DDU KAUSHAL Kendra

Centre for Physiotherapy and Rehabilitation Sciences

Jamia Millia Islamia

New Delhi-110025

(Syllabus)

w. e. f. Academic Session 2019-2020

B. Voc. Medical Laboratory Sciences

(B. Voc. - MLS)

Semester – 1st						
Paper Code	**Paper Name**	**Total Hrs**	**Credit**	**IA**	**SE**	**Total**
MLS 101	**Fundamentals of Human Anatomy**	**42**	**3**	**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 System: Structure of Neuroglia & neurouns Parts, Clsssification 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, Tongue (Auditory and Olfactory apparatus)

Unit IV : Cardiovascular System: Circulatory system – Structure of the Heart, Structure of Blood Vessels – arterial and venous system. Gross and microscopic structure of lymphatic tissue.

Unit V : Respiratory System: Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura.

Unit VI : Digestive System: Parts, Structure of Tongue, Salivary glands, stomach, Intestines, Liver, Pancreas.

Unit VII : Urinary & Reproductive System: Parts, structure of Kidney, Ureters, Urinary Bladder and Urethra. Parts of both male and female reproductive organs. Gross structure of both male and female reproductive organs.

Unit VIII : Endocrine System: Gross structure of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal glands

Essential Reading :

1. Chaurasia B D, (2016), Human Anatomy, 7th edition
2. Ross & Wilson,(2014),Anatomy & Physiology in health & illness,11th edition
3. Gray's anatomy for students
4. Text book of anatomy – VISHRAM SINGH
5. Text book of anatomy – VOL 1,2 – INDERBIR SINGH

Suggested Readings –

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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 102	**Fundamentals of Human Physiology**	**42**	**3**	**25**	**75**	**100**

Objective – This paper provide 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 – The student will be able to identify the structures and describe the functions of the musculoskeletal system, the functions of the nervous system, the endocrine system, functions of the special senses, components and relate the functions associated with blood and lymphatic system, physiology of absorption and Excretion, Identify the structures and describe the functions associated with the respiratory system, Structures and the functions associated with the digestive system and the urinary system.

Unit I: Blood –Plasma & Cellular Components - RBC, WBC & Platelet (Morphological features and functions), Haemopoiesis, Haemoglobin – Structure, Abnormal haemoglobins- Sickle-cell anemia and Thalassemia. Different types of anaemia and their causes. Hemostasis – factors, mechanism, anticoagulants, procoagulants.

Unit II: Muscle Physiology –Microscopic and electron microscopic structure of skeletal, smooth and cardiac muscles, Single-unit and multi-unit smooth muscle. Properties of skeletal muscle: excitability, contractility, all or none law, summation of stimuli. Muscle proteins. Mechanism of skeletal and smooth muscle contraction and relaxation : Excitation- contraction coupling.

Unit III : Nervous system Physiology –Functions of Brain, Spinal Cord, ANS & Cranial Nerves, Structure, classification and functions of neurons and neuroglias, Myelinogenesis, 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.

Unit IV : Cardiovascular System –Physiology of the heart, Properties of cardiac muscle, Origin and propagation of cardiac impulse, Conduction System of Heart, Cardiac Cycle- Pressure and Volume changes, Heart sounds, Cardiac output.

Unit V : Respiratory System **–** Principles of respiration, respiratory muscles, Transport of oxygen and carbon dioxide, Brief account of respiratory regulation, Definition of hypoxia, Cyanosis, asphyxia. Dead space and uneven ventilation, Oxygen dissociation curve of hemoglobin and myoglobin – factors affecting. Carbon dioxide dissociation curve

Unit VI : Gastro Intestinal Tract - Functions of alimentary canal, Digestive glands – Salivary glands, Pancreas, Liver, 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 VII : **Urogenital & Endocrine System –** Structure of Nephron, measurement and regulation of GFR, mechanism of urine formation, Clearance tests & values of inulin, PAH and urea clearance, functions of ovaries , sex hormones, menstrual cycle, pregnancy, parturition, lactation, Male sex hormones and spermatogenesis, Endocrine glands & their secretions, functions of various hormones.

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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 103	**Basic Biochemistry**	**42**	**3**	**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, function and classification of carbohydrate. Monosaccharide, glycoside formation, oligosaccharides and polysaccharides. Glycolysis, catabolic fates of pyruvate, metabolic fate of Acetyal-CoA and Citric acid cycle, gluconeogenesis, glycogen metabolism, pentose phosphate pathway.

Unit II : Biological Oxidation: Enzyme, coenzyme and 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, essential & non essential amino acids. Proteins definition and classification. Primary, secondry, tertiary and quaternary of proteins of proteins

Unit IV : Vitamins: Definition and classification of vitamins, difference between fat soluble and water soluble vitamins. Water soluble vitamins and fat soluble vitamins

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

Unit VI : Enzymes : Introduction, definition, classification, coenzymes, active site of enzyme, cofactors of coenzyme, isoenzymes, properties, mechanism of enzyme action.

Essential readings :

1. Lehninger,(2013),Principles of Biochemistry,6th edition, W H Freeman
2. Satyanarayan,(2008), Essentials of Biochemistry,2nd edition, Standard Publishers
3. Biochemistry for students, V.K. Malhotra

Suggested readings :

1. Pankaja Naik, Biochemistry , 4^{th} ed

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 104	**Cell Biology & Medical Genetics**	**42**	**3**	**25**	**75**	**100**

Objective – To develop an understanding that cell is 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 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 Structure: Cell as a basic unit of life - discovery of cell, prokaryotic and eukaryotic cell; unicellular and multicellular organisms; Microscopic Study of Cell: tools and techniques (compound microscope, electron microscope and cell fractionation); Ultrastructure of prokaryoytic and eukaryotic cell - cell wall, cell membrane - unit membrane concept (fluid mosaic model); membrane transport; cellular movement (exocytosis, endocytosis);

Unit II : Organelles of Cell: Cell organelles and their functions- nucleus, mitochondria, plastids, endoplamasic reticulum, Gogli complex, lysosomes, centrosome, mesosomes, vacuole, cytoskeleton, cilia and flagella, ribosomes.

Unit III : Cell Cycle**:** Eukaryotic Cell Cycle, Regulation of Cell cycle progression, Cell division, Mitosis & meiosis , Events of Mitotic , events of Meiosis , non disjunction , Fertilization. Programmed Cell Death -- Apoptosis , Stem Cells - Embryonic , Tissue and induced pluripotent stem Cells , cloning - reproductive and therapeutic

Unit IV : Chromosomes : structure of DNA & RNA , chromatin , comparison between Bacterial and eukaryotic chromosome , human genome ,Karyotyping , autosomes ,sex chromosomes , Chromosomal basis of inheritance, linkage and crossing over , mutations , Menelian inheritance ,other patterns of inheritance - incomplete dominance, multiple allelism, quantitative inheritance. Human genetics - methods of study, overview of genetic disorders.

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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 105	**Fundamentals of Computer & IT**	**42**	**3**	**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 , artificial intelligence .Windows, print , control panel, Paint , calculator, desktop, find, Run ,Snipping tool ,Sticky note , Word pad ,Notepad ,Gadgets , Windows defender ,Firewall.

Unit III : Microsoft Word - basic commands, Formatting-text and documents, sorting and tables, background images , hyperlinks , Mail merge , Graphics ,columns , Smart Art , spelling & grammer , Thesaurus , Translate , watermarks , borders , Drop Cap

Unit IV : Microsoft Excel - Conditional formatting , Formulas , Functions , Fill features, Sort & Filter , Wrap text , Merge & Centre . Insert – Tables ,illustrations, charts , Links , Text ,Background. Remove duplicates

UNIT V : Microsoft powerpoint – Designs, slide transition, Smart Art , animation hyperlinks , automatic slide advance , background images

List of practicals :

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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 106	**English**	**42**	**3**	**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: English grammar: Articles,Preposition,Tenses,Voice,Direct and Reported Speech

Unit II: Vocabulary: Common Vocabulary, Word Often Confused, Some Common Errors

Unit III: Paragraph Writing: Process Writing, Descriptions Summarizing and Writing in brief of Medical passages,Note- taking Exercise,Formal Correspondence (Letter and application)-Application for job, for higher studies- Letter to The Editor, Ordering Equipments, Requesting for Information

Unit IV: SPOKEN ENGLISH: Communicative Skills, Discussion Sessions, Dialogue Sessions

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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 107P	Practical I (MLS 101, MLS 102)	84	6	25	75	100

List of Practicals :

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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 108P	Practical II (MLS 103, MLS 104)	42	3	25	75	100

List of Practicals :

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

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 , an overview – health and disease - Determinants of health-- Etiology – cause of disease - multi – factorial causation of disease– significance of etiology , natural history of disease , pathogenesis , clinical manifestations- signs and symptoms , morphological changes – macroscopic and microscopic - in disease - common terms in pathology

Unit II : 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 , liquifactive , caseous , fibrinoid - Cellular adaptations –Causes ,types and morphology - Atrophy, Hypertrophy, Hyperplasia, Metaplasia.

Unit III : Inflammation and Healing – Types of inflammation -Acute and Chronic, chemical mediators of inflammation , Inflammatory Cells, Morphology and Fate of inflammation -Chronic inflammation – chemical mediators and morphology – types - non specific and Granulomatous . Healing – Regeneration, Repair, Healing in Skin -- Healing by primary and secondary intention, healing in other tissues

Unit IV : Pathophysiology of Haemodynamics –fluid compartments of the body – types of pressure gradients --- Disturbance of Body Water – pathogenesis of oedema –types of oedema , haemorrhage ,hyperaemia and congestion, Thrombosis ,embolism , ischaemia & infarction - Neoplasia – overview ,benign and malignant tumours , classification and nomenclature of neoplastic disease , Chemical, Physical and Biological Cacinogenesis -- Clinical and Gross Features --dysplasia- invasion and metastasis --cytological features of malignancy.

Unit V : **Clinical Pathology** - Routine urine examination—specimen collection -- physical examination -- chemical examination -- microscopic examination , body fluids –an overview – description of various body fluids --CSF , pleural , peritoneal , synovial – indications for collection of body fluids – normal and abnormal features - routine sample processing and examination .

Unit VI : Systemic Pathology –an overview of the systems and pathologic conditions - Cardiovascular system-atherosclerosis, ischaemic heart disease, Respiratory diseases- chronic obstructive lung disease, chronic restrictive lung disease, respiratory infections Musculoskeletal system - neurogenic disease , myopathies- muscular dystrophy, The nervous system— infective diseases, ischaemic brain damage, cerebral infarction, intracerebral haemorrhage, degenerative diseases Digestive System- Disease of Oesophagus , Stomach ,Hepatitis, Cirrhosis of Liver, Neoplasm of GIT, Excretory System- Glomerulonephritis ,Nephritic & Nephrotic Syndrome, Pyelonephritis, Renal Arteriosclerosis, Hydronephrosis ,Renal neoplasms

Essential reading :

1. Harshmohan (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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 202	**Clinical Biochemistry I**	**42**	**3**	**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 how abnormalities at this level result in disease.

Unit I : Introduction of Clinical Biochemistry: Introduction & importance of clinical biochemistry. Methods of taking blood specimen, Separating the serum and plasma aseptically. Anticoagulant.

Unit II : 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 III : Plasma proteins: Major classes of Plasma proteins, Synthesis of Plasma proteins, Function of Plasma Proteins, Separation of Plasma Protein.

Unit IV : Metabolic intermediates: Introduction to Non-protein nitrogenous compounds ,urea/BUN: Synthesis, clinico-pathological correlations and estimations, Creatin and creatinine :Synthesis, clinico-pathological correlations and estimations, Uric acid :Synthesis, clinico-pathological correlations and estimations, Ammonia, Prophyrins,

Unit V : Mineral & Metabolic Bone Diseases: Metabolism of Calcium, Phosphorus, Sulfur etc. Metabolism of Trace elements. Bone metabolism, Markers of bone metabolism.

Unit VI : Water, Electrolyte Balance and Imbalance: Distribution of water and electrolytes in the body. Water and electrolytes balance. Regulatory Mechanism. Water and Electrolyte Metabolism. Dehydration. 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 , U.Satyanarayan , 3rd ed .

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 203	**Instruments & Reagents**	**42**	**3**	**25**	**75**	**100**

Objectives :The students will learn about commonly used instruments , apparatus and equipment , and the properties of reagents and chemicals . They wil also learn about the safety norms practised 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 assoaciated infections, Preventing laboratory infection, Chemical and Biological waste disposal, Biosafety cabinets –types, Biosafety regulations for basic laboratory practises and procedures, WHO guidelines for clinical lab biosafety

Unit II : Clinical Laboratory Organization: Safe laboratory design and organization Operational standard and management, The Laboratory Manual or protocol accomodation, training of staff, quality assurance, Research and Literature in Clinical Laboratory: Medical Dictionaries, Merck Index, Pubmed Database, Role of seminar and conference

Unit III : Use of Basic Laboratory Instruments

Water bath, Balances, Hot plate, Magnetic stirrer, Hot air oven, pH meter, Incubator, Water Distillation Apparatus,

Unit IV : Preparation of Solutions and Reagents

Normal, Molar & percent solutions, Buffers-Preparation and types, pH and significance, Diagnostic kits

Unit V : Laboratory Techniques

Principle, & Applications of Centrifuges, Colorimetry and photometry, Spectrophotometry, flame photometry, fluorometry, End point reaction methods, Turbidimetry and nephelometry, Densitometry.
Chromatography**:** Principle, Chromatographic performance parameters, types of hromatography Electrophoresis:Principle, Types, electrophoresis of proteins & nucleic acids

Essential reading :

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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 204	**General Microbiology**	**42**	**3**	**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 : Control of growth of Microorganism & Biomedical Waste management: Physical and Chemical Method of Control of Microorganism. Classification of Hazardous Waste. Different Locations of Biomedicals waste Generation. Importance of Segregation. Biomedical Waste Management process.

Unit III : Microorganisms : The morphology and fine structure of Bacteria, Fungai, Alge, Protozoa and Viruses.

Unit IV : Cultivation of Microorganism: Purpose of cultivation of Microorganism. Basic growth requirements and Essential growth factor. Types of media, Preparation of media, storage of media.

Unit V : Staining: 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.

Essential reading :

1. Ananthanarayan and Paniker's Textbook of Microbiology , 10th ed.
2. An Introduction To Microbiology , M.G. Sequeira, K.K. Kapoor, K.S. Yadav, P. Tauro, 3rd ed

Suggested reading :

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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 205	**Haematology & Haemoglobinopathies**	**56**	**4**	**25**	**75**	**100**

Objective – To familiarise 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 haematological tests , correlate and compare the normal and abnormal values and be aware of the advantages and disadvantages of each technique.

Unit I : Blood –an overview , general aspects of Haemopoiesis , sites of haemopoiesis , regulation of haemopoiesis , haematopoetic 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 ,the megakaryocyte , development, structure and functions of platelets.

Unit II : Laboratory investigations of haematologic disorders ,Disorders of Red Blood Cells , Anaemia due to Impaired Red Cell Production: Iron Deficiency Anaemia, Megaloblastic Anaemia, Aplastic Anaemia, haemolysis & Anaemia due to Excessive Red Cell destruction , anaemias due to enzyme deficiencies – pyruvate kinase deficiency , G6PD deficiency , Haemoglobin Variants, Haemoglobinopathies—α-Thalassemia, β -Thalassemia , Sickle-cell disease/trait

Unit III : An overview of WBCs , types , Structure and functions of WBCs , normal ranges , Disorders of White Blood Cells , etiology , pathogenesis & laboratory diagnosis of disorders of granulocytes , causes of neutrophilia, lymphocytosis, eosinophilia , neutropenia, lymphopenia, eosinopenia , monocyte macrophage system , causes of monocytosis and monocytopenia , leukaemoid reaction , leukamias , lymphomas

Unit IV : Disorders of platelets, 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.

Essential reading :

1. Shirish M Kauthalkar, Essentials of haematology, 2nd ed.
2. Dacie & Lewis, Practical Haematolgy
3. Atlas of Haematology by Renu Saxena

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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS206P	**Practical III (MLS201,MLS 205)**	**98**	**8**	**50**	**150**	**200**

List of practicals :

Pathology practicals :

1. Demonstration of microscopic features of fatty change
2. To study microscopic features of coagulative necrosis
3. Demonstration of microscopic features of acute inflammation .
4. Demonstration of microscopic features of chronic inflammation
5. Demonstration of microscopic features of chronic granulomatous inflammation
6. Demonstration of microscopic features of metaplasia
7. To learn about the sample collection and routine examination of urine – physical & chemical properties
8. To study the microscopic aspect of urine examintion.

Haematology practicals :

1. Demonstration of different anticoagulant used in haematology laboratory, vials, vacutainers, colour codes and order of draw.
2. Preparation and staining of a blood smear
3. To determine the relative number of each type of white cell present in the blood by performing **differential leucocyte count (DLC)**
4. Determination of Erythrocyte sedimentation rate – Westergren and Wintobe methods
5. Procedure for preparation and determination of reticulocyte count.
6. Detection of abnormal haemoglobin

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS-207P	Practical IV (MLS202, MLS 203)	98	8	50	150	200

List of Practicals :

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-polyacylamide gel and performing electrophoresis.

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 208P	Practical V (MLS 204)	42	3	10	40	50

List of Practicals :

General microbiology :

1. Understanding the autoclave and sterilization procedures.
2. Understanding the laminar flow equipment and its function.
3. Preparation of liquid media
4. Preparation of solid media
5. Inoculation of cultures through loops.

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: Evaluation of liver & gastric function: - Test based on excretory function-serum bilirubin, bile acids and bile salts. Test based on synthetic function, test based on serum enzymes-serum enzymes as markers of hepatobiliary disease, markers of obstructive liver disease. Assessment of gastric & pancreatic function, malabsorption studies.

Unit II: Kideny function test: - Test to screen for kidney disease-complete urine analysis, plasma urea and creatainine. 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 III: 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.

Unit IV: Clinical enzymology & biomarkers: – Clinical enzymology, plasma lipid profile, hypolipoproteinemias, hyperlipidemias. Cardiac markers-creatine kinase (CK-MB), cardiac troponins, high sensitive TnT, AST & LDH. Markers of Muscle diseases-creatine kinase (CK-MM), aldolase. Markers of bone disease- Alkaline phosphatase, heat labile bone isoenzymes. Prostate markers- prostate specific antigen, acid phosphatase. Miscellaneous enzymes-Glucose-6-phosphate dehydrogenase, urease, glucose oxidase & peroxidase.

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 , U.Satyanarayan , 3rd ed .

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 microbiological samples , set up culture and antimicrobial sensitivity and identify the causative organisms using various culture media .

Unit I : Collection, Transport and Examination of specimens
Specimen collection, preservation transportation 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 culture methods, Identification methods-Morphology & Culture characteristics, Staining Reactions, Resistance, Metabolism, Biochemical properties-IMViC Tests, Biochemical reactions on TSI slants, Antibiotic resistance, Antimicrobial sensitivity tests

Unit III : Study of gram positive bacteria
Gram positive cocci – staphylococci,streptococci.
Gram positive bacilli – Corynebacterium, Mycobacterium, Listeria, LactoBacillus, Anaerobic bacteria -Clostridia.

Unit IV : Study of Gram negative bacteria
Gram negative cocci - Neisseria
Gram negative bacilli – Enterobacteriaceae, Pseudomonas, Vibrio, Aeromonas, plesiomonas, Campylobacter, Bacteroides, Bordetella, Brucella, Haemophilus, Pasteurella, Francisella, Spirochaetes, Chlamydia, Rickettsia, Mycoplasma, etc

Unit V : Automation in Bacteriology
Introduction, BACTEK system, The ATB system, The VITEK system, The API systems, BacT/ALERT 3D automated microbial detection system

Essential reading :
1. Clinical Microbiology & and Parasitology , Nanda Maheshwari
2. Diagnostic Microbiology , Ranjan Kumar De
3. Ananthanarayan and Paniker's Textbook of Microbiology , 10th ed.

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

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 immunohaematology , 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 as well as pre transfusion testing and resolution of post transfusion problems.

Unit I:-

Introduction to blood banking ---basic immunohematologic concepts — red cell Antigens--- Immunogenicity--Blood Group Antibodies---Natural antibodies –immune antibodies—autoantibodies ---alloantibodies ---The Complement System and role of Complement in Erythrocyte Destruction -- human blood group systems ---ABO and Rh blood group Systems -- other blood groups - inheritance of blood group systems

Unit II:-

Pretransfusion testing ---Blood groupig & Rh typing --- Basic Principles—Hemagglutination--- Factors Affecting Hemagglutination---Grading of Hemagglutination Reactions---Tube Reactions---ABO blood group typing problems - Antihuman globulin test --- direct Coomb's test--- indirect Coomb's test---antibody screening – cross matching ---Specimen Requirements ---Rh incompatibility , HDN ---blood screening for Transfusion transmitted diseases --TTD—quality control in blood bank procedures

Unit III:-

Blood collection –- donor selection criteria—phlebotomy—anticoagulants-- blood preservation ---techniques for separation of blood components—preparation , storage and dispensing of blood components like WB , PRBC , FFP , platelets ——blood and blood component transfusion therapy – indications & selection of blood components – leucoreduction -- irradiation - apheresis- indications , techniques and advantages

Unit IV:-

Blood transfusion --- presurgical blood donation – autologous transfusion -- Massive blood transfusion---exchange transfusion —neonatal and paediatric transfusion --- transfusion reactions—transfusion reaction investigations—non infectious complications of blood transfusion -- blood transfusion alternatives

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

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

List of Practicals :

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

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

List of practicals:

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 bacteria by IMViC test.
5. Antibiotic Sensitivity Test.

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 306 P	Practical VIII (MLS 303)	56	4	50	50	100

List of practicals :

Blood Banking & Transfusion medicine :

1. To understand the basic concept of Blood Grouping.
2. To determine ABO group of a sample by testing red cells and serum (forward and reverse) by tube test method
3. Blood grouping of an unknown sample
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 unexpected ,incomplete antibody on the surface of red cells by DAT .
7. To determine the presence of unexpected ,incomplete antibody in a blood sample by Antiglobulin test.
8. To perform Cross match between donor and recipient blood to check compatibility (or incompatibility) between them before blood transfusion

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
Haematology
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 .

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 basics of immunohaematology , 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 as well as pre transfusion testing and resolution of post transfusion problems.

Unit I : Introduction and classification of hormones, difference between hormones and enzymes, Regulation and general mechanism of action of hormones.

Unit II : Pituitary gland & hypothalamus, hormones of the Anterior Pituitary- Growth hormone, Prolactin, Gonadotropin, Follicle Stimulating hormone, Leuteinizing Hormone, Thyroid stimulating hormone (TSH), Adrenocorticotropic hormone (ACTH)

Unit III : Thyroid hormones – T3, T4, PTH, disorders. Neurohypophysis hormones- Oxytocin, Antidiuretic hormone.

Unit IV : Kidney hormone-Renin, Adrenal gland hoemones-Aldosterone, Glucocorticoids, Mineralocorticoids, cortisol, disorders.

Unit V : Gonads hormones-Testosterone, Estrogens, Progesterone, Human Chorionic Gonadotropin (HCG), disorders.

Unit VI : pancreatic hormone- Insulin, glucagon, somatostatin, disorders.

Unit VII : Diagnostic endocrinology techniques- ELISA, RIA, chemiluminescence assay Procedure for hormones – physiological effects produced by normal and abnormal levels of various hormones.

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

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 : Cells and organs of the Immune system, Immunity – innate and acquired immunity, humoral and cell mediated immunity, Primary and secondary immune response.

Unit II : Antigen – Classes, properties. Antibodies/Immunoglobulins – Structure, Properties, Types of Immunoglublins, Complement, Introduction to serology

Unit III : Immunological principles of various reactions and techniques: Affinity and avidity, cross reactivity, precipitation, agglutination, neutralisation, opsonisation, immunodiffusion, immunoelectrophoresis, ELISA (indirect, sandwich, competitive, chemiluminescence, and ELISPOT assay), western blotting, immunofluorescence, flow cytometry and immunoelectron microscopy.

Unit IV : Diagnostic Immunology & serology -qualitative & quantitative tests, Widal test, VDRL Test, ASO Titre, Rheumatoid factor, C Reactive protein, HbsAg, Anti HCV, Anti HIV, Automation in serology

Unit V : Allergy, Hypersensitivity, Different hypersensitive reactions -type I, II, III, IV, Major Histocompatibility Complex and Antigen presentation, Tumor immunity, Tolerance, Autoimmunity-Mechanism, Transplantation immunology

Essential Readings :

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

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—introduction -- 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 -- Heliminths-- Arthropods

Unit II

Medically important parasites -- Introduction & classification of medically important parasites --E.histolylica, Giardia - Malaria parasite-- Leishmanial parasites—Tapeworms-- Intestinal nematodes -- Filarial worms -- tissue nematodes --Arthropods--Importance of Arthropods in Parasitology -Classification of Arthropods -Medical conditions related to arthropods

Unit III

Mycology – introduction to fungi - structure , general properties and characteristic features - useful fungi - Classification of pathogenic Fungi-- Morphology of Fungi— Brief idea of Dermatophytes, - Cutaneous mycoses, Systemic mycoses, Opportunistic mycoses - Mycotoxins sample collection - Laboratory diagnosis of Fungi - Culture and laboratory test for fungus -- KOH preparation , LCB mount –India Ink preparation

Unit IV

Virology – discovery - General properties of viruses – structure, replication, growth, classification and nomenclature of medically important viruses –Common viral diseases – mode of transmission of infection - laboratory Diagnosis --arboviruses – oncogenic viruses –prevention and control of viral diseases - interferons - Elementary knowledge of viral vaccines -- Bacteriophage – Phage typing.

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. (2009) Textbook of Microbiology. 8th edition

Suggested reading :

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

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

List of Practicals :

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

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

List of practicals :
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
6. Detemination 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 by microscopic examination - wet mount
9. Demonstration of fungi in a clinical sample by treatment with 10 % KOH solution.
10. Detection of Hepatitis B -- qualitative detection of Hepatitis B Surface Antigen (HBsAg) in serum or plasma.

Semester -5th						
Paper Code	**Paper Name**	**Total Hrs**	**Credit**	**IA**	**SE**	**Total**
MLS 501P	**Histopathology & Cytology**	**56**	**4**	**25**	**75**	**100**

Objective – The students will learn about the techniques to study the structural changes in cells and tissues obtained by aspiration, biopsy or autopsy .

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 – Cells, Tissue ,organs and their functions -- Different human organs and their gross and histological structure and functions --- Collection of specimen -- tissue biopsies , cytological samples , FNAC , autopsy ,Fixation -- Classification of fixatives, Simple Fixatives and their properties --processsing bone tissue –Decalcification, procedure and chemicals used

Unit II

Tissue 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.

Unit III

Priniples of staining—Dyes and stains used in histopathology --Staining with Haematoxylin and Eosin --Congo red-- methyl violet-- Leishman stain —Giesma – Special stains ----VG - PAS ---Masson's trichrome , Gomori's trichrome -- Perl' Prussian blue -- Alcian blue ---Reticulin stain

Unit IV

Introduction to Cytology ---- Fine needle aspiration cytology (FNAC) - Exfoliative Cytology --Sample collection -- sputum, BAL, CSF, Pleural, peritoneal and pericardial fluid, Gynaecologic samples - preservation and fixation of samples --- Liquid Based Cytology LBC - Staining methods --- Papanicolaou's staining technique --- MGG staining --- H & E staining --- Cytospin technique -- cell block preparation

Essential reading :

1. Dr. D.R. Singh (2003) Principles & Techniques in Histology , Microsopy 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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 502	Molecular Diagnostics	56	4	25	75	100

Objective – the student will learn about the genomic organisation , 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 disgnostic 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, Chromosome structure, Structure of gene, Replication of DNA, Transcription of DNA to RNA, Translation, Transcriptional control, The operon concept, DNA repair, DNA mutations.

UNIT II

Molecular Biology Techniques- Nucleic acid extraction, Hybridization assays, DNA amplification techniques – Fundamentals of polymerase chain reaction, Restriction Fragment Length Polymorphism.

UNIT III

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

UNIT IV

Cytogenetics- Use of cell culture for cytogenetic studies, General method of preparation 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

Suggested reading :

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

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 state run programmes to promote health and 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 .

Unit I

Natural History of Disease--- Determinants of health---- multi – factorial 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 ----Disinfection of the infective materials received in the Laboratory by using the appropriate disinfection methods, at the health centre level.

Unit II

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 --National Programmes of Health and disease eradication-- Health Programmes---- Family Welfare Programme ---Immunization and universal immunization programme---- Disease Eradication programme---Leprosy ,--Disease control programmes---Tuberculosis--- Malaria—Goitre

Unit III

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

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

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

List of practicals :

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

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

List of Practicals :

Molecular Diagnostics :

1. Preparation of reagents for DNA isolation
2. Isolation of genomic DNA from blood
3. Agarose Gel electrophoresis
4. Polymerase chain reaction
5. Detection of viral markers by PCR Technique

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 506P	**Evaluative Clinical Training II**	**154**	**6**	**…….**	**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 have to 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 .

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 programme in the laboratory and practice ethical principles in the healthcare setting .

Unit I

Quality , an overview - Introduction to laboratory quality management --- Essential elements of Quality Assurance Programme – QMS – QLPs – quality assurance QAS – quality assessment QA –Indicators of laboratory quality - TAT –sample rejection - patient feedback -- quality control QC --- Internal Quality control—external quality control - EQUAS

Unit II

Good Laboratory Practice (GLP) - Control of pre-analytical variables-- control of analytical variables--- Quality Control of the chemicals, reagent –calibration of equipment --laboratory precision, accuracy & sensitivity –sources of error-- Validation of methods--- Reference materials and calibrating methods-- new reagent verification ---Systemic and random errors —Westgard rules -- Quality control charts--Levey-Jenning chart - ---corrective methods -- Corrective action preventive action – post analytical errors and their prevention and resolution

Unit III

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 improvement—introduction to laboratory accreditation - Advantages of Accreditation, Brief knowledge about National and International Agencies for clinical laboratory accreditation -ISO , NABL , CAP etc.

Unit IV

Medical ethics -Ethical Principles for a clinical laboratory professional --duty to the patient --duty to colleagues and other professionals --general application of ethical principles –Respect and equal treatment -- Dignity and privacy of patient -- Communication and informed consent--- Decision-making for incompetent patients-- Responsibility from acquisition of the specimen to the production of data --- confidentiality of information ---maintenance , storage and retention of medical records --- access to medical records.

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

Paper Code	Paper Name	Total Hrs	Credit	IA	SE	Total
MLS 602P	**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 laboratory 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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