203)	98	8	50	150	200
	9	MLS 209P	Practical V (MLS 204)	48	4	10	40	50
			Total	**548**	**44**	**260**	**790**	**1050**
3	**S. N.**	**Paper Code**	**Paper Name**	**Total Hrs.**	**Credit**	**IE**	**SE**	**Total**
	1	MLS 301	Clinical Biochemistry-II	56	4	25	75	100
	2	MLS 302	Systemic Bacteriology	56	4	25	75	100
	3	MLS 303	Blood Banking & Transfusion Medicine	56	4	25	75	100
	Skill Components							
	4	MLS 304P	Practical VI (MLS 301)	56	4	50	50	100
	5	MLS 305P	Practical VII (MLS 302)	56	4	100	50	100
	6	MLS 306P	Practical VIII (MLS 303)	56	4	50	50	100
	6	MLS 307P	Evaluative Clinical Training I	126	6	- - -	100	100
			Total	**462**	**30**	**275**	**475**	**700**

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Sem	S. N.	Paper Code	Paper Name	Total Hrs.	Credit	IE	SE	Total
4	1	MLS 401	Diagnostic Endocrinology	56	4	25	75	100
	2	MLS 402	Immunology & Serology	70	5	25	75	100
	3	MLS 403	Parasitology, Mycology & Virology	70	5	25	75	100
	Skill Components							
	4	MLS 404P	Practical IX (MLS 401, MLS 402)	98	8	100	100	200
	5	MLS 405P	Practical X (MLS 403)	98	8	100	100	200
			Total	**392**	**30**	**275**	**425**	**700**
5	**S. N.**	**Paper Code**	**Paper Name**	**Total Hrs.**	**Credit**	**IE**	**SE**	**Total**
	1	MLS 501	Histopathology & Cytology	70	5	25	75	100
	2	MLS 502	Molecular Diagnostic	70	5	25	75	100
	3	MLS 503	Public Health	56	4	25	75	100
	Skill Components							
	4	MLS 504P	Practical XI (MLS 501)	84	6	50	50	100
	5	MLS 505P	Practical XII (MLS 502)	84	6	**50**	50	100
	6	MLS 506P	Evaluative Clinical Training II	252	8	----	100	100
			Total	**616**	**34**	**175**	**425**	**600**
6	**S. N.**	**Paper Code**	**Paper Name**	**Total Hrs.**	**Credit**	**IE**	**SE**	**Total**
	1	MLS 601	Quality Assurance & Medical Ethics	56	4	25	75	100
	Skill Components							
	2	MLS 602P	Evaluative Clinical Training & Internship	588	18	- - -	300	300
			Total	**644**	**22**	**25**	**375**	**400**
			Grand total (Semester I-VI)	**3118**	**196**	**1210**	**3090**	**4250**

Total skill component credits in all (I-VI) semesters: **116 Credits**
Total knowledge component credits in all (I-VI) semesters: **80 Credits**
Total credits (I-VI) semesters = **196**
Total marks (I-VI) semesters = **4250**
Total hours (I-VI) semesters = **3118** (Skill components **2054** hrs. & Knowledge components **1064** hrs.

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Semester – 1st						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 101	Fundamentals of Human Anatomy	48	4	25	75	100

Objective — Students will become aware of the terminology used in human anatomy. They will also develop the basic knowledge of body plan and organization of human body, structure of cells, tissues, organs, organ systems and their coordination with each other.

Outcome intended — students will be able to identify the various anatomical structures in the human body and communicate scientifically with other health-care personnel as a result of the terms and nomenclature taught during anatomy tutorials.

Unit I: General & Systemic Anatomy: Introduction to anatomical terms and organization of the human body. Tissues –Definitions, Types, characteristics, classification, location, functions and formation.

Unit II: **Musculoskeletal system**: Bones – types, structure, Axial & appendicular skeleton. Bone formation and growth, Joints –classification and structure. Types and structure of muscles. Movements at the joints and muscles producing movements.

Unit III: Nervous and Endocrine System: Structure of Neuroglia & neurons Parts, Classification CNS – Structure of Brain and spinal cord and their functions. PNS - Cranial nerves and spinal nerves ANS - Sympathetic and Parasympathetic. Structure of Skin, Eye, Nose, Auditory and Olfactory apparatus. Endocrine System: Gross structure of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal glands

Unit IV: Cardiovascular and Respiratory System: Circulatory system – Structure of the Heart, Structure of Blood Vessels – arterial and venous system. Gross and microscopic structure of lymphatic tissue. Respiratory system: Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura.

Unit V: Digestive System, Urinary & Reproductive System: Parts, Structure of Tongue, Salivary glands, stomach, Intestines, Liver, Pancreas, Spleen. Urinary system: Parts, structure of Kidney, Ureters, Urinary Bladder and Urethra. Reproductive system: Gross structure of both male and female reproductive organs.

Essential Reading:

1. Chaurasia B D, (2024), Human Anatomy (Vol 1,2,3,4),10th edition
2. Ross & Wilson, (2022), Anatomy & Physiology in health & illness,14th edition
3. Gray's anatomy for students (2020), 42nd Edition
4. Text book of anatomy (Vol 1,2,3)– Vishram Singh, 4th Edition.
5. Text book of anatomy – VOL 1,2 – Inderbir Singh, 6th Edition.

Suggested Readings –

1. Text book of Anatomy – W.J. Hamilton

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Semester-1st						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 102	Fundamentals of Human Physiology	48	4	25	75	100

Objective – This paper lay out the knowledge of human systems physiology. To understand the functions of all physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems, to perform, analyze and report on experiments and observations in physiology.

Intended Outcome – At the end of semester students should have an enhanced knowledge of Human Physiology and understand the function of all physiological systems. Students should also understand how these specific systems interact to yield integrated physiological response. They should be able to perform, analyze and report on experiment and observation in Physiology.

Unit I: Blood– Plasma & Cellular Components: Functions and composition of Blood, morphological features of blood cells, Hematopoiesis, structure of Hemoglobin and its abnormalities. Types of anemia and their causes, Hemostasis.

Unit II: Nerve Muscle Physiology – Structure and functions of neurons and neuroglial cells, Resting membrane potential, Action potential. Properties of nerve fibers: excitability, conductivity, all or none law, accommodation, adaptation summation, refractory period, fatigability, Neuromuscular junction: structure, transmission. Microscopic and electron microscopic structure of skeletal, smooth, and cardiac muscles, Single-unit, and multi-unit smooth muscle. Muscle proteins and Properties of skeletal muscle. Mechanism of skeletal and smooth muscle contraction and relaxation.

Unit III: Cardiovascular and Respiratory System – Properties of cardiac muscle, Origin and propagation of cardiac impulse, Conduction System of Heart, Cardiac Cycle, Heart sounds. Functions of respiratory muscles, Respiratory and Volume capacities, exchange of oxygen and carbon dioxide, Brief account of respiratory regulation, Hypoxia and its types, Cyanosis, asphyxia, Dead spaces, Factors affecting Oxygen dissociation curve of hemoglobin and myoglobin, factors affecting Carbon dioxide dissociation curve.

Unit IV: Digestive System- Functions of alimentary canal, Physiology of Deglutition, Movements of alimentary canal, Composition, functions and secretion of salivary, gastric, pancreatic, and intestinal juices and bile, Digestion and absorption of carbohydrates, lipids, proteins, and nucleic acids. Defecation.

Unit V: **Excretory and Reproductive system –** Structure and functions of kidney, components of Nephron, measurement, and regulation of GFR, Renin Angiotensin system mechanism of urine formation, Clearance tests, functions of ovaries, sex hormones, menstrual cycle, pregnancy, parturition, lactation, contraception, male sex hormones and spermatogenesis.

Essential Reading –

1. Medical Physiology – Indu Khurana
2. Text book of Physiology – Prof. A. K. Jain
3. A Text book of Practical Physiology – Prof. A.K. Jain
4. Essential of Medical Physiology – K Sembulingam, Prema Sembulingam
5. Review of Medical Physiology – Ganong's

Suggested Readings –

1. Harrison's principles of Internal Medicine
2. Text book of Medical Physiology – Guyton
3. A Text book of Practical Physiology – C. L. Ghai

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Semester-1st						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 103	Basic Biochemistry	48	4	25	75	100

Objective: The students will understand the chemical nature, function, metabolic pathways and biological importance of carbohydrates, proteins, lipids, vitamins and enzymes.

Intended outcome: The students will understand the structure, function and biological importance of carbohydrates, proteins, lipids, nucleic acids, enzymes, vitamins and the regulation of biochemical processes. They will also become aware how deficiency or excess of these will cause disease.

Unit I: Carbohydrates: Definition and function of carbohydrate, classification of carbohydrates: Monosaccharide, oligosaccharides, and polysaccharides. Glycoside formation. Metabolism of carbohydrate: Glycolysis, catabolic fates of pyruvate, metabolic fate of Acetyl-CoA and Citric acid cycle, gluconeogenesis, glycogen metabolism, pentose phosphate pathway.

Unit II: Biological Oxidation and Enzyme: Definition and classification of enzymes, coenzyme, active sites of enzymes, isoenzymes, properties and mechanism of enzyme action, enzyme inhibition, electron carriers involved in biological oxidation, electron transport chain, oxidative phosphorylation, substrate level phosphorylation, inhibitors of electron transport chain.

Unit III: Amino acids and proteins: Definition, structure, classification of amino acids-essential & non-essential amino acids. Proteins-definition and structure- primary, secondary, tertiary, and quaternary of proteins of proteins, peptide bonds, properties of protein, classification of protein, denaturation of protein.

Unit IV: Vitamins: Definition and classification of vitamins, fat soluble and water-soluble vitamins, biochemical functions and deficiency symptoms of common individual vitamins.

Unit V: Lipids: Definition, classification, and function of lipids. Fatty Acids, Triacylglycerols or Triacyl glycerides or neutral fat. Fatty acid metabolism. Ketone body metabolism.

Essential readings:

1. Lehninger (2021) Principles of Biochemistry,8th edition, W H Freeman
2. Satyanarayan (2021), Essentials of Biochemistry, 3rd edition, Standard Publishers
3. Biochemistry for students, V.K. Malhotra, 12th Edition.

Suggested readings:

1. Pankaja Naik, Biochemistry, 4th ed

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Semester-1st						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 104	Cell Biology & Medical Genetics	48	4	25	75	100

Objective – To develop an understanding of the cell as the fundamental unit of life. The students will also learn the structure and function of cells, cell organelles, and their life processes. In genetics, the students will learn the basis of heredity and variation in humans.

Outcome intended – Students will be able to appreciate the general properties shared by all cells and the highly complicated functions of some specialized cells. They will also learn how changes in the human genome result in disease and disability.

Unit I: Cell Organelles: Prokaryotic and eukaryotic cells. Endosymbiotic theory of evolution. Structure and function of Endoplasmic reticulum and Golgi apparatus. Lysosomes (role in degradation and LSDs). Intracellular vesicular trafficking. Mitochondria (structure and basic idea of function)

Unit II: Cytoskeleton Network: Structure, organization and role of Microfilaments, Intermediate filaments and microtubules. Mitotic spindle (MTOCs), Cilia, Flagella, Filopodia, Microvilli structure

Unit III: Membrane Transport and Cell Signaling: Lipid bilayer and membrane proteins. Cell junctions. Membrane transport (simple, facilitated active and voltage gated). Signaling molecules and receptors (GPCR, Tyrosine kinase based). Signal transduction, second messengers.

Unit IV: Nucleus Organization and Cell Cycle: Structure and function of nucleus. Nuclear membrane and transport, nuclear pore complex, Chromatin structure and positioning. Cell cycle: Controls and checkpoints. Cell division – Mitosis and Meiosis (stages and the process of crossing over). Apoptosis. Stem Cells – Embryonic, Tissue, and induced pluripotent stem cells. Cloning - reproductive and therapeutic.

Unit V: Medical Genetics: Structure of DNA & RNA, Chromosomes and Karyotyping, Basics of human genome. Mendelian and non-Mendelian patterns of inheritance. Mutations. Genetic disorders (types and examples).

Essential Readings:

1. S. C. Rastogi, (2005), Cell Biology, 3rd ed.
2. Manu L. Kothari, Lopa A. Mehta, Sadhana S. Roychoudhury, Essentials of Human Genetics. (2009), 5th ed.
3. Kapur & Suri's Basic Human Genetics, Dipali S. Trivedi

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Semester-1st						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 105	Fundamentals of Computer & IT	48	4	25	75	100

Objective – To develop a basic understanding of computers and their role in the practice of modern medicine.

Outcome intended – The students will get an idea of the computer hardware, software, programming languages, networking, and applications in a clinical setting.

Unit I: John Von Neumann Architecture, Different Type of Computer, Hardware, CPU, Input Devices, Output Devices, Storage Devices, Communication Devices, Configuration of hardware devices and their applications, convert decimal to binary and vice versa.

Unit II: Networking: Basic idea of Local Area Network (LAN), MAN, Wide Area Network (WAN), E-mail, browsers and servers, Multimedia, Operating System: Software needs, application software, programming language. Windows, print, control panel, Paint, calculator, desktop, find, Run, Snipping tool, Sticky note, Word pad, Notepad, Gadgets, Windows defender, Firewall.

Unit III: Microsoft Office-
Ms Word - basic commands, Formatting-text and documents, sorting and tables, background images, hyperlinks, Mail merge, Graphics, columns, Smart Art, spelling & grammer, Thesaurus.
Ms Excel - Conditional formatting, Formulas & Functions, Sort & Filter, Wrap text, Merge & Centre. Insert- Tables, illustrations, charts, Background, Remove duplicates.
Ms PowerPoint – Designs, slide transition, Smart Art, animation, hyperlinks, automatic slide advance, background images

Unit IV: Biological data and Internet- Introduction to Bioinformatics, Scope of Bioinformatics, Growth of databases, basics of internet, www, IP address, domain, Network-based services (Cloud & Grid Computing).

Unit V: **AI, Machine Learning, and NGS:** An introduction to Artificial Intelligence (AI) and Machine Learning (ML), Overview of ML (supervised, unsupervised), AI application in data analysis and healthcare solutions, the basics of Next-Generation Sequencing (NGS) and its significance.

List of Practical:
1. Microsoft Word
2. Microsoft PowerPoint
3. Microsoft Excel
4. Microsoft Access

Essential reading:

1. Computers Fundamentals by P. K. Sinha, 6th edition, BPB Publications
2. Fundamentals of Computers by E Balagurusamy

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Semester-1st						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 106	English- I	48	4	25	75	100

Objective — The students will learn to communicate in English, make simple sentences and understand the significance of English comprehension in healthcare industry.

Outcome intended — The students will be able to speak, write and understand simple English and improve their vocabulary required for personal and professional life.

Unit I: Grammar: Articles, Prepositions, Verb, Conjunctions, Tenses, Voices, Direct and Indirect Speech, Subject- Verb Agreement

Unit II: Vocabulary: Common Vocabulary, Words Often Confused, Common Errors, Prefixes, Suffixes

Unit III: Formal Correspondence: Letters and Applications, Letter to the Editor. Professional letter: sales, enquiry, order, complaints and other. Applications for jobs: cover letter/ resume/ CV

Unit IV: Spoken English: Speech/ Extempore/ Group Discussions/ Interview/ Dialogue Session

Unit V: Reading Comprehension and Unseen Passage: Vocabulary- Understanding the meaning of most words in the text. Fluency- Recognizing words quickly, including words that can't be sounded out. Sentence structure and cohesion- Understanding how sentences are built and how ideas connect within and between sentences. Understanding the main idea: Identifying the main thought of a passage. Drawing inferences: Drawing inferences from a passage about its contents. Visualizing: Visualizing the text. Recalling prior knowledge: Recalling prior knowledge connected to the text. Recognizing confusion: Recognizing confusion or attention problems. Recognizing literary devices: Recognizing the literary devices or propositional structures used in a passage. Determining tone: Determining the tone of a passage

Essential reading:

1. High School English Grammar & Composition by Wren & Martin, Blackie ELT Books
2. Business English. Department of English, University of Delhi, Pearson

Suggested reading:

1. English Grammar Composition & Usage by J.C. Nesfield, Macmillan Publishers

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Semester-1st						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 107 P	Practical I (MLS 101, MLS 102)	84	6	25	75	100

List of Practical:

Fundamentals of Human Anatomy:

1. Demonstration of Major organs through models and permanent slides.
2. Demonstration of parts of circulatory system from models.
3. Demonstration of parts of respiratory system from models.
4. Demonstration of structural differences between skeletal, smooth, and cardiac muscles.
5. Demonstration of various bones
6. Demonstration of various joints

Fundamentals of Human Physiology:

1. Study the Basic structure of microscope and its use
2. Estimation of Hemoglobin
3. RBC count
4. WBCs Count
5. Bleeding Time, Clotting Time
6. Blood Group
7. Arterial Blood pressure

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Semester-1st						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 108 P	Practical II (MLS 103, MLS 104)	84	6	25	75	100

List of Practical:

Basic Biochemistry

1. Identification of carbohydrates by Molisch's test.
2. Identification of reducing sugar by Benedict's test.
3. Identification of ketose sugars by Seliwanoff's test.
4. Identification of reducing sugar by Osazone test.
5. Identification of cholesterol by Salkowski's test.
6. Identification of protein by Biuret's test.
7. Identification of protein by Ninhydrin test.

Cell biology& Medical Genetics:

1. Parts of a microscope, usage & caring for the microscope
2. Buccal smear - characteristic features of human cheek cells
3. Demonstration of transport across cell membrane
4. Phases of mitosis – demonstration by teaching slides
5. Mitosis in onion root tip – preparation and observation of a crush smear
6. Demonstration of phases of meiosis in grasshopper testes.
7. Introduction of isolation of genetic material from different clinical samples and their detection by conventional and Real time PCR.

Semester – 2nd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 201	General, Clinical & Systemic Pathology	56	4	25	75	100

Objective: To develop the basic understanding of why and how diseases develop and the changes that occur at the macroscopic, tissue and cellular level.

Outcome intended: At the end of the semester, the student will become familiar with the terminology used in pathology, identify changes that occur at the macroscopic and microscopic level, perform various basic clinical pathology tests like routine examination of urine and body fluids.

Unit I: General Pathology: Introduction to pathology, study of pathology, Determinants of health, etiology of disease, multi – factorial causation of disease, natural history of disease, pathogenesis, clinical manifestations- signs and symptoms, morphological changes-macroscopic and microscopic, common terms in pathology. Cell injury, etiology of injury, reversible and irreversible Injury, morphology of reversible injury, hydropic, hyaline, mucoid and fatty change. Intracellular Accumulation, endogenous and exogenous pigments, morphology of irreversible injury, cell death, autolysis, apoptosis, necrosis, coagulative, liquefactive, caseous, fibrinoid. Cellular adaptations, Atrophy, Hypertrophy, Hyperplasia, Metaplasia.

Unit II: **Inflammation and Hemodynamics**: Immune system, normal immune response, hypersensitivity, Types of inflammation, Acute and Chronic, chemical mediators of inflammation, Inflammatory Cells, morphology, and fate of inflammation. Chronic inflammation, chemical mediators, Granulomatous. Healing- regeneration, repair, healing in skin, healing by primary and secondary intention, healing in other tissues. Pathophysiology of hemodynamics, fluid compartments of the body, types of pressure gradients, pathogenesis of oedema –types of edemas, hemorrhage, hyperemia and congestion, Thrombosis, embolism, ischemia, infarction, shock.

Unit III: Neoplasia: Overview, Types- benign and malignant tumors, classification, and nomenclature of neoplastic disease. Chemical, physical, and biological basis of carcinogenesis. Clinical and gross features of neoplasia, dysplasia, invasion and metastasis, cytological features of malignancy.

Unit IV: **Clinical Pathology:** Routine urine examination- indication, specimen collection. Examination of urine- physical, chemical and microscopic. Automation in urine examination. Body fluids- CSF, pleural, peritoneal, synovial, pericardial. Indications for collection of body fluids, normal and abnormal findings in body fluids, processing and examination in a body fluid including physical, chemical, TLC, DLC and microscopic examination.

Unit V: **Systemic Pathology**: An overview of the systems and pathologic conditions
Cardiovascular system-atherosclerosis, ischemic heart disease, respiratory diseases- chronic obstructive lung disease, chronic restrictive lung disease, respiratory infections. Thyroid-Goiter, Hashimoto's thyroiditis. Breast- benign conditions and carcinoma, types of surgeries in breast carcinoma. The nervous system— infective diseases, ischemic brain damage, cerebral infarction, intracerebral hemorrhage, degenerative diseases. Digestive System- Disease of esophagus, stomach, hepatitis, cirrhosis of liver, neoplasm of GIT, excretory System-glomerulonephritis, nephritic & nephrotic Syndrome, pyelonephritis, hydronephrosis, renal neoplasms.

Essential reading:

1. Harsh Mohan (2017), Textbook of Pathology,7th edition, Jaypee Publications
2. Robbins, (2012), Text book of Pathology, 3rd edition, Elsevier Publications

Suggested reading:

1. Boyd's Textbook of Pathology (Systemic Pathology) , 10th ed ,Dr. J.R. Bhardwaj
2. Essentials of Clinical Pathology, Kawthalkar, Shirish M

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Semester-2nd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 202	Clinical Biochemistry I	48	4	25	75	100

Objectives: The students will be able to understand the bimolecular architecture of cells and organelles, the chemical nature and metabolism of macromolecules and the integration of metabolism at various levels.

Intended outcome: At the end of the semester, the student will be able to understand the molecular make up of cells and tissues and clinicopathological consequences of biochemical abnormalities.

Unit I: Integration of Metabolism and Metabolism in Starvation: Definition and Significance of integration of Metabolism, Integration of Metabolism at Cellular and Tissue or Organ Level. Blood glucose regulation. Metabolism in Starvation, Phases of Starvation and Diabetes.

Unit II: Plasma proteins: Definition, major classes, synthesis, functions and separation of plasma proteins, anticoagulants, aseptically separation of serum and plasma.

Unit III: Metabolic intermediates: Introduction to Non-protein nitrogenous compounds, urea/BUN: Synthesis, clinicopathological correlations and estimations, Creatin and creatinine: Synthesis, clinicopathological correlations and estimations, Uric acid: Synthesis, clinic pathological correlations and estimations, Ammonia, Porphyrins.

Unit IV: Mineral & Metabolic Bone Diseases: Classification of minerals, metabolism of calcium, phosphorus, sulfur etc, disease associated with abnormal metabolism of calcium and phosphorus, metabolism of trace elements. bone metabolism, markers of bone metabolism.

Unit V: Water, Electrolyte and Acid-Base Balance: Distribution and balance of water and electrolytes in the body, regulatory mechanism, water and electrolyte metabolism, dehydration, acid base balance, disorders of acid base balance, acidosis and alkalosis.

Essential reading:

1. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics, Carl A. Burtis, David E. Bruns, 7th ed
2. Harper's Illustrated Biochemistry, Robert K. Murray, Darrly K. Granner, Peter A Mayes, Victor W Rodwell, 26th ed.

Suggested reading:

1. Essentials of Biochemistry, Satyanarayan, 3rd ed.

Semester-2nd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 203	Instruments & Reagents	48	4	25	75	100

Objectives: The students will learn about the commonly used instruments, apparatus and equipment, and the properties of reagents and chemicals. They will also learn about laboratory management and the safety norms practiced in a medical laboratory.

Intended outcome: The student will be able to understand the safety measures and methods of prevention of accidents in the laboratory, uses of instruments and the preparation and storage of various chemicals used in the laboratory.

Unit I: Laboratory Safety: Laboratory safety measures, safe use and storage of chemicals and reagents, laboratory hazards and accidents, first aid in accidents, laboratory contamination and laboratory associated infections, preventing laboratory infection, chemical and biological waste disposal, biosafety cabinets –types, biosafety regulations for basic laboratory practices and procedures, who guidelines for clinical lab biosafety.

Unit II: Clinical Laboratory Organization: Laboratory management system, various types of labs, safe laboratory design and organization operational standard and management, the laboratory manual or protocol accommodation, training of staff, quality assurance, research and literature in clinical laboratory: medical dictionaries, Merck index, PubMed database, role of seminar and conference.

Unit III: Basic Laboratory Instruments: Centrifuges- importance, principle, working, care and maintenance, water bath, balances, hot plate, magnetic stirrer, hot air oven, pH meter, incubator, water distillation apparatus, microscope-types, principles, indication.

Unit IV: Solutions and Reagents: Definitions, acids, bases, preparation of reagents, types of solutions, normal, molar & percent solutions, buffers-preparation and types, pH and significance, diagnostic kits, reagent water grade, buffered substrates.

Unit V: Laboratory Techniques: Colorimetry and photometry, spectrophotometry, flame photometry, fluorometry, end point reaction methods-qualitative and quantitative, turbidimetry and nephelometry, densitometry, principle of chromatography, chromatographic performance parameters, types of chromatography, electrophoresis- principle and types, electrophoresis of proteins & nucleic acids, immunochemical techniques, immunoturbidimetry.

Essential reading:

1. Manual of Laboratory Safety, Najat Rashid, Ramnik Sood
2. Textbook of Medical Laboratory Technology, Praful B. Godkar, Darshan P. Godkar.

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Semester-2nd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 204	General Microbiology	48	4	25	75	100

Objectives: The students will develop an understanding of the history of microbiology, microorganisms and basic requirements for their growth, methods of cultivation and staining and biomedical waste management

Intended outcome: The student will be able to understand growth of microorganisms, methods of cultivation and detection by different types of staining, management of biomedical waste

Unit I: Introduction to Microbiology: Introduction of Medical Microbiology, Discovery of microorganism. Contribution of Antony Van Leeuwenhoek, Louis Pasteur and theory of spontaneous generation**,** Robert Koch and his postulates, Metchnikoff, Alexander Fleming.

Unit II: Sterilization and Disinfection: Physical and Chemical Method of Sterilization and Disinfection. Newer methods of Sterilization, Testing of Disinfectants, Central Sterile Services Department (CSSD).

Unit III Staining techniques: Classification of microbiology stains and different types of staining – Simple staining, Negative staining, Impregnation methods, Different staining (Gram staining), Special Staining — Z. N. stain & Albert stain, KOH test.

Unit IV: Morphology and Physiology of Micro-organism: The morphology and fine structure of Bacteria, Fungi, Algae, Protozoa and Viruses. Cultivation of Microorganism. Basic growth requirements, Essential growth factor, and metabolism. Types of media, Preparation of media, storage of media, Quality Control.

Unit V: Hospital Infection Control: Hospital acquired Infections, Biomedical Waste Management, treatment and Disposal methods, Waste segregation in Hospitals, Needle Stick Injuries- Prevention and Management.

Essential reading:

1. Anantha Narayan and Paniker's Textbook of Microbiology, 13th ed.
2. An Introduction to Microbiology, M.G. Sequeira, K.K. Kapoor, K.S. Yadav, P. Tauro, 4th ed

Suggested reading:

1. Textbook of Medical Laboratory Technology, Praful B Godkar, Darshan P. Godkar

Semester-2nd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 205	Hematology & Haemoglobinopathies	56	4	25	75	100

Objective – To familiarize the student with the structure and function of blood and the techniques used to diagnose disease by studying the different components of blood in the laboratory.

Outcome intended– At the end of the semester, the students will be able to perform various basic hematological tests, clinicopathological correlation of abnormal values and be aware of the advantages and disadvantages of each technique.

Unit I: Introduction to Hematology: An overview, general aspects of hematopoiesis, sites of hematopoiesis, regulation of hematopoiesis, hematopoietic stem cell, structure of bone marrow, examination of bone marrow, sites of bone marrow aspiration and biopsy, development of blood cells, erythropoiesis, granulopoiesis, lymphopoiesis, development of monocyte macrophage series, megakaryocyte, development, structure and functions of platelets.

Unit II: Anemia: Definition, classification, clinical presentations of anemia, anemia due to impaired red cell production, iron metabolism, hemolytic anemia- definition and classification, iron deficiency anemia, hemochromatosis, megaloblastic anemia, aplastic anemia, anemias due to enzyme deficiencies – pyruvate kinase deficiency, G6PD deficiency, autoimmune hemolytic anemia, laboratory evaluation in anemia.

Unit III: Hemoglobinopathies and Blood parasites: Hemoglobinopathies- definition, classification, hemoglobin variants, sickle cell anemia, thalassemia, classification of thalassemia- alpha and beta thalassemia. Methods of analysis-electrophoresis, HPLC. Blood parasites- types, malaria, filaria.

Unit IV: Disorders of WBC: Etiology, pathogenesis & laboratory diagnosis of disorders of granulocytes, causes of neutrophilia, lymphocytosis, eosinophilia, neutropenia, lymphopenia, eosinopenia, monocyte macrophage system, monocytosis, leukemoid reaction, leukemias- definition and classification (Acute leukemia, CML, CLL), lymphomas.

Unit V: Disorders of hemostasis-
Definition, classification, thrombocytopenia, thrombocytosis, mechanism of coagulation, tests for coagulation, disorders of coagulation, fibrinolysis, bleeding disorders caused by abnormalities of the blood vessels, vascular purpuras, anticoagulant therapy, heparin therapy, oral anticoagulants and monitoring, clinical features of hemostasis disorder, laboratory evaluation and work up in hemostasis.

Essential reading:

1. Shirish M Kauthalkar, Essentials of hematology, 2nd ed.
2. Dacie & Lewis, Practical Hematology (2016), 12th ed.
3. Atlas of Hematology by Renu Saxena (2011).

Suggested reading:

1. Godkar.B. Praful, (2016) Textbook of MLT,3rd edition, Bhalani Publications
2. Sood Ramnik, (2015), Text book of Medical Laboratory Technology,2nd edition, Jaypee Publications

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Semester-2nd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 206	English - II	48	4	25	75	100

Objective: The students will learn to communicate in English, make simple sentences and understand the significance of English comprehension in healthcare industry.

Outcome intended — The students will be able to speak, write and understand simple English and improve their vocabulary required for personal and professional life.

Unit I: Medical Vocabulary and Terminology: terms associated with medical professions, correct usage of the medical terminology, essential concepts of punctuations in medical field, an understanding of principles of medical word formation, familiarity with many prefixes, roots and suffixes that commonly appear in medical terminology, knowledge of basic(and some not so basic) medical term, an understanding of other aspects of medical terminology such as abbreviations and nomenclature, knowledge of strategies and resources for further terminology

Unit II: Effective Medical Communication: communication- meaning, types, level, understanding 7c's of professional communication and 5c's of communication in medical fields, formal and informal communication, barriers/challenges to communication and the strategies to overcome them, communication process

Unit III: Writing Skills: Paragraph writing, Description and Report Writing, Note-taking/ Summary/ Paraphrasing/ Briefs of Medical Passages

Unit IV: Understanding Research and its process in Medical Field: Research Papers for Journals and papers to be published and presented in Seminars/ Conferences/ Workshops, Process and method of writing abstract, articles and research paper, Understanding Chicago style (CSE), Understanding American Medical Association (AMA), Understanding American Psychological Association (APA), Understanding Vancouver style

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Semester-2nd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 207 P	Practical III (MLS 201, MLS 205)	98	8	50	150	200

List of practical:

Pathology practical:

1. To study microscopic features of coagulative necrosis and fatty change.
2. To study microscopic features of acute inflammation.
3. To study microscopic features of chronic inflammation and granulomas.
4. To study microscopic features of metaplasia
5. To study microscopic feature of neoplasia.
6. Procedure of routine urine examination including sample collection, physical and chemical examination (dipstick method).
7. Procedure of manual chemical examination of urine.
8. Procedure of microscopic examination of urine.

Hematology practical:

1. Demonstration of different anticoagulant used in hematology, laboratory, vials, vacutainers, color codes, order of draw and procedure of venipuncture.
2. Preparation and staining of a blood smear.
3. Examination of peripheral blood smear
4. Determination of Erythrocyte sedimentation rate – Westergren and Wintrobe methods.
5. Procedure for preparation and determination of reticulocyte count.
6. Detection of abnormal hemoglobin
7. Automation in Hematology: Basic components in a hematology analyzer and principles.

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Semester-2nd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 208 P	Practical IV (MLS202, MLS 203)	98	8	50	150	200

List of Practical:

Clinical Biochemistry 1

1. Blood collection.
2. Separation of serum and plasma.
3. Estimation of glucose by GOD POD method.
4. Estimation of protein by Bradford method.
5. Estimation of urea by Urease (Berthelot) test.
6. Estimation of uric acid by Uricase/PAP method.

Instrumentation and Reagents

1. Preparation of percent solution, Molar solution and Normal solution.
2. Preparation of buffers and adjusting their pH by using pH meter.
3. Quantitative estimation of protein by using spectrophotometry.
4. Performing thin layer chromatography.
5. Preparation of agarose gel and SDS-polyacrylamide gel and performing electrophoresis.

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Semester-2nd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 209 P	Practical V (MLS 204)	48	4	10	40	50

List of Practical:

General microbiology:

1. Laboratory acquired infections.
2. Understanding the autoclave and sterilization procedures.
3. Understanding the laminar flow equipment and its function.
4. Preparation of liquid media
5. Preparation of solid media
6. Inoculation of cultures through loops.
7. Isolation of microbial agents from clinical samples and their detection through real time PCR.

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Semester – 3rd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 301	Clinical Biochemistry II	56	4	25	75	100

Objectives: The students will learn about the secretory, absorptive and excretory mechanism taking place in the digestive and excretory system. They will also learn about acid base balance and the role of enzymes.

Intended outcome: At the end of the semester the student will be able to understand the mechanism of development of disease in different organ systems and the role of metabolites, excretory products and enzymes as biomarkers.

Unit I: Clinical enzymology: Clinical enzymology-overview and clinical importance, catalysis, isoenzymes, cofactors, plasma lipid profile, hypolipoproteinemia, hyperlipidemias. miscellaneous enzymes-glucose-6-phosphate dehydrogenase, urease, glucose oxidase & peroxidase.

Unit II: Biomarkers and tumor markers: Definition and importance of biomarkers, cardiac markers- creatine kinase, CK-MB, cardiac troponins, TnT, AST, myoglobulins, LDH. Muscle disease biomarkers- CK-MM, aldolase, myoglobulin, IGF, lactate, IL-6. Markers of bone disease-BAP, osteocalcin, type I collagen, TRAP, other ALP isoenzymes. Tumor markers- Alpha feto protein (AFP for liver cancer), CA 19.9 (Pancreatic cancer), CA 15.3 (Breast cancer), CA 125 (ovarian cancer), PSA (Prostrate cancer), CEA (GIT caner).

Unit III: Evaluation of liver & gastric function: Test based on excretory function- serum bilirubin, bile acids and bile salts. Test based on synthetic function-serum albumin, coagulation factors, test based on serum enzymes (AST, ALT, LDH)-serum enzymes as markers of hepatobiliary disease, markers of obstructive liver disease. Assessment of gastric & pancreatic function, malabsorption studies.

Unit IV: Kidney function test: Test to screen for kidney disease-complete urine analysis, plasma urea and creatinine. Test to assess renal function-glomerular filtration rate, clearance tests, glomerular permeability, proteinuria, assessment of tubular function- reabsorption studies, secretion test, concentration and dilution test, renal acidification. Uric acid excretion.

Unit V: Acid-Base balance & pH: Buffers of body fluids, respiratory regulation of pH, renal regulation of pH, disturbances in acid-base balance- metabolic acidosis, metabolic alkalosis. Respiratory acidosis & alkalosis, anion gap, determination of blood pH & gases.

Essential reading:

1. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics, Carl A. Burtis, David E. Bruns, 7th ed
2. Harper's Illustrated Biochemistry, Robert K. Murray, Darrly K. Granner, Peter A Mayes, Victor W Rodwell, 26th ed.
3. Biochemistry for medical students, 10th ed. DM Vasudevan.

Suggested reading:

1. Essentials of Biochemistry, U. Satyanarayan, 3rd ed.

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Semester-3rd						
Paper Code	**Paper Name**	**Total Hrs**	**Credit**	**IA**	**SE**	**Total**
MLS 302	Systemic bacteriology	56	4	25	75	100

Objectives: The students will learn the techniques of sample collection, culture, identification and study of different types of bacteria.

Intended outcome: At the end of the semester the student will be able to collect samples from various sites, set up culture, identify the causative organisms using various culture methods and put antimicrobial susceptibility testing.

Unit I: Collection, Transport and Examination of specimens: Specimen collection, Storage, transport, and examination of specimens- urine, urogenital, throat and mouth, feces, blood and bone marrow, CSF, eye specimens, ear discharge, pus from wounds, abscesses, burns & sinuses.

Unit II: Identification of Bacteria: Culture media, Culture Methods-Aerobic & Anaerobic, Identification Methods-Morphology & Culture characteristics, Direct Microscopy – Gram staining, Albert staining and ZN Staining, Biochemical properties- IMViC Tests, Urea Hydrolysis test, TSI test, Oxidase test, Catalase Test, Coagulase test (Tube and Slide), Antimicrobial agents and, antimicrobial susceptibility testing. Resistance mechanism.

Unit III: Gram positive bacteria: Gram positive cocci – Staphylococcus aureus, CONS, Streptococci, Enterococci. Gram positive bacilli – Corynebacterium, Mycobacterium, Listeria, Lactobacillus, Anaerobic bacteria -Clostridia.

Unit IV: Gram negative bacteria: Gram negative cocci – Neisseria gonorrhoeae, Neisseria meningitidis, Moraxella, Gram negative bacilli – Enterobacteriaceae, Pseudomonas species, Acinetobacter species, Vibrio, Aeromonas, Plesiomonas, Campylobacter, Bacteroides, Bordetella, Brucella, Hemophilus, Pasteurella, Francisella, Spirochaetes, Rickettsia, Chlamydia, Mycoplasma.

Unit V: Automation in Bacteriology and Molecular Methods: Introduction, BACTEK s ystem, The ATB system, The VITEK 2 system, The API systems, Bac T/ALERT 3D automated microbial detection system, MALDI-TOF, Molecular methods in diagnostic Microbiology.

Essential reading:

1. Clinical Microbiology & and Parasitology, Nanda Maheshwari
2. Diagnostic Microbiology, Ranjan Kumar De
3. Ananthanarayan and Paniker's Textbook of Microbiology, 13th ed.

Suggested reading:

1. Godkar.B. Praful, (2016) Textbook of MLT,3rd edition, Bhalani Publications

Semester-3rd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 303	Blood Banking & Transfusion Medicine	56	4	25	75	100

Objective — To understand the basics of immunohematology, blood grouping, compatibility testing, blood donation, component preparation and problem solving in transfusion practice.

Outcome intended: At the end of the session, the student will be able to perform the basic techniques in blood donation, component preparation, blood banking, pre transfusion testing and resolution of post transfusion problems.

Unit I: Introduction to blood banking: Basic immunohematology concepts, immunity-definition, types, antigens, antibodies, antigen-antibody reactions, red cell antigens, immunogenicity, blood group antibodies, natural and immune antibodies, autoantibodies and alloantibodies, complement system and role of complement in erythrocyte destruction, human blood group systems-ABO and Rh blood group systems, genetic and biochemistry of blood group antigen, subgroups and variants of blood groups, ABO and Rh antibodies, Bombay blood group, other blood groups system.

Unit II: Pretransfusion testing: Blood grouping & Rh typing-reagents and different methods, hemagglutination, factors affecting hemagglutination, grading of hemagglutination reactions, ABO blood grouping discrepancies, antihuman globulin test-definition and clinical indication,types- Direct Coomb's test (DCT), Indirect Coomb's test (ICT), antibody screening. Compatibility testing, cross matching, types of cross matching.

Unit III: Blood collection and Apheresis: Importance of blood donation, types of donors, donor selection criteria, venipuncture/phlebotomy, donor adverse reactions, anticoagulants and preservatives of blood bag. Apheresis- definition, types of apheresis, indications, techniques and advantages. Transfusion transmitted diseases and their screening methods.

Unit IV: Blood component preparation: Basic principle and concept of component preparation, centrifugation-types, types of blood components and their preparation, clinical indication of different blood components, leucodepletion-definition, and types. Fresh frozen plasma, cryoprecipitate- indication, methods of preparation. Irradiated blood components.

Unit V: Transfusion practice in clinical: Presurgical blood donation, autologous transfusion, massive blood transfusion, exchange transfusion, neonatal and pediatric transfusion, transfusion reactions, transfusion reaction investigations, FFP transfusion, platelet transfusion, blood transfusion alternatives. Hemolytic disease of newborn, Rh incompatibility, and ABO incompatibility.

Essential reading:

1. Essentials of blood banking, SR Mehdi, 2nd ed
2. Godkar.B. Praful, (2016) Textbook of MLT,3rd edition, Bhalani Publications
3. Technical Manual - American Association of Blood Banks - AABB- 16th ed
4. Handbook of Blood Banking and Transfusion Medicine, Rao Gundu HR

Suggested reading:

1. Wintrobe's Clinical Hematology (2014),13th edition, Lippincott Williams & Wilkins
2. Handbook of Blood banking and Transfusion medicine, H.R. Gundurao

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Semester-3rd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 304 P	Practical VI (MLS 301)	56	4	50	50	100

List of Practical:

Clinical Biochemistry II:

1. Estimation of total cholesterol in a sample of blood
2. Estimation of HDL cholesterol in a sample of blood
3. Estimation of albumin in a sample of blood
4. Estimation of calcium in a sample of blood
5. Estimation of serum enzymes ALT in a given sample of blood
6. Estimation of serum enzymes AST in a given sample of blood

Semester-3rd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 305 P	Practical VII (MLS 302)	56	4	50	50	100

List of practical:

Systemic Bacteriology

1. Preparation of solid and liquid media.
2. Procedure of growth of microorganisms in solid media by streaking and spreading method.
3. Gram Staining.
4. Identification of GPC by Catalase, and Coagulase test.
5. Identification of GNR by IMViC test.
6. Antibiotic Sensitivity Test.

Semester-3rd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 306 P	Practical VIII (MLS 303)	56	4	50	50	100

List of practical:

Blood Banking & Transfusion medicine:

1. To understand the application of antisera used in Blood bank and demonstrate ABO, Rh grouping by slide method.
2. To demonstrate the preparation of red cell suspension and washing of red cells.
3. To determine ABO group of a sample by testing red cells and serum (forward and reverse) by tube test method.
4. To demonstrate the presence of H antigen on red cells
5. To determine subgroups of blood group A by the use of anti-A1 antiserum
6. To determine the presence of incomplete antibody on the surface of red cells by Direct Coomb's Test (DCT).
7. To determine the presence of incomplete antibody in a blood serum by Indirect Coomb's test (ICT).
8. To perform Cross match between donor and recipient blood to check compatibility (or incompatibility) between them before blood transfusion.

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Semester-3rd						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 307 P	Evaluative Clinical Training I	126	6	---	100	100

The ECT I is a clinical training of 45 days duration to be done in a Laboratory /Hospital /Medical College approved by the University. MLS trainee students have to go for observational cum hands on clinical postings during which they will observe and assist in the techniques and procedures under supervision of an experienced staff in the following areas:

- Blood and sample collection
- Clinical pathology
- Hematology
- Basic microbiology
- Basic biochemistry

The students will be provided a Posting Manual in which they will record their daily technical activities and get them verified by the supervisor / in charge under whom they work. It is compulsory to submit duly signed and stamped Posting Manual to the DDUKK before ECT I examination.

The supervisor / in charge will issue a duly signed and stamped certificate after satisfactory completion of the training.

The ECT I examination will include assessment of record of work in the Posting Manual and evaluation of knowledge and skill by viva voce.

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Semester – 4th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 401	Diagnostic Endocrinology	56	4	25	75	100

Objective: To understand the biochemical features, functions and abnormalities associated with hormones along with different laboratory methodologies to diagnose endocrine related disorders.

Outcome intended: At the end of the session, the students will be able to perform immune-assays for detection of various hormones and interpret the clinical diagnosis associated with abnormal serum hormone levels.

Unit I: General Introduction: Classification of hormones, biosynthesis and transport, regulation and general mechanism of action of hormones, hormone receptors

Unit II: Pituitary gland & hypothalamus: Releasing hormones, Neurohypophysis hormones - Oxytocin, Antidiuretic hormone (ADH). Hormones of the Anterior Pituitary - Growth hormone (GH), Prolactin, Gonadotropin, Follicle Stimulating hormone (FSH), Luteinizing Hormone (LH), Thyroid stimulating hormone (TSH), Adrenocorticotropic hormone (ACTH). Related clinical disorders and diagnostic tests**.**

Unit III: Thyroid and Parathyroid hormones: T3 and T4 (regulation of synthesis), PTH, Calcitonin. Adrenal gland hormones- Hormones of adrenal cortex: Aldosterone, Glucocorticoids, Mineralocorticoids, Cortisol. Hormones of adrenal medulla: Catecholamines (epinephrine, norepinephrine). Related clinical disorders and diagnostic tests.

Unit IV: Reproductive Hormones: Testosterone, Estrogens, Progesterone, Human Chorionic Gonadotropin (HCG). Kidney hormone – Renin. Pancreatic hormones – Insulin, glucagon, somatostatin. Related clinical disorders and diagnostic tests.

Unit V: Diagnostic endocrinology techniques: (Types, Principle and Applications.) ELISA, RIA, Chemiluminescence Assay.

Essential reading:

1. Introduction to Endocrinology, Negi & Chandra S
2. Godkar. B. Praful, (2016) Textbook of MLT, 3rd edition, Bhalani Publications

Suggested reading:

1. Endocrinology, Mac Hadley, 6th ed

Semester-4th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 402	Immunology & Serology	70	5	25	75	100

Objective — The student will learn the basics of immunology, the types and outcome of immune response, principles of antigen-antibody reactions, principles of serological procedures and their application in laboratory medicine.

Outcome intended: At the end of the semester the student will be able identify the structure, function, and special features of of immunoglobulin, perform serological tests and correlate their results with disease conditions.

Unit I: Structure and Function of Immune System: Cells and organs of the Immune system, Immunity — innate and acquired immunity, humoral and cell mediated immunity, Primary and secondary immune response, measurement of Immunity- Local and Herd Immunity.

Unit II: Antigen and Antibody: Antigen: Classes, properties. Antibodies, Immunoglobulins: Structure, Properties, Types of Immunoglobulins, Complement.

Unit III: Principles of Immunological Reactions: Immunological principles of various reactions and techniques: Affinity and avidity, cross reactivity, Precipitation, Agglutination, Neutralization, Opsonization, Immunodiffusion, Immunoelectrophoresis, Compliment Fixation Test (CFT), Western blotting, Immunofluorescence, Immunochromatographic test (ICT), Chemiluminescence Immunoassay (CLIA) Flow cytometry and Immunoelectron microscopy.

Unit IV: Diagnostic Immunology & serology: Qualitative & quantitative tests, Widal test, VDRL Test, ASO Titre, Rheumatoid factor, C Reactive protein, Detection of Hepatitis B surface Antigen, Hepatitis C Antibody, Antibody against HIV I &II, Automation in serology

Unit V: Hypersensitivity: Allergy, Hypersensitivity, Classification of hypersensitive reactions -type I, II, III, IV, Major Histocompatibility Complex and Antigen presentation, Tolerance, Autoimmunity-Mechanism, Immunology of Transplantation and Malignancy.

Essential Readings:

1. Essentials of Immunology and Serology, Jaqueline Stanley
2. Kuby's Immunology, Owen, Judith A

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Semester-4th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 403	Parasitology, Mycology & Virology	70	5	25	75	100

Objective — The students will be introduced to the characteristic features of parasites and hosts, life cycles, diseases, and laboratory methods of detection of various medically important parasites, fungi, and viruses.

Outcome intended: At the end of the semester the student will be able to perform the basic techniques in detection and identification of various parasite, fungi, and viruses of medical significance.

Unit I: General Parasitology: Basic concepts in Medical Parasitology, Association between parasite and host, Surface, Intestinal, Blood and Tissue parasites, Effect of parasites on the host, Mechanism of disease production by parasites, Classification of medical parasitology, General characteristics of medically important parasites -Protozoa, Helminths, and Arthropods. Medical Entomology.

Unit II: Protozoa: Life cycle, Pathogenesis, Clinical Presentation and Laboratory Diagnosis of diseases caused by *Entameba histolylica, Giardia lambia, Trichomonas vaginalis, Plasmodium spp., Leishmania.*

Unit III: Helminths: Life cycle, Pathogenesis, Clinical Presentation and Laboratory Diagnosis of diseases caused by *Ascaris lumbricoides, Wuchereria bancrofti, Taenia solium.*

Unit IV: Mycology: Structure, general properties and characteristic features of clinically important fungi. Classification of pathogenic Fungi, Brief idea of Dermatophytes, Tinea species, Cutaneous mycoses, Systemic mycoses, Opportunistic mycoses, Laboratory Diagnosis of Fungi- Sample collection, Microscopy (KOH preparation, LCB mount –India Ink preparation), Culture and Serology, Antifungal Susceptibility testing (AFST), Mycotoxins.

Unit V: Virology: Discovery of viruses, and General properties of viruses- structure, replication, growth, classification and nomenclature of medically important viruses, Common viral diseases- mode of transmission of infection, Laboratory Diagnosis of Viral Infections. Brief discussion on Arboviruses, Influenza virus, Parainfluenza virus, Measles, Mumps, Rubella, Rabies, HIV, Hepatitis virus and Oncogenic virus. Prevention and control of viral diseases, Interferons, Immuno-prophylaxis for Viral Diseases. Bacteriophage- Lytic and Lysogenic life cycles, Phage typing, PCR- different types (qPCR, RT-PCR, multiplex PCR, nested PCR) and their clinical significance.

Essential Readings:

1. Paniker's Textbook of Medical Parasitology by C. K. Jayaram Paniker
2. Chatterjee, K. D., Parasitology: Protozoology and Helminthology
3. Ananthanarayan R. and Paniker C.K.J. (2024) Textbook of Microbiology. 13th edition

Suggested reading:

1. Clinical Microbiology and Parasitology, Nanda Maheshwari
2. The Short book of Medical Microbiology (including Parasitology), Gupte Satish

Semester-4th						
Paper Code	**Paper Name**	**Total Hrs**	**Credit**	**IA**	**SE**	**Total**
MLS 404 P	Practical IX (MLS 401, MLS 402)	98	8	100	100	200

List of Practical:

Diagnostic Endocrinology:

1. Estimation of the concentration of TSH in a blood sample by ELISA method
2. Estimation of the concentration of T3 in a blood sample by ELISA method
3. Estimation of the concentration of T4 in a blood sample by ELISA method
4. Estimation of the concentration of Prolactin in a blood sample by ELISA method
5. Estimation of the concentration of Estradiol in a blood sample by ELISA method

Immunology & Serology:

1. Principle and procedure of Widal test
2. Slide test for Rheumatoid factor
3. Test for syphilis using RPR test kit
4. Estimation of antibody titres using Ouchterlony's double diffusion method
5. Antibody capture by ELISA

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Semester-4th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 405 P	Practical X (MLS 403)	98	8	100	100	200

List of Practical:

Parasitology, Mycology & Virology:

1. Preparation, staining and examination of a blood smear and performing DLC.
2. To determine the number of eosinophils in a sample of blood by performing absolute eosinophil count (AEC)
3. Preparation of thin & thick blood films for demonstration of blood parasites
4. Rapid diagnosis of malaria infection by detection of malaria antigen in a blood sample.
5. To perform routine and microscopic examination of stool sample and Stool Concentration techniques.
6. Determination of reducing substance in stool — measurement of unabsorbed sugars in stool.
7. Determination of Occult blood in stool – testing presence of blood in stool
8. Demonstration of fungi in a clinical sample by treatment with 10 % KOH solution.
9. Qualitative detection of Hepatitis B Surface Antigen (HBsAg), Hepatitis C antibody and antibody against HIV I & II in serum or plasma.

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Semester -5th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 501	Histopathology & Cytology	70	5	25	75	100

Objective — The students will learn about the techniques to process tissues obtained by aspiration, biopsy or autopsy for interpretation of pathological changes and diagnosis.

Outcome intended: At the end of the semester the student will be able to perform sample handling, preservation, tissue processing, routine and special staining procedures.

Unit I: Introduction to Histotechnology and Fixation: Human organs and their gross features. Basic histology- cells, tissue, organs. Collection of specimens- tissue biopsies, grossing techniques, autopsy. Fixation- definition and classification of fixatives, properties of fixatives, processing of bone tissue –decalcification, procedure and chemicals used.

Unit II: Tissue processing: Principle, types of tissue processing methods, factors affecting processing, manual & automated tissue processing, fixation, dehydration, clearing, impregnation, embedding, paraffin block making, section cutting, microtomes and microtome knives- types, use and care, sharpening of knife, honing, stropping, technique of section cutting. Frozen section- Indications, principle, sectioning, staining.

Unit III: Staining in Histopathology: Staining dye, principles of staining, physical and chemical properties, types of dyes, factors affecting staining, metachromasia, mordants, accentuators. Hematoxylin and Eosin- components, extraction, types, principle of H/E staining. Special stains: Congo red, methyl violet, PAS, Masson's trichrome, Gomori's trichrome, Perl' Prussian blue, Alcian blue, Reticulin stain, mucicarmine, Sudan Black.

Unit IV: Cytopathology: Definition and types: Fine needle aspiration cytology (FNAC)- techniques and indication, exfoliative cytology, sample collection, sputum, CSF, pleural, peritoneal and pericardial fluid, gynecologic samples, preservation and fixation of samples, fixatives in cytology, processing of cytology samples, liquid based cytology (LBC), staining methods- Papanicolaou's staining technique, MGG staining, cytospin technique, cell block preparation.

Unit V: Immunohistochemistry and Immunocytochemistry: Basic principle of IHC, different methods, antigen retrieval, immunocytochemistry, chromogen, indications.

Essential reading:

1. Dr. D.R. Singh (2003) Principles & Techniques in Histology, Microcopy and Photomicrography.
2. Godkar.B. Praful (2016) Textbook of MLT,3rd edition, Bhalani Publications

Suggested Reading:

1. Techniques Histopathology & Cytopathology. A guide for medical laboratory students, Sadhana Vishwakarma, Jun 2017

Semester-5th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 502	Molecular Diagnostics	70	5	25	75	100

Objective: The student will learn about the genomic organization, variation and the techniques used in detection of these variations.

Outcome intended: At the end of the semester the student will develop an insight into the molecular diagnostic techniques used in the detection of infectious disease, cancers, genetic disorders, and forensic testing.

UNIT I: Organization of the Genome: Molecular composition and structure, Pathway for the transfer of genetic information, Structure of DNA and RNA, Chromosome structure, Structure of gene.

UNIT II: Transcription and Translation: Central Dogma of Molecular biology, Replication of DNA, Transcription of DNA to RNA, Translation, Transcriptional control, The operon concept, DNA repair, DNA mutations.

UNIT III: Molecular Biology Techniques: Nucleic acid extraction, Hybridization assays, DNA amplification techniques — Fundamentals of polymerase chain reaction, Restriction Fragment Length Polymorphism (RFLP), Real time PCR, Restriction Digestion, Southern blot, Northern blot, Western blot, NGS.

UNIT IV: Applications of Molecular diagnostics: Diagnosis of cancer by using molecular techniques, Molecular diagnosis of genetic diseases, Forensic identity testing (Parentage testing, DNA finger printing), Diagnosis of Infectious Diseases.

UNIT V: Cytogenetics: Use of cell culture for cytogenetic studies, General method of Preparation of cell culture, Types of cell culture, Study of constitutional chromosome patterns.

Essential reading:

1. Tietz Textbook of clinical Chemistry and Molecular Diagnostics, 5th ed
2. Laboratory Manual for Molecular Genetic Tests, Madhumita Roy Chaudhary
3. Molecular Biology- Fundamental process- Dr. Kailash Chaudhary

Suggested reading:

1. Godkar. B. Praful, (2016) Textbook of MLT,3rd edition, Bhalani Publications.
2. Principles of Molecular Biology- Veer Bala Rastogi.

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Semester-5th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 503	Public Health	56	4	25	75	100

Objective – The students will learn about the prevalence of disease in the community , accessibility of the public to healthcare facilities and programmes running by the State Government to promote health and to prevent, control and treat diseases.

Outcome intended– At the end of the semester, the students will become familiar with the magnitude of disease in the community, health indicators and their significance, health care facilities being provided by the government at the primary, secondary and tertiary levels. They will also become aware of the various national disease prevention & control and health promotion programmes and the national and international agencies like WHO, UNICEF, Red Cross involved in healthcare delivery

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Unit I: Concept of Health and Disease-

Natural History of Disease, Determinants of health- multifactorial causation of disease –host, agent, environment relationship, Primary, Secondary and Tertiary levels of prevention with examples related to few diseases of national importance, Mode of transmission of disease- Air borne, vector and vehicle transmission, Methods of control, Mode of Interventions, Biomedical Waste Management at the health care facility.

Unit II: National and International Healthcare System-

Description of organization of health services at the centre and state levels primary, secondary and tertiary health care delivery, International health, WHO, UNICEF. Primary Health Care - Definition, components, and principles of primary health care- sub centre, Aanganwadi, PHC, CHC, district hospitals, Apex hospitals, Health for all indicators. Immunization and universal immunization programme.

Unit III: Health Program & Organization-

National Programmes of Health and disease eradication, Health Programmes, Family Welfare Programme, Disease Eradication programme- Leprosy, Disease control programmes- Goitre, Kala azar, Japanese Encephalitis, National Vector Born Disease Control Programme (NVBDCP), National AIDS Control Programme (NACO), National Tuberculosis Elimination Programme (NTEP), Revised National Tuberculosis Control Programme (RNTCP).

Unit IV: Basic Medical Statistics-

Presentation of data, general tabulations, Simple Tables, Frequency Distribution Tables, diagrams, Bar Diagrams, Histogram, Line Diagram, Pie Diagram, Statistical averages- calculation of Mean, Median, Mode. Measures of dispersion, Normal Curve, Range, Standard Deviation, and their significance.

Unit IV: Nutrition and Health-

Environmental sanitation--- Methods of water purification and disinfection, collection of water samples, their transport and bacteriological analysis, Food and Nutrition-Food-borne diseases of Public Health importance, Assessment of Nutritional status. Nutrition programmes- Management of Sanitation in Public Health- Health education — definition, principles, objectives, purpose.

Essential Readings:

1. K. Parks & Sunder Lal, (2015), Textbook of Preventive Social Medicine ,3rd edition, Bhanot Publications

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Semester-5th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 504 P	Practical XI (MLS 501)	84	6	50	50	100

List of Practical:

Histopathology & Cytology:

1. Demonstration of various cells and tissues in the human body.
2. Preparation of 10% buffered formalin for fixation of surgical specimens
3. To study the properties of various fixatives used in histopathology
4. Decalcification of bone specimens for subsequent tissue processing
5. Gross examination of surgical samples
6. Tissue processing and block preparation by manual method
7. Tissue processing and block preparation – Automatic tissue processor
8. Section cutting, floatation and slide preparation
9. Staining and mounting of cut sections by H& E stain.
10. Staining and mounting of cytological smears by Papanicolaou method

Semester-5th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 505P	Practical XII (MLS 502)	84	6	50	50	100

List of Practical:

Molecular Diagnostics:

1. Preparation of reagents for DNA isolation
2. Isolation of genomic DNA from clinical samples (blood, nasopharyngeal etc.)
3. Agarose Gel electrophoresis
4. Polymerase chain reaction
5. Detection of viral markers by PCR Technique.
6. Detection of genetic material by Real time PCR.

Semester-5th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 506 P	Evaluative Clinical Training II	252	8	---	100	100

The ECT II is a clinical training of 45 days duration to be done in a **blood bank** approved by the University. MLS trainee students will go for hands on clinical postings during which they will observe and assist in the techniques and procedures under supervision of an experienced staff in the blood bank

The students will be provided a **Blood bank Posting Manual** in which they will record their daily technical activities and get them verified by the supervisor / in charge under whom they work. It is compulsory to submit completed, duly signed, and stamped Blood bank Posting Manual to the DDUKK before the ECT II examination.

The supervisor / in charge of the blood bank will issue a duly signed and stamped certificate after satisfactory completion of the training.

The ECT II examination will include assessment of record of work in the blood bank Posting Manual, written examination of blood bank techniques and evaluation of knowledge and skill by viva voce.

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Semester – 6th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 601	Quality Assurance & Medical ethics	56	4	25	75	100

Objective: The students will be made familiar with good laboratory practices to ensure and improve quality in the laboratory and basic ethics to be followed in a laboratory/ health care setting.

Outcome intended: At the end of the semester, the student will be able to implement the quality assurance program in the laboratory and practice ethical principles in the healthcare setting.

Unit I: Good Laboratory Practice (GLP): Introduction to laboratory quality management, Essential elements of Quality Assurance Programme, Good Laboratory practices (GLP), Quality assurance (QAS), Quality assessment (QA), Indicators of laboratory quality, Turnaround time (TAT), sample rejection, patient feedback, Internal Quality control, external quality control- External Quality Assurance Schemes (EQAS).

Unit II: Basic Concept of Ethics: Medical Ethics Definition and code of conduct**,** Principle of Ethics-Autonomy, Beneficence, Non-Maleficence, Justice, Accountability, Confidentiality, Ethical Guidelines, Good Clinical practices (GCP), Protocol, Standard operating procedure (SOP), Inclusion Exclusion criteria, Informed consent form, Ascent form, Case record form, Ethics committee, reporting of Adverse event and serious adverse events.

Unit III: Medical Records: Introduction to Medicolegal Aspects, Structure and Maintenance of Medical Records, Confidentiality of Medical Records, Privileged Communication, Release of Medical Information, Retention and Disposal of Medical Records, Medicolegal Cases Involving Medical Records, Digital Health Records and Legal Considerations, Medical Records in Public Health, Regulatory and Accreditation Standards.

Unit IV: Basic format of a test report: Reference ranges, abnormal results, critical values, critical value reporting protocol, release of test results, urgent, emergency and routine reporting of results, alteration in reports protocols, Quality Control of chemicals, reagent, calibration of equipment, laboratory precision, accuracy & sensitivity, sources of error, verification and validation of new reagents, methods, reference materials.

Unit V: Documentation and Laboratory Information System (LIS): Definition and importance, difference between report, record and document, list of documents in a lab, QMS, quality manual, Introduction to laboratory accreditation, advantages of accreditation, brief knowledge about National and International agencies for clinical laboratory accreditation – ISO, NABL, CAP etc.

Essential reading:

1. Henry's Clinical Diagnosis and Management by Laboratory Methods, (2011), 22nd edition.
2. Quality Management in Hospitals by SK Joshi, 2nd ed

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Semester-6th						
Paper Code	**Paper Name**	**Total Hrs.**	**Credit**	**IA**	**SE**	**Total**
MLS 602 P	Evaluative Clinical Training & Internship	588	18	…..	300	300

The ECT & Internship is a clinical training of 5 months duration to be done in a Laboratory /Hospital / Medical College approved by the University. MLS trainee students have to go for hands- on clinical training during which they will observe and assist in the techniques and procedures under supervision of an experienced staff in the different areas of medical laboratories like blood and sample collection, pathology, Haematology, Microbiology, Biochemistry, Molecular diagnostics, Histopathology & cytopathology, quality assurance & improvement etc.

The students will be required to prepare at least one case study in every section, in all not less than 5 case studies. The case studies will be verified by the supervisor / in charge under whom they work. It is compulsory to submit duly signed case studies to the clinical posting incharge before ECT & Internship examination.

The supervisor / in charge will issue a duly signed and stamped certificate after satisfactory completion of the training.

The ECT & Internship examination will include presentation of the case studies, written examination of the techniques and viva voce for evaluation of knowledge and skill.

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Hony. Director
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