Syllabus
for Courses affiliated to the
Kerala University of Health Sciences
Thrissur 680596

BACHELOR OF SCIENCE IN MEDICAL LABORATORY TECHNOLOGY
Course Code: 012

(2024-25 Academic year onwards)

2024

2 COURSE CONTENT

2.1 Title of course:

Name of the course shall be the "BACHELOR OF SCIENCE IN MEDICAL LABORATORY TECHNOLOGY" – BSc (MLT)

2.2 Objectives of the course

At the end of the course the candidates shall be:

1. Aware of the principle underlying the organization of a clinical laboratory.
2. Able to do routine and special investigative procedures in medical laboratory practice.
3. Provide a good theoretical and practical education who plan to work with in the field ofmedical laboratory technology and science.
4. Develop knowledge and skill in accordance with the society's demand in medical Laboratorytechnology.
5. Qualify the students for official approval as medical laboratory technologist.
6. Able to operate and maintain all equipment used in laboratory diagnostics.
7. Able to establish and manage a clinical or Research laboratory.
8. Qualify the students for official approval as a junior faculty to teach under graduate coursein medical laboratory technology.

2.3 Medium of instruction:

Medium of instruction shall be English

2.4 Course outline

The course of study enhances student's knowledge and skills in several major categorical areas of medical laboratory technology. The degree in medical laboratory technology provides advanced skills to practicing laboratory professionals in health administration, leadership, quality assurance and health informatics. It is a four-year professional Degree course comprising four papers in each year. Total course duration is 5860 hours including 100 hours of training in reputed external Hospitals/institutes. There will be three internal examinations conducted by the Institutes/Colleges and one public examination at the end

of each academic year.

2.5 Duration of the course

a) Duration of the course shall be four academic years. The students should undergo training for at least 2 weeks in one or more national reputed institutions during the period of the course especially for Virology, Mycology and recent advances in medical technology. Maximum timespan for acquiring the degree will be 8 years from the joining of the course. (Double the normal course duration)

2.6 Subjects

As given under "Content of each subject in each year "

2.7 Total number of hours

The students have to attend a minimum of 240 working days. Total course duration is 5860 hours including 100 hours of training in reputed external Hospitals/institutes.

2.8 Branches if any with definition:

a) Branches of study

The course shall comprise of both theory and practical studies in different branches of medical laboratory technology and its related subjects such as

1. Anatomy
2. Physiology
3. Medical Laboratory Science and Ethics
4. Biochemistry
5. General Microbiology
6. Immunology
7. Mycology
8. Virology
9. Applied Microbiology
10. Parasitology
11. Entomology
12. Systemic Diagnostic Bacteriology

13. Transfusion technology
14. General and Clinical Pathology
15. Hematology
16. Cytology
17. Histopathology techniques
18. Cytogenetics
19. Molecular biology
20. Research methodology and Biostatistics
21. Computer applications
22. Laboratory managements.

2.9 Teaching/Learning methods

- Lecture and practical classes
- Regular clinical Laboratory posting to pick up practical skill and practice techniques on diagnostic investigations, laboratory responsibility and supervision.
- Students should present seminars in various clinical subjects in medical laboratory technology to attain presentation skill.

a) Title of subjects & hours of study

Subject		Total Hours/subject/year			
		Theory	Practical	Clinical Lab Posting	Total
	First Year				
Paper-I	Anatomy	100	80	-	180
	Physiology	115	65	-	180
Paper-II	Biochemistry-I	130	230	-	360
Paper III	Basic Microbiology & Immunology	130	230	-	360
Paper IV	Basic Medical Laboratory Science & Haematology - I	130	230	-	360
	Second year				
Paper V	Biochemistry II	90	174	96	360
Paper VI	General Microbiology	90	174	96	360
Paper VII	Parasitology & Entomology	90	174	96	360

Paper VIII	Haematology-II& Clinical Pathology	90	174	96	360
	Third year				
Paper IX	Biochemistry III	100	200	150	450
Paper X	Bacteriology	100	200	150	450
Paper XI	Cytology and Transfusion technology	100	200	150	450
Paper XII	Computer Application, Research methodology & Laboratory management	90	--	--	90
	Final year				
Paper XIII	Biochemistry IV	90	180	160	430
Paper XIV	Mycology, Virology and Applied Microbiology	90	180	160	430
Paper XV	Histotechnology and Cytogenetics	90	180	160	430
Paper XVI	Project	150			150
	**Training at reputed external Hospitals/ National Institutions				100
	Grand Total				**5860**

b) Qualification of Teacher

Minimum qualification for a teacher is the Acquisition of MD in the concerned subject

OR

Four-year BSc MLT Degree and Master's Degree in MLT (MSc MLT) in Biochemistry / Microbiology/ Pathology from any Institute or Medical College and approved by the Kerala University of Health Sciences and Govt. of Kerala.

2.10 Content of each subject in each year

FIRST YEAR

Paper I - Anatomy & Physiology

Paper I A - ANATOMY - Theory -100Hours & Practical-80 hours

Paper I B- Physiology – 115 Hours & Practical 65 hours

Paper I A – ANATOMY INCLUDING HISTOLOGY- Theory -100 Hours & Practical-80 hours

Course Description: The Course is designed to enable students to acquire General knowledge of thenormal structure of various human body systems and more emphasis given to those relevant for Medical Laboratory Technology students. The Course content is divided in to 3 categories; **must know, desirable to know and nice to know,** which is indicated as must know **(***)**, desirable to know **(**)** and nice to know **(*)**.

A maximum of 60% of questions for the University examination should be from must know portionsof the content, 30% may be from desirable to know portions of content and a maximum of 10% of questions from Nice to know content for university examination. There will be no University practical and viva examination for Paper –I Anatomy & Physiology and also no practical internal assessment. But practical classes should be conducted as per the hour distributed for the same.

	Anatomy including Histology Topics
1)	Introduction to Anatomical terms organization of the human body. a) Microscopic structure of Human cell ** b) Classification, functions and Microscopic Structures of Primary tissues, Epithelial tissue, connective, tissue, muscular tissue, Nervous tissue (With Histology) ** c) Histology of Cartilage – Hyaline, Elastic, fibro cartilage **
2)	**The Skeletal System** a) Classification of bones, constituents of bone and bone tissue. Functions of Skeleton, Microscopic Structure of compact bones. ** b) Histology: Bone cross section and longitudinal section * c) Organizations of skeleton, Structure of typical vertebrae. *

	d) Brief study on individual bones: Axial skeleton, appendicular skeleton, cartilages and its classifications. * e) Scapula, Humerus, Radius & ulna, Sacrum, Clavicle, Hip bones, pelvic bones,femur, tibia, fibula* f) Carpel and tarsal bones. * g) Classification of joints**, movements*, with examples type of ligament * h) Skull bones - Importance of sutures: coronal, sagittal and lambdoid, cranial fossae, foramen magnum (elementary knowledge only). Bones of Cranium, Auditory meatus, Mandible and Ramus. i) Difference between foetal and adult skull. **
3)	**Muscular System** a) General function and actions of Nerve supply and blood supply of muscles*. Classification of muscles*. Diaphragm. * b) Nerve supply and blood supply of hands and legs. ***
4)	**Thorax** a) Thoracic cavity***, Mediastinum***, Pleura ***
5)	**Respiratory System** a) Trachea and lungs – Position, relation, structure***, and blood supply*. Broncho-pulmonary segments. Bronchiole, alveoli and muscles of respiration. * b) Histology of Trachea and lungs*
6)	**Heart** a) Position, shape, size, structure, borders, chambers of heart, valves, pericardium*** blood supply* and nerve supply of heart*, b) Conducting system of heart**. Atrio ventricular node. **
7)	**Vascular system** a) Blood vessels, classification and its structure*** b) Differences in the structure of artery and vein. Portal venous system. *** c) Histology: Large artery – Aorta, Medium sized artery, large veins – Inferior venacava, Medium sized vein*
8)	**Lymphatic System** a) Lymph node, spleen, thymus, tonsil, lymphatic duct***.

9)	**Digestive System** a) Oral cavity, salivary glands, teeth, tongue, pharynx, oesophagus,stomach *** b) Glands in digestive system, small intestine - duodenum, jejunum, ileum***. c)Pancreas, liver, gall bladder, gall stone, biliary tract. Large intestine, colon,appendix, rectum-recto-vesical and recto-uterine pouch***
10)	**Urinary System** a) Kidney, nephron***, ureter, urinary bladder and its relation in male and females, urethra. *** (With Histological approach *) blood supply**, venous drainage*
11)	**Reproductive system** a) Male reproductive system*** – testis, seminiferous tubules, epididymis, seminalvesicles, external genitalia of male***. (With Histology *) a) Female reproductive system – vagina, cervix, uterus, fallopian tubes, ovary,ovarian follicles*** (With Histology*).
12)	**Nervous System** a) Classification and structure of neurons, brain - parts, ventricles, cranial nerves,spinal cord, spinal nerves. b) Histology of Neuron, Spinal ganglion, Sympathetic ganglion. Nerve Fibre – Optic nerve, Sciatic nerve *
13)	**Integumentary system.** **a)** Skin - parts, function. (Histology)**
14)	**Endocrine system.** **a)** Pituitary glands, thyroid, parathyroid, suprarenal gland. *** **b)** Histology of Pituitary, Thyroid & parathyroid, Adrenal gland and Pancreas. *
15)	**Special senses** **a)** Olfactory epithelium, taste buds of tongue. ** **b)** Structure of ear, eye; functions. **

Practical* 80 hours.**

Demonstration of gross anatomy – organs

Demonstration of Veins, arteries and nerves in the handsand legs

Demonstration of bones Identification of normal tissues Human skeleton-parts demonstration

Preparation of histology slides

Microscopic demonstration and identification of histology slides as per theory. Museum jars, Preparation & Demonstration.

Visit an Anatomy Museum

Text Books

1. Gross Anatomy - Chaurasia vol1,2,3
2. Histology -I. B. Singh's textbook.
3. General Anatomy -Chaurasia.

Paper I B- Physiology – 115 Hours & Practical 65 hours

Course Description: The Course is designed to enable the students to acquire knowledge of the normal physiology of various human body systems and understand the alterations in physiology in diseases and apply this. More emphasis shall be given to those relevant for medical Laboratory Technology students. The Course content is divided in to 3 categories; **must know, desirable to know and nice to know,** which is indicated as must know **(***)**, desirable to know **(**)** and nice to know **(*)**.

A maximum of 60% of questions for the University examination should be from must know portions of the content, 30% may be from desirable to know portions of content and a maximum of 10% of questions from Nice to know content for university examination. There will be no University practical and viva examination for Paper – I B - Physiology and also no practical internal assessment. But practical classes should be conducted as per the Hour distributed for the same.

	Topic
1	**Introduction to physiology**
2	**Blood physiology** a) Composition and functions of blood*** b) Plasma proteins – types, functions ***

	c) RBCs – morphology, functions, erythropoiesis*** d) WBCs – classification, morphology, functions, WBC count, leucopoiesis*** e) Platelets – normal count, thrombopoiesis*** f) PCV, ESR, osmotic fragility, RBC count, blood indices – MCH, MCV, MCHC*** g) Hemostasis – mechanism*** Coagulation of blood – extrinsic and intrinsic pathway*** h) Bleeding time, clotting time*** i) Blood groups – ABO system, determination, importance, mismatch blood transfusion, Rh system***
3	**Respiratory system** **a)** Functional anatomy – phases of respiration – inspiration and expiration – mechanism** b) Lung volumes and capacities – values** c) Spirometry* d) Pulmonary gas exchange – diffusion of gases, transport of respiratory gases in blood – O 2 and CO 2 *** e) O 2 – Hb dissociation curve*** f) Regulation of respiration – chemical and neural***
4	**Cardiovascular system** a) Functional Anatomy, conducting system and spread of cardiac impulse Cardiac cycle – definition, duration of phases. *** b) Heart sounds, Pulse – Definition, Heart rate, Systemic circulation** c) ECG – Basic principle of recording, types of leads – Normal ECG** d) Cardiac output – definition** e) Determination of blood pressure and normal values, regulation, determination of BP in man. ***
5	**Endocrine system** a) General introduction, Hormones – definition*** **b)** Endocrine glands – names, their secretions, major functions, (hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenal glands, ovary and testis). ***
6	**Muscle and nerve** a) Transport across cell membrane, Resting membrane potential and its bandsAction potential – its basis, refractory period, latent period. *** **b)** Neuron – Morphology, properties *** **c)** Muscle – Types, difference between them, properties. **

	d) Neuromuscular junction, structure, neuromuscular transmission. *
7	**Nervous system** **a)** Introduction, organization of brain and spinal cord, functions. *** **b)** Synapse – definition, types, synaptic transmission and synaptic inhibition. ** **c)** Reflex action – definition, components, important properties, importance. ** **d)** Cerebral cortex – Gross structure importance, EEG, Cerebellum – Gross structure, functions, Hypothalamus – functions** **e)** Thalamus – functions, Basal ganglia – functions** **f)** Autonomic nerves system** **g)** CSF –Production, circulation, composition, functions*** h) Lumbar puncture. **
8	**Special senses** a) Vision – Basic optics. Briefly on refractory errors of eyes, Visual receptors, visual pathway** **b)** Audition –Functional anatomy, Functions of ear** **c)** Olfaction, Gestation**
9	**Digestive system** a) Functional Anatomy – Innervations, Salivary secretion*** **b)** Gastric secretion – phases, control, Gastric – functions; Pancreatic secretion functions, regulation; Liver – functional anatomy, Bile – functions and composition*** **c)** Small intestine – secretion, GI motility-Deglutition, Peristalsis; Functions of stomach, small intestine and colon. ***
10	**Excretory system** 1. Renal system*** a) Kidney - Functional anatomy of kidney, Functions of kidney*** b) Urine formation – glomerular ultrafiltration, tubular reabsorption, tubular secretion*** c)Glomerular filtration rate – definition, measurement, factors affecting. *** d)Tubular functions – reabsorption of sodium, water, glucose, tubular secretion of H+ (Acidification of urine) ** e) Diuresis and diuretics, micturition** f) Dialysis** 2. Skin

	Mechanism of temperature regulation**.
11	**Reproductive system** **a)** Sex determination, Role of hormones in sexual differentiation in foetal life** **b)** Male reproductive system – organs, functions of testis; Female reproductive system – functions of ovaries*** **c)** Menstrual cycle – ovarian cycle and uterine cycle*** d) Fertilization, pregnancy, functions of placenta, Parturition, Pregnancy test principle***

Practical* 65 Hours**

1.Heamoglobin estimation
2.ESR determination
3.RBC count
4.WBC count
5.Differential count
6.PCV, Red cell indices.
7.Osmotic fragility test
8.Bleeding time, Clotting time
9.Blood grouping
10. Measurement of Blood pressure in man

Text Books

1. Essentials of Medical Physiology- K. Sambulingam & Prema Sambulingam

2.Text book of physiology for BDS students - Prof. Jain A.R.

3. Text book of physiology - Choudhary

4. Text book of physiology -Ganong

5.Text book of physiology -G.K.Pal.

First year Paper II

Biochemistry I – 130 hours

Basic Clinical Biochemistry

Main objective is to impart the knowledge of cell, Glass wares, Equipment's, reagents, apparatus, units and volumetric analysis in the laboratory of Clinical Biochemistry

1. **General overview:** classification and organization of medical laboratories, Role of medical laboratory services, lab technologists, lab rules, professional ethics and professional code of conduct. (3 hrs)

2. **Introduction to the Chemistry of the LIVING THINGS AND CELL.**

   Cell Biology: Definition of cell. Cell as a basic UNIT of living systems, fundamental cell types (PPLO's, bacteria, eukaryotic microbes, plant and animal cells), difference between prokaryotic and eukaryotic cells, Structure and function of cell organelles, ultra-structure of cell membrane, cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin, microtubules etc.), Mitochondria, lysosomes, nucleus and cell fraction.

   Evolution: Origin of life, theories of evolution, evidences of evolution from plant and animal kingdom, modern concept in Evolution and concept of speciation. (7hrs)

3. **Laboratory Glass wares**: Glass - composition, properties, varieties, grades of glassware's. calibration of pipettes and other volumetric apparatus. plastic- PVC, polycarbonate, Teflon etc. advantages and disadvantages of various disposable lab ware. Cleaning of laboratory glass wares. Preparation of cleaning solutions. Care of laboratory wares and utensils. (7hrs)

4. **Chemicals** – Grades of chemical, Chemical hazards, safety measures, universal safety precautions, storage and handling of chemical and reagents, Primary and secondary standard chemicals, Units of measurements, expression concentration of solutions in

physical unit and chemical units- Molarity, Normality, Molality, percent solution, saturated solutions, PPM solutions and standard solutions. Dilutions of solutions, interconversion of solutions, and First aid in the laboratory (8hrs)

5. **Water the universal solvent**, Ionization of Water, weak acids and weak bases, dissociation constants, buffer systems, Henderson Hassel Bach equation, PH and PH meter. Preparation and storage of distilled water, double distilled and deionized water. Evaluation of water purity. (7hrs)

6. **Laboratory equipment's**- Principles, Instrumentation, working, uses, care and maintenance. Colorimetry, Spectrophotometry, Fluorimetry, Atomic Absorption Spectrophotometry, nephelometry, Flame photometry, pH meter, Ion selective electrode, analytical balance, electronic balance, centrifuge, homogenizers, vortex mixer, magnetic stirrer, Desiccators and distillation apparatus (12hrs)

7. **Biological specimens** – Collection, preservation and processing of biological specimens for analysis, Blood, urine, CSF, gastric juices , Amniotic fluid, Ascitic fluid , synovial fluid and other body fluids. Preparation and use of anticoagulants and urine preservatives.
   10hrs
8. **Volumetric analysis** - Preparation and standardisation of volumetric solutions. Preparation of standard solutions of Oxalic acid, Sodium hydroxide, Hydrochloric acid, Sulphuric acids, Silver nitrate and Potassium permanganate. Chemical indicators and theory of indicators (10 hrs)
9. **Elementary knowledge of Physical Chemistry**-Adsorption, diffusion, colloids, emulsions, Viscosity, surface tension, partition coefficient, osmosis, dialysis and Donnan membrane equilibrium (10 hrs)
10. **Radio isotopic Techniques**: Basic concepts of radioisotopes, basic principles of Radioactivity , detection and measurements of radioactivity -theory and applications of Geiger-Muller tube counter, solid and liquid scintillation counters, primary and secondary fluors, safety rules for radio isotopic studies and applications of radioisotopes . (6 hrs)

one can understand the physiological function that regulates the proper growth and development of a human body.

1.CARBOHYDRATES 15 hrs

Structural aspects; Introduction & Occurrence, Classification. Chemistry and properties of monosaccharide, disaccharides and polysaccharides. Stereoisomers, epimers, and reactions of monosaccharide and other carbohydrates. Digestion and absorption of carbohydrates. Mucopolysaccharides and glycoproteins.

Reactions of carbohydrates- reactions of glucose, fructose, maltose, lactose, sucrose, starch and glycogen.

2. PROTEINS 15 hrs

Structural aspects – General introduction, Classification, properties and biological function, AMINO ACIDS Structure & properties- peptide bond, primary, secondary, tertiary and quaternary structures, sequence analysis. Digestion and absorption of proteins. Lipoproteins and nucleoproteins, structural proteins.

Colour reactions of amino acids and proteins- albumin, globulin, casein, gelatin and peptone. Reactions of NPN substances (urea, uric acid, creatinine)

3. LIPIDS 15 hrs

Structural aspects; General introduction, Classification of lipids, chemistry and properties of fatty acids- saturated, & unsaturated fatty acids, triglycerides, phospholipids and steroids. Saponification number, Iodine number and rancidity. Lipoproteins: structure, types and functions. Digestion and absorption of lipids,Cell membrane: Structure and function – fluid Mosaic model and, transport mechanisms.

4.NUCLEIC ACIDS 5 hrs

Structural aspects – Components of DNA and RNA, Chemistry of purines, pyrimidines, nucleosides, nucleotides, nucleic acids, nucleosomes. Structure of DNA and RNA. various forms of DNA and RNA, functions of DNA and RNA.

BIOCHEMISTRY PRACTICALS 230 Hours

1. Familiarization with Glass wares , chemicals and laboratory equipment
2. Sample collection, labelling, storage and processing of blood, separation of serum and plasma
3. Measurements of liquids, Weighing solids
4. Calibration of pipette and other volumetric glass wares
5. Cleaning of lab wares and laboratory utensils, preparation of cleaning fluids.
6. Preparation of distilled and de-ionised water
7. Preparation of anticoagulants and preservatives for specimen collection.
8. Use and proper maintenance of -Analytical balance, Electronic balance, Centrifuge, Colorimeter, spectrophotometer, pH meter, Homogenizer, vortex mixer , water bath ,and Desiccators
9. Measurement of pH, preparation of buffers
10. Preparation of saturated solution and half saturated solutions, Preparation of standard solutions, % solutions(V/V. W/V) normal and molar solutions.
11. Preparation of buffers: acetate ,phosphate and tris buffers and measurement of pH
12. Titration of acids and bases, preparation of standard solution of Sodium hydroxide, Hydrochloric acid, sulphuricacid. Silver nitrate and Potassium permanganate solutions
13. Reactions of carbohydrates, reactions of glucose, fructose, maltose, lactose, sucrose, dextrin, starch andglycogen.
14. Reactions of Amino acids, colour reactions of albumin, globulin, casein, gelatin and peptone.
15. Reactions of fatty acids and cholesterol
16. Reactions of NPN substances (urea, uric acid, creatinine)
17. Demonstration of osmosis and dialysis
18.. Verification of Beer-Lambert's Law

Recommended books

1. Text book of Biochemistry by DM Vasudevan , Sreekumari.S and Kannan Vaidyanathan
2. Medical Laboratory Technology by Kanai L Mukherjee
3. Text book of Medical Laboratory technology By Proful Godker
4. Harper's Biochemistry by Robert K murray

5. Instrumental analysis by Charwal Anand

Reference books

1. Clinical diagnosis and management by Laboratory methods (John Bernard Henry)
2. Lehninger: Principles of Biochemistry , Nelson, D.L. and Cox, M.M., W.H.
3. Biochemistry – Lubert STRYER

Paper III BASIC MICROBIOLOGY & IMMUNOLOGY - 130 hours

BASIC MICROBIOLOGY – 55 hours

1. Introduction to Microbiology

Historical review (Contributions of Edward Jenner, Louis Pasteur, Robert Koch and postulates, Anton van Leeuwenhoek, Alexander Fleming) and scope of microbiology Role of medical microbiology in diagnosis and control of infections.

2. Sterilizations and disinfection

Definitions of sterilization, disinfection, antisepsis. Classification of sterilization and disinfection.

3.Sterilization –Physical methods and chemical methods.

Different methods of sterilization: Heat, radiation, filtration, chemical methods (Emphasis should be given to each method) Selection of material for sterilization or disinfection

- **Autoclaves**-Different types, principles, operating procedures, precautions, applications and quality control Advantage and disadvantages various types of autoclaves
- **Filtration-** Principles, methods, applications
- **Radiation -** Principles, methods, applications ,Principles, methods, applications

Chemical methods of sterilization

- **Sporicidal disinfectants- action and exposure period**

4.Disinfection-Physical methods and Chemical methods

- **Physical methods**-Heat, Filtration, Radiation

  Disinfecting filters - principles, Methods, types of filters, applications

- **Chemical methods**

  Factors influencing the performance of the chemical disinfectants.

  -Different types of chemicals used for disinfection purposes

  -Emphasis should be given to its mode of action and period of exposure

  -MIC, its period of exposure, application and limitations.

  -Quality control tests for each method.

5. Decimal reduction time (D Value).

6. Testing of disinfectants

In use test, Rideal – Walker test or Chick – Martin test for the phenol co-efficient determ (Students should know the sterilization or disinfection of the following – floors, work benches, safety cabinets, rooms, operation theatres, skin, hospital wares, and laboratory Equipment.Theatre instruments, different types of media,plastic materials, cotton materials, instruments used in surgery etc.)

-Preparation of disinfectant for laboratory use.

-Decontamination of equipment and wastes,especially in microbiology

-Washing, cleaning, packing and sterilization of glasses and storage of sterile articles.

-Classification of microbes on the basis of hazards.

-Principles of classifications of laboratory safety cabinet and its applications

7.. Incubators

design, different models, working principles, precautions, calibration of temperature.

Anaerobic incubators, Walk in incubator –principles and its applications

8. Cell morphology

Prokaryotic and Eukaryotic cell – structure and function

9.. Morphology of bacteria

Anatomy of the bacterial cell. (Special emphasis should give to cell wall, capsules, flagella, plasmid, bacterial spores, spheroplasts, protoplasts, L–forms)

10.Staining

Definition of stain, Acidophilic, Basophilic and Neutral stains. Preparation of smears, its fixation and uses. Principles, preparation of reagents, procedures , modifications. Uses advantages and disadvantages of the following staining methods

Simple staining

Differential staining (Gram's staining, AFB staining)

Negative staining

Fluorochrome staining

Staining of volutin granules

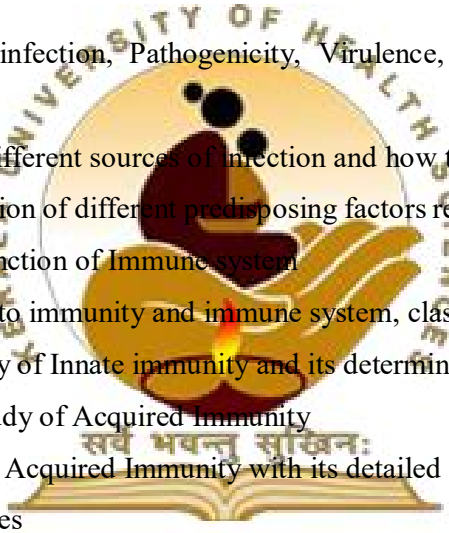
Staining of spirochetes

Special stains of spores, capsules, Flagella

Quality control in staining

IMMUNOLOGY - 75 hours

Section B



● Definitions of infection, Pathogenicity, Virulence, Primary infection, nosocomial infection

● Description of different sources of infection and how they are transmitted to others.

● A brief introduction of different predisposing factors responsible for bacterial infection.

● Structure and function of Immune system

● An introduction to immunity and immune system, classification of immunity

● Descriptive study of Innate immunity and its determinants

● A descriptive study of Acquired Immunity

● Classification of Acquired Immunity with its detailed description

● Immune responses

● Principles of cell mediated and humoral immunity

● Discussion on cellular immune responses (more emphasis should be given for lymphokines or cytokines, TNF, Interferon)

● Lymphocytes subsets and its functions, Natural killer cells.

● Antigens and their properties, Super Antigens, Heterophile Antigens.

● Immunoglobulin and their structure and functions.

● Monoclonal antibody

● Major Histocompatibility complex – a brief description of gene organization, structure and its functions, transplantation.

● A brief description of complement and its properties

● Activation and regulation of complement path ways.

● Biological effects of complement

● A brief introduction of Immunodeficiency disease and Hypersensitivity reactions.

● Discussion on Auto immunity.

● A detailed study of Vaccines and; adjuvants.

● Descriptive study of Antigen-antibody reactions –

Precipitation, Agglutination, complement fixation, Neutralization, ELISA, RIA, IF,

(more emphasis should be given to ELISA, IF, Counter current immunoelectrophoresis)

PRACTICALS 230 Hours

● Introduction and demonstration of Laboratory Equipment used in Microbiology.

● Cleaning of new and used glass wares for microbiological purposes. Students be familiar to use autoclave, hot air oven, water bath, steamer etc.

● Demonstration of different types of physical methods of sterilization

● Sterilization of heat labile fluids, glass wares, liquids, plastic and other laboratory and hospital wares.

● Demonstration of different methods of disinfection

● Students should be familiar to use different types of filters and its decontamination.

● Rideal - Walker test or chick – Martin test for the phenol co-efficient determination.

● Test for minimum inhibitory concentration of at least 2 commercially available disinfectants, In use test

● Students should prepare the working dilutions of common disinfectant.

● Decontamination of wastes and carcasses – method

● Students should be thorough to work with light microscope

● Study of the morphological characters of bacteria

● Detection of motility *- Hanging drop examinations with motile bacteria, non - motile bacteria. Method by using semi solid medium.

● Preparation and examination of wet films*. Direct microscopic examination of wet film

● Preparation of smear, fixation and staining of bacterial smears and its quality control methods

● Simple staining methods* – Pure culture, mixed culture

● Gram's staining and any one modification* – Pure culture - Mixed culture

● A.F.B. staining and its modification *– Normal smear, AFB positive smear

● Fluorochrome staining and its demonstration

● Special staining technique for the demonstration of bacterial capsule (any two methods)

● Special staining technique for the demonstration of spores (any one method)

● Special staining technique for the demonstration of Flagella (Any one method)

● Special staining technique for the demonstration of volutin granules

● Preparation of stains and reagents used for the above staining technique. Quality control testing for the stains.

(repeated exercises should be given till the students become thorough with the (*) marked techniques)

RECOMMENDED BOOKS

1. Mackie & Macartney practical medical Microbiology - Collee. Fraser, Mar mion, Simmons

2. Medical Laboratory Manual for Tropical Countries Vol-1 & Vol - 2 Monica Chees brough

3. Text Book of Microbiology- Baveja

4. Text Book of Microbiology-Ananthariarayanan & Jayaram Panikker

5. Essential Immunology-Roitt

REFERENCE BOOKS

1. Medical Microbiology - David green Wood, Slack Pentherer

2. Topley and Wilson's Microbiology and Microbial infections 9 th edi: Leslie Collier, Albert Balow Vol – 2 Systematic Bacteriology

3. Medical Laboratory Technology – Kanai. L. Mukherjee.

4. Sterilization and Disinfection – G. Sykes

5. Sterilization and Disinfection – Black.

6. Bailey and Scott's Diagnostic Microbiology: Forbes Sahm, Weissfeld

7. Foundations in Microbiology -Talaro, Taloro

8. Microbiology an Introduction – Tortora, Funke, Case.

9. Microbiology – Prescott Harly Klein.

10. Laboratory Experiments in Microbiology – Johson Case.

11. Microbiology in practice - Lois Beisheir.

12. Microbiology – A Laboratory Manual.- Cappuccino, Sherman

13. Microbiology – Pelczar, Chan, Krieg.

14. Introductory Immunology - Davie

15. Fundamental Immunology - Paul
16. Basic & Clinical Immunology - Daniel P. Stites.

PAPER IV - BASIC MEDICAL LABORATORY SCIENCE AND HAEMATOLOGY-I 130 Hours

BASIC MEDICAL LABORATORY SCIENCES –

1.Introduction to National Healthcare System-5 hours**

The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world. Topics to be covered under the subject are as follows:

- Introduction to healthcare delivery system a. Healthcare delivery system in India at primary, secondary and tertiary care b. Community participation in healthcare delivery system c. Health system in developed countries. d. Private Sector e. National Health Mission f. National Health Policy g. Issues in Health Care Delivery System in India
- National Health Programme- Background objectives, action plan, targets, operations, achievements and constraints in various National Heath Programme.
- Introduction to AYUSH system of medicine (not asked for University examination) a. Introduction to Ayurveda. b. Yoga and Naturopathy c. Unani d. Siddha e. Homeopathy
- Health scenario of India- past, present and future 5. Demography & Vital Statistics- a. Demography – its concept b. Significance and recording of vital statistics c. Census its impact on health policy
- Epidemiology a. Principles of Epidemiology b. Natural History of disease c. Methods of Epidemiological studies d. Epidemiology of communicable & non-communicable diseases, disease transmission, host defense, immunizing agents, cold chain, immunization, disease monitoring and surveillance.

2. **Medical terminologies and record keeping

This course introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes.

Topics include: origin word building abbreviations and symbols terminology related to the study. Spelling is critical and will be counted when grading tests.

Topics to be covered under the subject are as

- Derivation of medical terms.
- Define word roots, prefixes, and suffixes.
- Conventions for combined morphemes and the formation of plurals.
- Basic medical terms
- Form medical terms utilizing roots, suffixes, prefixes, and combining roots.
- Interpret basic medical abbreviations/symbols.
- Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.
- Interpret medical orders/reports
- Data entry and management on electronic health record system.

3.Basics of emergency care and life support skills**

Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA) and activation of the emergency response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED). Initial recognition and response to heart attack and stroke are also considered part of BLS. The student is also expected to learn about basic emergency care including first aid and triage.

Topics to be covered under the subject are as follows:

- Vital signs and primary assessment
- Basic emergency care – first aid and triage
- Ventilations including use of bag-valve-masks (BVMs)
- Choking, rescue breathing methods
- One- and Two-rescuer CPR
- Using an AED (Automated external defibrillator).
- Managing an emergency including moving a patient

At the end of this topic, focus should be to teach the students to perform the maneuvers

in simulation lab and to test their skills with focus on airways management and chest compressions. At the end of the foundation course, each student should be able to perform and execute/operate on the above mentioned modalities.

4. Medical law and ethics

- Medical ethics - Definition - Goal – Scope – 1hr
- Introduction to Code of conduct – 1hr
- Basic principles of medical ethics – Confidentiality – 1hr
- Malpractice and negligence - Rational and irrational drug therapy -1hr
- Autonomy and informed consent - Right of patients – 1hr
- Care of the terminally ill- Euthanasia – 1hr
- Organ transplantation – 1hr
- Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects. 2hrs
- Professional Indemnity insurance policy -1hr
- Development of standardized protocol to avoid near miss or sentinel events – 1hr
- Obtaining an informed consent- 1 hr

5. Basics of Medical Laboratory

- Common laboratory layout and design -level, category – research laboratories.- 3 hrs
- Role of Laboratory in Health care delivery – 2 hrs
- Care of laboratory wares, equipments and chemicals: general principles –3 hrs
- Glass – composition, properties, varieties, grades of glass wares. 2 hrs
- Making simple glass wares in the laboratory – glass blowing techniques- 2 hrs
- Common laboratory wares – PVC, polycarbonate, plastic. - 2 hrs
- Advantages and disadvantages of various disposable lab ware. – 1 hrs
- Cleaning of laboratory wares. Preparation of cleaning solutions. Care of

laboratory wares and utensils- 2 hrs

- Laboratory safety – General principles, laboratory hazards and safety measures, universal safety precautions - 3 hrs

6. Microscopes

- History and development of microscopes. – 1 hrs
- A brief review of light microscopes, its image formation, numerical aperture resolution, magnification. - 1 hrs
- Different types of objectives, eye piece, condensers and illuminations, their applications. -2hrs
- Methods of use of microscopes for the demonstration of wet films and dry preparations. – 30 min
- Care and safe use of microscopes. - 30 min
- Classification of microscopes.

  -Bright field monocular & binocular microscopes. - 1hr

  -Phase contrast microscope. - 1hr

  -Dark ground microscope. – 1hr

  -Fluorescent microscope. - 1 hr

  -Electron microscope. Principles, methods of safe working, different parts, use, preparation of smears for its examinations and application of the above microscopes. -2 hrs
- Micrometry – Light microscopic micrometry, Photographic micrometry and electron microscopic micrometer. – 2hrs

7. HAEMATOLOGY-I - 80 Hours

- Blood and blood components – normal blood cell morphology – 3 hrs
- Origin, development, maturation, function and fate of blood cells-10 hrs
- Capillary and Venous blood. Methods of blood collection and advanced techniques – 4 hrs
- Various anticoagulants, their functions, uses, advantages and disadvantages order of blood draw – 3 hrs
- Principles of staining, Romanowsky stains, preparations and staining properties of various Romanowsky stains with emphasis to Leishman's stain. Preparation and use of Buffer solutions in staining. 8 hrs
- Preparation of Blood smears. Thin smear, thick smear, wet preparations and buffy coat preparation. -4 hrs
- Leishman's staining - procedure and observation-3 hrs

- Different Leucocyte count in Blood smears with recognition of abnormal blood cells. -3 hrs
- Collection of bone marrow and Preparation of Bone marrow smears, Morphologic study of Marrow films and its differential count. Indications of Bone marrow aspiration. -5 hrs
- Different types of Haemocyto meters their rulings- 3 hrs
- Total count of RBCs, WBC (with correction of NRBC), Eosinophils and platelets. Micropipette methods and Bulk dilution technique, their advantages and disadvantages. Composition, function, preparation, and storage of various diluting fluid. Errors in sampling, mixing, diluting, and counting, Quality control methods in cell counts-8 hrs
- Automatic Blood cell counters. – 5 hrs
- Haemoglobin and Estimation of Haemoglobin – Principles, techniques, advantages, and disadvantages of different methods. Normal and abnormal values. Errors and quality control in various methods. – 5 hrs
- Abnormal Haemoglobin Method of identification of abnormal Haemoglobin. Sickling phenomenon. Hb-F and its demonstration. Haemoglobin electrophoresis- 8 hrs
- Principles and different methods of determining ESR and PCV. Advantages and disadvantages of each method. Clinical significance of ESR and PCV, Normal values. - 3 hrs
- Methods of determination of Red Cell Indices (MCV, MCH, MCHC and Colour Indices) and its significance. - 2 hrs
- Supravital staining technique – Principles and uses, Demonstration and counting of Reticulocytes. Composition and preparation of Brilliant Cresyl Blue and New methylene blue stains. - 3 hrs

Practical

- Care and use of light microscope
- capillary and venous blood collection
- Preparation of anticoagulated bottle
- Preparation of Romanowsky staining solutions
- Preparation of diluting fluids for cell counts.
- Preparation of thick and thin smears and their staining
- Haemoglobin estimation- cyanmethaemoglobin method and Sahli's method
- ESR determination

- RBC count
- WBC count
- Differential count
- Platelet count
- Absolute eosinophil count
- Reticulocyte count
- PCV, Red cell indices.
- Osmotic fragility test

Reference Books

1. Laboratory acquired infections – C.H. Collins.

2. Clinical Diagnosis and Management by Laboratory methods – Todd, Sandford, Davidson

3. Manual of clinical laboratory methods-Copal.E.Hopier

4. Medical laboratory methods-Dr. Ramnik sood

5. Clinical laboratory methods-Beu

6. Introduction to Medical laboratory technology-Baker

7. Practical haematology- Dacie and Lewis

SECOND YEAR

PAPER V BIOCHEMISTRY II 90 hours

1. CARBOHYDRATE METABOLISM: 15 hrs

- Glycolysis, Cori's Cycle, Oxidation of pyruvates. Citric Acid Cycle, Hexose Mono Phosphate Shunt Pathway,
- Glucuronic acid Pathway, Gluconeogenesis, Glycogenolysis, Regulation of Glycogen Metabolism, Fructose Metabolism, Galactose Metabolism, Glyoxylate Cycle, Hormonal regulation of Blood Glucose,
- Hyperglycemia Diabetes Mellitus, Diabetic Ketoacidosis, Glycosuria, Hypoglycemia, Pentosuria, fructosuria, galactosemia Glycosylated Hemoglobin.
- Investigation of disorders of carbohydrate metabolism: glucose, HbA1C , Glucose tolerance tests

2. METABOLISM OF PROTEINS & AMINO ACIDS 12 hrs

- Metabolism of individual amino acids. Catabolism of Amino Acids, Formation of Ammonia, Transamination and Oxidative deamination. Urea Cycle.
- Formation of Creatine and Creatinine. One Carbon Metabolism, Conversion of amino acids to specialized products.
- Principles and methods for the estimation of Urea, creatine, creatinine, Total protein and Albumin

3. METABOLISM OF LIPIDS 15 hrs

- Oxidation of fatty acids, Biosynthesis of fatty acids, Ketogenesis.
- Biosynthesis of Triglycerides, Phospholipids & Sphingolipids ,
- Biosynthesis of cholesterol & Bile Acids, Plasma Lipoproteins, Apo lipo proteins & Lipoprotein metabolism
- Obesity, Fatty Liver, Lipotropic factors and ketosis
- PUFA , Lipid per oxidation & Eicosanoids-Prostaglandins & Leukotrienes
- Lipid and Lipoprotein measurements- blood sampling and storage, Estimation of lipids-Cholesterol,Triglycerides, Phospholipids & lipoproteins- Colorimetric and enzymatic methods

4. Inter – relation between the metabolism of Carbohydrate, lipids and proteins, 5 hrs

- Generation of ATP, substrate level phosphorylation and; Oxidative phosphorylation, Electron transport chain

5. **NUCLEIC ACID METABOLISM** 8 hrs

- Biosynthesis of Purine and Pyrimidine nucleotides, denovo and salvage pathway ,
- Degradation of purine and pyrimidine nucleotides ,
- Principles & methods for the estimation of Uric acid

6. COMMON INBORN ERRORS OF METABOLISM 10 hrs

- Disorders of Carbohydrates metabolism – Glycogen storage diseases, galactosemia, fructose & Lactose intolerance
- Disorders of lipid metabolism-DYSLIPOPROTEINEMIA- Hypolipoproteinemia, Hyper lipo proteinemia ,Atherosclerosis and sphingolipidosis.

- Disorders of Amino Acid metabolism, Cystinuria, Haemoystinuria, Cystathionuria, Phenyl ketonuria, Alkaptonuria, Albinism. Maple Syrup Urine diseases, Hartnups's diseases.
- Disorders of Nucleic acid metabolism - Gout, Lesch-Nyhan Syndrome, Laboratory diagnosis of Inborn errors of metabolism

7. NUTRITION 5 hrs

- Nutritional importance and Calorific value of food- BMR, Protein energy malnutrition- Kwashiorkor and Marasmus

8. URINE - 5 hrs

- Composition of normal and abnormal constituents
- Routine examination of Urine, Specific gravity, reactions, detection of protein, reducing sugar, ketone bodies, bile pigment, bile salts, Urobilinogen, and blood in Urine.
- Urinary screening for Metabolic inherited diseases

9. C.S.F AND OTHER BODY FLUIDS 5 hrs

- Physical and chemical examinations, Estimation of sugar, protein and chloride
- Composition and Chemical analysis of Synovial, Pleural, Peritoneal, Pericardial, Amniotic fluid etc
- Estimation of sugar, protein and chloride in CSF

10. Common Laboratory methods-10 hrs

- estimation and its interpretation of Glucose, protein, Cholesterol (total Cholestrol, HDL, LDL &;VLD L), Uric Acid, Creatine, Creatinine, Urea, Triglyceride, phospholipids, Total lipids, Glycosylated Haemoglobin and tests for inborn errors of Amino acid metabolism

BIOCHEMISTRY – II

PRACTICAL 174 hours

- Estimation and standardization of Blood/Serum/Plasma constituent's glucose, Urea, Total protein, Albumin, Cholesterol, Triglyceride, Phospholipids, total lipid ,Uric Acid, Creatine, Creatinine, Ammonia, Non- protein nitrogen, Amino Acid

Nitrogen

- Qualitative detection of normal and abnormal constituents of Urine.
- Quantitative analysis for Urine protein, Bence-Johne's protein, Reducing sugars ,and chloride in Urine,Urea, Creatinine, Uric Acid, Aminoacids, Ammonia, Keto acids in Urine.
- Estimation of sugar, protein and chloride from C.S.F., plural fluid, peritoneal fluid, amniotic fluid – foam test
- Glucose tolerance test and GCT
- Estimation of Ketone bodies in blood and urine.
- Estimation of Glycosylated Haemoglobin
- Tests for inborn errors of Amino Acid metabolism in Urine.

RECOMMENDED TEXT BOOKS:

1. Harper's Biochemistry: R. K. Murray and Grannor
2. Test book of Biochemistry: Vasudevan , Sreekumari and Kannan Vaidyanathan
3. Practical – Clinical Biochemistry - Volume 1: Harold Yarkey
4. Clinical Biochemistry - Principles and Practice: Praful B. Godkar
5. Gradwohls Clinical Laboratory methods and diagnosis: Alex c Sonnenweth and Leonard Jarett

REFERENCE BOOKS

1. Henrys Clinical diagnosis and management by Laboratory methods -Richard A McPherson and Matthew R Pincus
2. Lehninger: Principles of Biochemistry , Nelson, D.L. and Cox, M.M., W.H.
3. Biochemistry – Lubert STRYER
4. Biochemistry - David Voet and J.G Voet
5. Text book of Clinical Chemistry: Novert W. Teitz
6. Biochemistry with Clinical Correlation: Devlin
7. Harrisons Principles of Internal Medicine: Jameson Fauci, Kasper Hauser and Longo Loscalzo
8. Clinical Diagnosis and Management: John Bernard Henry
9. .Biochemistry - David Voet and J.G Voet
10. Outlines of Biochemistry by E.E Conn & Stump
11. Biochemistry by Geoffry L Zubay

Paper VI

GENERAL MICROBIOLOGY – 90 hours

Topics

- Classification and taxonomy of microorganisms.
- Bacterial growth and Nutrition – Batch culture, Continuous culture, growth curve, total count and viable count.
- A brief description on microbial metabolism, catabolism, respiration and Anabolism.
- Physical conditions required for bacterial growth- Oxygen, CO, Temperature, water,pH, Light, osmotic pressure.
- Major requirements and common nutritional requirements of culture media.
- **Media for microbial growth**– classification of media
  - Routine laboratory media like
  - Basal - Peptone water, Nutrient broth, Nutrient agar
  - Enriched - Blood agar, Chocolate agar, R.C.M
  - Enrichment - Alkaline- Peptone Water, Selenite F broth
  - Selective - Mac Conkey agar, XLD, DCA, TCBSA, L.J.medium, Tellurite blood agar, Mannitol salt agar

  -Differential - Mac Conkey agar, CLED.
  - Transport media.

  -Anaerobic media.
  - Principles and method of preparation of media, pH adjustments- different methods, sterilization and storage of different types of media.

• Quality control in culture media and preparation.

- Cultivation of Bacteria – Equipment and devices used in the cultivation of bacteria.
- Standardization of wire loop.
- Inoculation methods, incubation methods, Inoculation on different types of culture media in Petri dishes, Slopes, Butt, and Broths.
- Morphological study of bacterial colonies on plated media.
- Growth characteristics of bacteria in liquid media.
- Anaerobic culture techniques and incubation methods.

Quantitation of Microorganisms:

- Quantitation of microorganisms - using the photoelectric colorimeter and spectrophotometer.
- Total count and viable count
- A brief description of measuring bacterial growth by determining its dry weight, wet weight, and total nitrogen concentration
- Preparation of Mc Farland standard and its interpretation / Simple opacity tubes.

Biochemical Tests

- Tests for identification of bacteria, detailed study of the principle, preparation of media, reagents used, different methods, interpretation and quality control for the following identification tests.
- Tests for the metabolism of Carbohydrates- OF test, simple sugar media, TSI/KIA citrate utilization, MR, VP tests
- Tests for the metabolism of proteins and Amino acids- Indole, PPA, Gelatin liquefaction, decarboxylation test, Lysine Iron Agar
- Tests for enzymes. - Catalase, Urease, Nitrate reductase, Coagulase, and Oxidase, ONPG
- Test for the metabolism of fat.
- Rapid identification tests.

Typing methods

- A brief description of methods of Bio typing, Serotyping, Bacteriocin typing and Phage typing.

Bacterial genetics

- General Principles of Bacterial Genetics
- Genotypic Phenotypic variation, Operon model of gene expression
- Mutation -Types of mutation, Mutagens, Isolation of mutants
- Gene transfer – Transformation, Conjugation, Transduction
- Plasmids & Transposons.

Care and management of laboratory animals

- A Basic knowledge of the feeding, housing, breeding and care of the following animals-rabbit, rat, mouse, guinea pig.
- Handling and care of normal and infected animals in the laboratory and in the animal house.

- Collection of blood samples, preparation of RBC suspension, transport of animal specimens
- Different routes of animal inoculations: scarification, subcutaneous injections, intravenous inoculation, intra-peritoneal inoculations, intramuscular inoculations, intracerebral, intra-testicular inoculation.
- Animal House records
- Killing of animals and post- mortem examination.
- Disposal of dead animals

PRACTICALS 174 Hrs

- Preparation and use of pH indicator solutions.
- Preparation of Reagents used for pH adjustments, use of p H Paper,
- Adjustments of pH for Acidic medium and alkaline medium by using Lovibond Comparator .
- Cleaning and preparation of glassware for media preparation and sterilization
- Preparation of sterile normal saline.
- Students should be familiar with commonly used laboratory media and should know its sterilization, Quality control and storage. Peptone water, Nutrient broth, Nutrient agar, Blood agar, Chocolate agar, R.C.M , Alk. Peptone,Water, Selenite F broth, Mac Conkey agar, XLD, TCBSA, L.J.medium, Transport medium (anyone) and other Media routinely used for the isolation for medically important bacteria.
- Preparation and standardization of bacterial loop.
- Inoculation methods on plate media, liquid media, slope and butt media
- Inoculation and isolation of pure and mixed bacterial cultures
- Study of colony morphology on different media and growth characters.
- Viable count of bacteria from a culture. Preparation of standard opacity tubes.
- Aerobic and Anaerobic incubation techniques
- Preparation, Sterilization, Quality control, Inoculation and use of Biochemical media and its reagents used in bacteriology.
- Preparation of Reagents like methyl red indicator, V.P. reagent, Nitrate reagent,Ferric Chloride. ONPG, H 2 O 2 , Oxidase reagent, Kovac's reagent, Ehrlich's reagent.
- Inoculation methods and quality control in different Biochemical media and interpretation.

- Anaerobic cultivation methods - Anaerobic jar - Other methods-Quality control
- Students should visit an Animal house and observe the organization and management of animal houses and their stock. Also, they should observe the management of animals on experiments, safe handling of laboratory animals like Rabbit, Rat, Mouse, Guinea Pig and disposal of dead animals

RECCOMMENDED BOOKS

1. Mackie & McCartney practical medical Microbiology - Colle. Fraser, Marmion, Simmons
2. Medical Laboratory Manual for Tropical Countries Vol - 2 Monica Cheesbrough

REFERENCE BOOKS

1. Medical Microbiology - David g[illegible] Wood, Slack Peutherer.
2. Topley and Wilson's Microbiology and Microbial infections 9th Edn: Leslie Collier, Albert Balow Vol – 2 Systematic Bacteriology.
3. Cowan & Steel's Manual for the Identification of Medical Bacteria – G.I Barron. K.K.A.Feltham.
4.MacFADDIN-Text book for biochemical tests for identification of medical bacteria
5.PRESCOT -Text book of microbiology.
6.Bailey and Scott's-Diagnostic microbiology- Forbes, Sahm, Weissfeld.
7.Pelczar-text of microbiology

Paper VII

PARASITOLOGY & ENTOMOLOGY - 90 hours

Topics

PARASITOLOGY 45 Hours

An elementary study of the types of animal associations, parasitism, commensalism and Symbiosis.

Types of Parasites. Classification of protozoa and Helminthes.

An elementary knowledge of the structure and life history of parasites belonging to the following genera with reference to the forms seen in human pathological material and the methods used to identify them.

a. **Protozoa** : Entamoeba, Dientamoeaba, Iodomoeba, Trichomonas, Trypanosoma, Leishmania, Giardia, Plasmodium, Isospora, Balantidium, Toxoplasma, Pneumocystis carrinii, Cryptosporidium, Babesia.

b. **Platyhelminthes:** Diphyllobothrium, sparganum, Taenia, Echinococcus, Hymenolepis, Schistosoma, Fasciola, Fasciolopsis, Clonorchis, Paragonimus

c. **Nemathelminthes**: Ascaris, Ancylostoma, Necator, Strongyloides, Trichinella, Enterobius, Trichuris, Filarial worm.

Collection, preservation and transport of specimens for parasitological examination, preservation of specimens of parasite eggs or embryos, preserving fluids.

Detection of Intestinal parasites: Detection and identification of amoeba and other intestinal protozoa and other parasites in fecal samples.

Detection of Blood parasites: Detection and identification of Malaria, Microfilaria and other

blood parasites, Quantitative buffy coat.

Examination of biopsy material and other body fluids: Brief account of spleen puncture for diagnosis of kala–azar, bone marrow biopsy, lymph node, and skin biopsy for parasites.

Examination of urine for parasites.

Serological tests used.

Practical: 87 Hours

- Identification of parasites of medical importance dealt in the theory.
- Macroscopic and microscopic examination of stool for adult worms, ova, cysts, Larvae.
- Concentration techniques for intestinal parasites in stool.
- Collection of blood and preparation of thin and thick smears.
- Staining of blood smears for blood parasites.
- Examination of blood smears for malaria and microfilaria and their identification.

ENTOMOLOGY 45 hours

Introduction. Classification of Arthropods of Public Health Importance.

- Role of Arthropods in the transmission of diseases.
- Mosquito: Morphology, Lifecycle, Bionomics and public health importance of anopheles, Culex, Aedes and Mansonia.

- Mosquito Control: Various methods. Mosquito – borne diseases and their control.
- Phlebotomes (Sand fly): Morphology, Life cycle, public health importance and control.
- House Fly: Morphology, life cycle and public Health importance.
- Black Fly (Simulium) morphology, life cycle, public health importance and control.
- Fleas : Morphology, life cycle disease transmitted and control
- Louse: Morphology, lifecycle, disease transmitted and control.
- Bedbug: Morphology, Life-cycle, disease transmitted and control.
- Ticks: Morphology, Life cycle, disease transmitted and control.
- Trombiculid: Morphology, Lifecycle, disease relationship and control.
- Sarcoptes scabiei: morphology, life cycle, Public Health Importance and control.
- Cyclops: Morphology, Public Health importance and control.
- Reduviidbug: Morphology, Public Health importance and control.
- Tsetse fly: Morphology, Public Health importance and control.
- Insecticides used for the control of Arthropods of Public Health Importance, classification, Insecticide resistance, Bioassay test.

Practical 87 Hours

- Identification of arthropods of Medical importance dealt in the theory.
- Identification up to genera of common vectors of Malaria, Filariasis, Japanese Encephalitis and Dengue.
- Collection and preservation of arthropods of public health importance.
- Preparation of permanent mounts of arthropods of public health importance. (Minimum 10 slides)
- Dissection of Mosquitoes to display mouth parts, wings, and legs.

Books recommended:

1. Medical parasitology: N.C.Dey.
2. A guide to medical entomology: W. W. Service.
3. Entomology in human and animal health: Harwood and Maurice T. James.
4. Text book of Medical parasitology- K. D. Chatterjee.
5. Medical Laboratory Manual for Tropical Countries Vol-1 Monica Cheesbrough.
6. Text Book of Parasitology- Jayaram Panicker.

REFERENCE

1.Medical Parasitology- D.R. Arora.

Paper VIII

HEAMATOLOGY-II AND CLINICAL PATHOLOGY

90 HOURS

Topic

HEAMATOLOGY-II - Section – A 60 Hours

- Morphology of Red cells in health and diseases. -2 hrs
- Systematic methods of examination of Blood Film (Blood picture) and Reporting. -1 hr
- Definition, classification and etiology of anaemia. -1hr
- Disorders of structure and synthesis of Haemoglobin. -7 hrs
- Principle, method and significance of Ham's test.-1 hr
- Laboratory diagnosis of various types of anaemia.- 5 hrs
- Polycythaemia, Polycythaemia vera.-1.hr
- Leucocytosis, Leucopenia, Eosinophilia, Neutrophilia, Basophilia, Lymphocytosis, Monocytosis,Agranulocytosis -3 hrs
- Infectious mononucleosis. -2 hrs
- Definition and classification of Leukaemia-2 hrs
- Blood and Bone marrow findings in Acute Myeloid Leukaemia (AML) Acute Lymphatic (ALL),Chronic Mycloid Leukaemia (CML), Chronic lymphatic Leukaemia(CLL), Leukaemoid Blood Reactions.- 5 hrs
- Multiple myeloma. -2 hrs
- Cytochemistry – Peroxidase, PAS, LAP, esterase.-2 hrs
- Perl's Staining and its significance. -1hr
- Identification of parasites (Malaria, Microfilaria, L.D. bodies and Trypanosomes) in Blood and Bone marrow films- 2 hrs
- General introduction to Bone marrow transplantation techniques-2hrs

- LE phenomenon and demonstration of LE cell, Principle -2 hrs
- Coagulation factors, mechanism of blood coagulation, Fibrinolytic system. -3 hrs
- Disorders of coagulations. -4 hrs
- Laboratory methods used in the investigation of haemostasis:- Clotting time, Bleeding time, Partial Thromboplastin time, Plasma prothrombin time, INR. Thromboplastin generation time,Prothrombin consumption time, Thrombin time, Test for fibrinogen degradation product. Test for fibrinolysis. Assay of plasma fibringen.-4 hrs
- Haemophilia and its laboratory parameters. -3 hrs
- Disorders of Platelets and Blood vessels. -2 hrs
- Platelet function test.2 hrs
- Automation and Recent advance in Haematological Techniques-2 hrs

CLINICAL PATHOLOGY - Section B

30 Hours

1. Urine

- Microscopical examination of urine, collection of urine and its preservation, Colour, cloudiness, specific gravity, reaction, Ph -3 hrs
- Different methods for detection, importance and its interpretation of – Protein, Sugar, Bile pigment, Bile salt, Urobilinogen, ketone bodies, Bence-Johnes proteins Blood-4 hrs
- Examination and identification of sediment for: various cells, crystals, casts, parasites. -1 hrs
- Concentration methods for examination identification of urine sediment for: Gonococci, Trichomonas vaginalis, monilia. -1 hrs
- Pregnancy test-Production of HCG, HCG level at various stages of pregnancy, pregnancy test, Different types of pregnancy test such as Gravindex test& card test. Method of urine collection, Compare their advantage, disadvantages accuracy. -3 hrs

2**. Faeces**

- Examination of motion sample for: colour, mucous, consistency, ova, Amoeba, cyst, Parasites, Pus cells, RBCs& crystals. Concentration techniques-2 hrs
- Detection of occult blood in stool, measurement of faecal urobilinogen and; faecal fat, their importance interpretations. -2 hrs

3. Sputum

- Method for the collection, examination of sputum for AFB, sputum in disease conditions. -2 hrs

4. Semen

- Methods of collection, Macroscopic and microscopic examination of semen, Motility, count, other findings. -3 hrs
- Staining and morphological studies of spermatozoa, importance & interpretation in each step of investigation in case of infertility. -4 hrs

5. Cerebrospinal Fluid

- Collection, transport, preservation, storage, examination and interpretation total and differential count, staining methods, CSF in disease. -2 hrs

6. Other Body Fluids

- Examination of Ascetic fluid, Pleural fluid, Pericardial fluid, Synovial fluid. -3 hrs

Practical 174 Hours

- Peripheral blood smear examination and reporting
- Haemoglobin electrophoresis
- Blood cell cytochemistry- Peroxidase, PAS, LAP, Esterase
- Perl's stain
- Osmotic fragility test
- Sickling tests
- LE cell demonstration
- Bleeding Time, Clotting Time, PT and APTT, clot retraction test, fibrinolysis test
- Ham's test
- Serum electrophoresis of myeloma proteins.
- Familiarisation of automation in Haematology
- Urine analysis, pregnancy test
- Examination of feces, detection of occult blood in stool, fecal urobilinogen and fecal

  fat detection
- Semen analysis
- Examination of CSF
- Examination of body fluids
- Examination of sputum

Books recommended for reference

1. Lynch's Medical Laboratory Technology -Raphael
2. Gradworl clinical laboratory methods and diagnosis
3. Medical laboratory technology and clinical pathology - Lynch,Raphael,Meller
4. Manual of clinical laboratory methods -Copal.E.Hopier
5. Medical laboratory methods -Dr.Ramnik sood
6. Clinical laboratory methods -Beuer.
7. Introduction to Medical laboratory technology -Baker
8. Clinical pathology and bacteriology -Sachdev
9. Clinical pathology -Batra.
10. Hand book of routine urine analysis - Graft
11. Practical hematology - Dacie and Lewis.

THIRD YEAR

Paper IX - Biochemistry-III - Theory: 100 HOURS

1. VITAMINS AND CO-ENZYMES: 12 hrs

Vitamins- water soluble-Chemistry, sources, RDA, Biochemical role , Deficiency and assay

Vitamins Fat soluble-chemistry, sources, RDA, biochemical role, Deficiency, toxicity and assay

Estimation of Vitamin A, C, E and D

2. ENZYMES 30 hrs

Classification , Co-enzymes, Co factors, Mechanism of enzyme action, factors affecting in Enzyme action ,Enzyme Kinetics, Michaelis Menton constant, Enzyme Inhibition , Regulatory enzymes, Immobilization of enzymes

Clinical Enzymology - Enzyme activity determinations-End point assay and Kinetic assay.

Principles & Methods for the activity determination of Phosphatases, Transaminases, Amylase, lipase,Lactate dehydrogenase, Creatine kinase, Ceruloplasmin, Glucose 6 phosphate dehydrogenase, Aldolase, 5'-Nucleotidase, Leucine Amino peptidase, Gamma glutamyl transpeptidase, Choline esterase, Enolase ,Isocitrate dehydrogenase

Isoenzymes in Diagnostic Biochemistry, Plasma isoenzyme pattern in diseases- MI,

Liver disease, Muscle disease etc

3. HAEMOGLOBIN 15 hrs

Chemistry and properties of Haemoglobin and myoglobin, Chemistry of respiration,Transport of gases.Oxygen dissociation curve, Isohydric transport of Carbon dioxide,Biosynthesis of Haemoglobin, Catabolism of Haem, Bile pigments-Bilirubin and related chromoproteins.Haemoglobin derivatives , Haemoglobin variants, Jaundice

Principles & Methods for the estimation of Direct and total Bilirubin, Urobilinogen and urobilin Congenital disorder of haem metabolism

4. PORPHYRINS 7 hrs

Porphyrins and disorders of porphyrin metabolism.

Chemistry of porphyrins ,

Porphyrias: primary and secondary porphyrias and its analytical procedures.

Methods for the estimation porphyrias and its precursors in urine

5. ANALYTICAL CALCULI 4 hrs

Urinary & Biliary calculi

6. ELECTROPHORESIS 12 hrs

Introduction, Theory of electrophoresis, General methods , instrumentation and application of Electrophoresis- paper, gel, disc and Immuno electrophoresis, isoelectric focussing.

Electrophoresis of Serum protein and its interpretations, Electrophoresis of Haemoglobin and its interpretations.

Electrophoresis of Lipoproteins and its interpretations

7. CHROMATOGRAPHY 12 hrs

Introduction , Principle, experimental technique, and application of different types of chromatography

Forms of chromatography -absorption, ion exchange, gel, affinity , paper, thin layer, HPLC and gas liquid chromatography.

Chromatography of Aminoacid , Aminogram and chromatography of sugars & lipids.

8.IMMMUNOLOGICAL METHODS AND RELATED TECHNIQUES 8 hrs

Antigen- Antibody reactions. Immunodiffusions (ID), Immuno electrophoresis, Radioimmunoassay (RIA),

ELISA and Fluorescent immunoassay (FIA)

Receptor assays

PRACTICALS - 200 hours

1. Estimation of Vitamin A,C,E , D and Metabolites of Vitamins in Urine (B complex)
2. Activity determination of Clinically important enzymes- Alkaline Phosphates , Acid phosphates, Alanine amino transferase , Aspartate aminotransferase, Amylase, Ceruloplasmin, LDH, CPK and G6 PD
3. Testing and semi quantitative assessment of urobilinogen in urine estimation of urobilin in urine. Estimation of porphyrin and porphobilinogen
4. Estimation of bilirubin – Total and direct
5. Qualitative analysis of Urinary calculi.
6. Estimation of Haemoglobin, myoglobin and abnormal haemoglobins- Hb electrophoresis
7. Identification of substances by column chromatography, Thin layer chromatography, paper chromatography, amino acids (Amino gram) and sugars.
8. Technique of paper electrophoresis, agar gel electrophoresis of serum proteins, Polyacrylamide gel electrophoresis of serum proteins & Lipoproteins
9. Technique of RIA (T3, T4 and TSH) and ELISA.

Recommended text books

1. Harper's Biochemistry: R. K. Murray and Grannor
2. Test book of Biochemistry: Vasudevan , Sreekumari and Kannan Vaidyanathan
3. Practical – Clinical Biochemistry - Volume 1: Harold Yarkey
4. Clinical Biochemistry - Principles and Practice: Praful B. Godkar

5. Gradwohls Clinical Laboratory methods and diagnosis: Alex c Sonnenweth and Leonard Jarett
6. Wilson and Walker Principles and techniques of biochemistry and Molecular biology –Andreas Hofmann and Samuel Clokie
7. Chromatpgraphic & Electrophoretic Techniques :Principles and practices - Fulcin Saltan and Ozlem Bagadirq

Reference books

1. Henrys Clinical diagnosis and management by Laboratory methods -Richard A McPherson and Matthew R Pincus
2. .Lehninger: Principles of Biochemistry , Nelson, D.L. and Cox, M.M., W.H.
3. Biochemistry – Lubert STRYER
4. Biochemistry - David Voet and J.G Voet
5. Outlines of Biochemistry by E.E Conn & Stump
6. Biochemistry by Geoffrey Zubay
7. Understanding enzymes: Palmer T., Ellis Harwood ltd.
8. Enzyme structure and mechanism. Alan Fersht, Freeman & Co.
9. Principles of enzymology for food sciences: Whitaker Marc Dekker
10. Methods in enzymology Ed. Colowick and Kaplan, Academic Pr (Continuing series)
11. Chrpmatographc methods –F.J. Smith A Braitheaite
12. Reiner Westermeier Electrophoresis in practice

Paper X

BACTERIOLOGY - 100 hours

Topics

1. SYSTEMATIC BACTERIOLOGY

Detailed Systematic and diagnostic study of bacteria (emphasis should be given for medically important pathogenic and related organisms). A detailed study of the

general characteristics, classification, different pathogenic species, non-pathogenic species (brief account only), morphology, staining characters, cultural characteristics in different culture media, susceptibility to physical and chemical agents, biochemical reactions, antigenic properties, special tests for identification of species, epidemiology, specimens and their collection, lab diagnosis,

antimicrobial susceptibility of the following bacteria.

• Staphylococcus, Streptococcus, Pneumococcus, Anaerobic cocci, Neisseria species

- Listeria, Bacillus, Clostridium, Pseudomonas, Burkholderia, Legionella, Non-fermenting gram negative rods, Bordetella, Brucella, Haemophilus, Pasteurella, Franscisella
- Entero bacteriaceae (brief introduction of all the genus and detailed study for the medically important genus such as Escherichia, Klebsiella, Serretia, Enterobacter, Citrobacter, Proteus, Morganella, Providencia, Salmonella, Shigella, Yersinia)
- Mycobacteria.
- Actinomyces, Nocardia.
- Vibrio, Aeromonas, Plesiomonas.
- Campylobacter, Helicobacter.
- Bacteriodes & other non sporing anaerobes, Chlamydia, Rickettsiae, Mycoplasma. Spirochaetes
- Preservation of bacteria.
- Normal flora in a healthy human body.

2. DIAGNOSTIC BACTERIOLOGY

Specimen processing

● Collection, preservation, transport and processing of clinical specimens for the diagnosis of bacterial infections.- Urine, Pus, CSF, Blood, Stool, Rectal swab, Body fluids, Exudates, Sputum, Throat swab, Eye specimens, Ear specimens, Tissues, Skin specimens.

3. Antibiotic susceptibility tests

● Basic knowledge of various antimicrobial agents and their action on microbes.

● Detailed study of different methods of antibiotic susceptibility tests, media used preparation of antibiotic disc, selection of drugs, quality control drug resistance, beta lactamase detection, antibiotic assay in blood and body fluids.

4**. Bacterial infections and clinical syndromes**

Detailed study of multiple etiology involving microorganisms and their laboratory diagnosis for the following clinical syndromes.

- Pyrexia of unknown origin, Enteric fever.
- Upper and lower respiratory tract infections, pleuropulmonary and bronchial infections,Tuberculosis.
- Urinary tract infections.
- Sexually transmitted diseases.
- Gastrointestinal infections, food poisoning, peritonitis.
- Infections in central nervous system – meningitis.
- Skin and soft tissue infections.
- Eye infections.
- Students should know lab diagnosis of the following clinical conditions
- Brucellosis, Q fever, Gas gangrene, Diphtheria, Rat bite fever, Relapsing fever, Rheumatic fever,Plague, Leptospirosis, Anthrax, Leprosy, Bacterial vaginosis
- Bacterial infections in the immune compromised patient.

5. Bacterial Serology

Students should know in detailed the serodiagnosis of bacterial infections such as:

- Enteric fever – Widal test
- Syphilis – STS- VDRL Test, RPR, Treponemal tests-TPHA, TPI, FTA-ABS
- Streptococcal infections- ASO Test, Anti DNAase B, Anti hyaluronidase test
- Brucellosis
- Rickettsial fever
- Primary atypical pneumonia.

(An illustrative knowledge of collection of specimens, preservation, principles, preparation of antigens, methods, and interpretation).

Practical 174 Hours

Identification of medically important bacteria from pure culture.

- Staphylococcus.
- Streptococcus.
- Meningococcus, Gonococcus.
- Escherichia, Klebsiella, Serratia, Proteus, Salmonella, Shigella.
- Pseudomonas, Acinetobacter.

- Vibrio.
- Haemophilus.
- Students should be familiar with the collection, transportation and processing of all type of clinical specimens for the diagnosis of bacterial infections discussed in theory.
- Different methods and interpretation of antibiotic sensitivity tests
- Isolation and identification of Mycobacterium tuberculosis from clinical specimens.Preparation of smear, staining, culture and reporting, concentration technique for the diagnosis of tuberculosis.
- Examination of specimens from patient for the diagnosis of leprosy.
- Bacterial Serology
- Antigen preparation and standardization for Widal test. Widal test technique and interpretations
- VDRL Test, RPR, TPHA
- ASO Test
- Brucella agglutination test.

Recommended Books

1. Medical Microbiology - David green Wood, Slack Pentherer
2. Mackie & Macartney practical medical Microbiology - Colle. Fraser, Marmion, Simmons
3. Text Book of Microbiology :Ananthanarayanan & Jayaram Paniker
4. Medical Laboratory Manual for Tropical Countries Vol-2 Monica Cheesbrough.
5. Bailey and Scott's Diagnostic Microbiology :Forbes Sahm, Weissfeld

REFRENCE BOOKS

1. Topley and Wilson's Microbiology and Microbial infections 9 th edi: Leslie Collier, Albert Balow Vol – 3 Bacterial Infections
2. Medical Bacteriology - C. H. Collins
3. Principles and Practice of Infectious diseases – Mandell, Bennett, Dolin Vol-1
4. Colour Atlas and Text book of Diagnostic Microbiology Koneman &

Allan Janda

5. Basic Laboratory Procedure in clinical Bacteriology WHO, Geneva.
6. Gradwohl's Clinical Laboratory Methods and diagnosis Vol – 2- Alex. C.Sonne.
7. Medical Microbiology – Murray, Kobayashi.
8. Medical Microbiology – Mims, Play fair, Roitt.
9. Microbiology and Infection – Inglis.
10. Microbiology Pelczar, Chan, Krieg

Paper XI

CYTOLOGY & TRANSFUSION TECHNOLOGY - 100 HOURS

Topic

CYTOLOGY - Section A **40 Hours**

Introductions to Cytology

- History, development, and scope of cytology. -2 hrs
- Cell structure, function, cell cycle, division with recent advances. -4 hrs
- Cytology of epithelial and connective tissues. – 3 hrs

Cytopathology Techniques

- Fixation of Cytology specimens – various fixatives, pre fixation, coating and spray fixation,advantages and disadvantages. -2 hrs
- Staining – Routine cytology stain Pap, MGG, H&E advantages and disadvantages. -3 hrs
- Collection, preparation of gynaecological and non-gynecological specimens- exfoliative cytology. -Gynecological – vaginal, cervical, endocervical, endometrial- 2 hrs
- Non-gynecological – sputum, bronchial, Body fluids (serous effusions), CSF, urine. - 3 hrs
- Concentration technique in cytology - Centrifugation, cyto-centrifugation, membrane filters, cell blocks. – 2 hrs

- Liquid based cytology – monolayer preparation. -1 hrs

Female Genital Tract Cytology

- Cervical cytology: Normal cells in cervical smear, inflammatory lesions of the female genital tract –specific and nonspecific inflammation. -3 hrs
- Hormone cytology. -2 hrs
- Respiratory tract cytology – sputum, bronchial materials. -2 hrs
- Urinary cytology – urine. -2 hrs

Other Body Fluids

- Serous effusions.-1hrs
- CSF. -1 hr
- Gastro Intestinal Tract cytology. -1 hr
- Fine Needle Aspiration Cytology – Scope, advantages, and disadvantages, -2
- Organization of cytology lab. -1hr
- Cytology laboratory safety. -1hr
- Quality control measures in cytology. -1hr
- Automation in cytology – Preparation, staining, Auto screening. 2 hrs

TRANSFUSION TECHNOLOGY- Section B 60 Hours

- General introduction to Blood Banking. -1hr
- Blood group and its inheritance. Laws of Heredity. -1hr
- ABO blood group system and its distribution. -2hr
- Inheritance and distribution of Rhesus system. General introduction to Rh system. -3 hrs
- Antigen Antibody reactions in immune Haematology -1hr
- Naturally occurring and immune antibodies. Complement and Blood group antibodies1 hr
- Preparation of grouping sera. -2 hrs
- General methods of Antigen and antibody detection -1hr
- ABO grouping methods and factors influencing - 2 hrs
- Rh-typing methods (using complete and incomplete anti-D). -1 hr
- The MNs blood group system. P-Blood group system. Lutheran Blood group system. Kell Blood group system, Lewis Blood group system. Duffy

Blood group system, kid blood group system, Private Blood group, Bombay Blood group. Diego and I / I system. Du Antigen and their importance. -3 hrs

- Blood bag materials, preparation, type- sterilization and disposal of outdated blood bags. -1hr
- Collection and storage of Blood sample for blood grouping, preservation of Red cells in Glycerol and in liquid Nitrogen, Storage of sera. Preparation and use of Enzyme treated Red cells in Blood grouping methods of differentiation of group A1 from Group A2 -4 Secretors Non-secretors and the method to detect them. -1hr
- Blood grouping for Antenatal work. ABO and Rh Haemolytic disease of new born and principle of coomb's test - Direct and indirect their method and applications. Exchange Blood transfusion.Prevention methods of Rh-Haemolytic disease of Newborn. -4 hrs
- Compatibility test in blood transfusion and abnormal reactions which are not due to ABO or D-incompatibility. Compatibility testing method in urgent and Non-urgent cases. Special problems of compatibility. -3 hrs
- Antibody Titrations: Basic titration technique, Numerical scoring of results. -2 hrs
- General Management and Essential components in Blood Bank-2. hrs
- Grouping, Cross matching and Serological tests on donor blood.-2 hrs
- Screening of Donors: Physical and clinical Examination. Copper sulphate method for Haemoglobin,Screening for Parasitic infections – Malaria, Filaria. VDRL test, Icteric Index, grouping and Rh-typing,Antibody screening, Screening for HBs Ag, HCV and HIV. -4 hrs
- Anticoagulant solution used in blood Transfusion. Pyrogen and its complications. Test for detecting pyrogens. -2 hrs
- Temperature for storage of Blood. Preservation / storage of Blood. Transport of Blood. Storage of Plasma. Disadvantage of storage. International colouring of Blood labels. -2 hrs
- ● Transfusion reactions, principles, and methods of investigating transfusion reactions. -2hrs
- ● Transmission of diseases by blood transfusion- 2 hrs
- Component therapy:- Preparation of transfusion of Leucocytes poor blood, red cells concentrate, platelet rich plasma, platelet concentrate, factor VIII

concentrate, plasma apheresis, Transfusion in von Willebrand's disease, transfusion of plasma, transfusion of leucocytes/granulocytes, -3hrs

- Apheresis-plasmapheresis, leucopheresis, and others – principle types,method-advantage and disadvantage -4 hrs

Practical 174 Hours

- Preparation of fixatives used in cytology
- Papanicolaou staining, May Grunwald Giemsa stain
- Shorr stain
- Processing and staining of various fluids for cytological examination
- Examination of normal and inflammatory cervical smears.
- Demonstration of normal cytology of respiratory tract, urinary tract, CSF, effusions.
- Preparation of 5% red cell suspension.
- ABO Blood grouping – cell grouping and serum grouping
- Rh typing methods
- Du typing
- Preparation of IgG coated cells, Direct and Indirect Antiglobulin tests
- Antibody titration
- Secretory status
- Screening tests done in donors
- Collection and storage of blood in blood bank
- Separation of packed red cells, FFP and cryoprecipitate

BOOKS RECOMMENDED FOR CYTOLOGY

1. Diagnostic Cytology and its Histopathologic Basis - Vol 1 and; II- E.G. Koss
2. Test Book of Cytology - Walter.V. Bran & Eldrige
3. Cytological techniques - J.F. Baker
4. Exfoliative cytology in Gynecological practice - Erisa.G. Wachtel
5. Diagnostic cytopathology in the uterine cervix - Glaudes Gempal
6. Atlas of Diagnostic cytology - Glaudes Gempal, Stanley.L.Lamber
7. Functional medical laboratory technology A comprehensive series of manual histology and cytology - Robert Rothatem Avi
8. Compendium on diagnostic cytology, Tutorial of cytology - Weid, George etal

9. Manual and atlas of fine needle aspiration cytology - Svante R, Orell.

Recommended books for Blood Banking:

1. Basic Essentinals of Blood Group Theory and Practice -Boorman and Dodd
2. Introduction to Blood Group serology -Boorman and Dodd
3. Essentials of Blood groupin and clinical applications -K. S. Ranganathan
4. Blood group Serology -Boorman
5. Laboratory Hand book of Blood Transfusion Technique -Farr
6. Blood Grouping Techniques -Schief and Boyd
7. Technical methods and procedures of the American Association of Blood Bank -Revised 1956
8. Clinical Blood Transfusion -Kay
9. Blood Transfusion -Kelton
10. Blood Transfusion in Clinical Medicine -P. L. Mollison
11. Manual of Clinical Blood Transfusion -Brozovic

Paper XII

COMPUTER APPLICATION, RESEARCH METHODOLOGY, BIOSTATISTICS & LABORATORY MANAGEMENT - 90 HOURS

1.Computer application and Information sciences -10 hours

- System software with examples ,Need and functions of operating systems , networks and internet and its application. Computerized laboratory information systems ,types and benefits
- Application of computers in clinical settings -Practical on fundamentals of computers - Learning to use MS office: MS word, MS PowerPoint, MS Excel.
- To install different software and Data entry efficiency

2. Medical laboratory science management - 20 hours

- Ethical principles and standards for a clinical laboratory professional
- Good laboratory practice regulations and Accreditation- introduction, aim and advantages, brief knowledge of national and international agencies for clinical laboratory accreditation
- Awareness and safety in a clinical laboratory – General safety precautions ,

pre and post exposure guidelines of HIV& Hepatitis B

- Biomedical waste management in a clinical laboratory – Segregation, collection, transportation, treatment and disposal (including colour coding) Liquid BMW, Radioactive waste
- Use of Personal protective equipment (PPE)
- Quality management system – introduction, quality assurance, quality control systems, quality improvement approaches, standards and norms , quality improvement tools , introduction to NABL guidelines
- Laboratory information systems (LIS) and hospital information system (HIS) -introduction and function

3.Professionalism and values -10 hours

a) Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality

b) Personal values- ethical or moral values

c) Attitude and behaviour- professional behaviour, treating people equally

d) Code of conduct , professional accountability and responsibility, misconduct

e) Differences between professions and importance of team efforts

f) Cultural issues in the healthcare environment

4. Research methodology -25 hours

a) Introduction to research methods

b) Identifying research problem

c) Ethical issues in research

d)Research design

e) types of Data

f) research tools and data collection methods

g) sampling methods

h) Testing of hypothesis

i) Developing a research proposal

5. Biostatistics – 25 hours

Introduction , statistical data , tabular and diagrammatic presentation of data , sample design & sampling methods, measures of central tendency and dispersion , Theory of

probability and distribution , common statistical tests -parametric (Z test, students t test and F test) and non parametric tests (Chi-square test and; The Mann–Whitney U Test) , Elements of linear correlation and Regression , computers in statistics.

RECOMMENDED TEXT BOOK

1. Research methodology methods and techniques -C R Kothari
2. Basics statistics B L Agarwal
3. 3.Clinical Laboratory management Lynne S Garcia

Reference Books

1. ABC of Research Methodology and Applied Biostatistics—A Primer for Clinicians And Researchers by N Parikh Mahendra, Gogtay Nithya
2. Research methodology methods and techniques – C K Kothari & Gourav Garg
3. Statstics in Medicine -Dr K. Syamalan
4. Fundamentals of Computer Science and Information Technology: Umesh Kumar Singh And Sumit Jain
5. Laboratory Management, Principles and Processes, Third Edition, Dr. Denise M. Harmening.
6. Linne & Ringsrud Clinical Laboratory Science: Concepts, Procedures and Clinical Applications by Turgeon
7. Henry's Clinical Diagnosis and Management by Laboratory Methods, 22 nd Edition, By Richard A. McPherson, MD and Matthew R. Pincus,
8. Biomedical informatics -Edward H Shortliffe and James J Cimino

Question paper pattern for paper XII

No	Topic	Theory questions mark pattern
1	Basic Computer Sciences and Information sciences	10 marks
2	Medical laboratory science management	25 marks
3	Professionalism and values	5 marks
4	Research methodology	30 marks
5	Biostatistics	30 marks
	Total	100 marks

FINAL YEAR

Paper XIII - Biochemistry-IV Theory: 90 HOURS

1. MINERAL METABOLISM AND ESTIMATION 10 hrs

- Calcium, phosphate, magnesium, sodium, potassium, Chloride, Iron, Copper, Zinc,Iodine: metabolism and disorders.
- Methodology of the estimation of the above minerals in blood, plasma and other body fluids

2.FUNCTION TESTS 16 hrs

- LIVER FUNCTION TESTS: Disease of the liver-Jaundice, acute and chronic hepatitis, Cirrhosis, Cholestasis
- KIDNEY FUNCTION TESTS -Glomerular function and measurements, clearance tests, -Tubular function tests, clinical syndromes,Cardiac function tests - Cardiac enzymes , Cholesterol related, protein related, indicators of inflammation and test for ard vascualr risk assessment,Diabetic profiles- Blood sugar , Hb A1C , Insulin , GTT, other tests for risk assessment
- GASTRO INTESTINAL FUNCTION TESTS -Collection of Gastric Juice. Tests for Gastric Function, Stimulation methods -Test meals, Measurements of other Gastric Components, Malabsorption, Tests for occult blood in faces, Tests for malabsorption studies, Schilling test, D-xylose absorption test, faecal fat estimation.Estimation of free and total acidity
- PANCREATIC FUNCTION TESTS -Tests in Pancreatic diseases,-Serum Enzymes and Urinary Enzymes Direct stimulation tests and indirect stimulation of the pancreas-Sweat tests
- THYROID FUNCTION TESTS-hyperthyroidism and hypothyroidism
- GONADAL FUNCTION TESTS –disorders in males and females
- FOETAL PLACENTAL FUNCTION TESTS -Haemolytic disease of New-borns, biochemical assay for fetal lung maturity,Biosynthesis of Estriol , measurements and clinical applications.

3. ACID-BASE BALANCE 7 hrs

- Body buffer system, Respiratory regulation of pH, renal regulation of pH. Disturbance in acid base balance, Anion gap, metabolic acidosis, metabolic alkalosis, Respiratory acidosis, Respiratory alkalosis, Fluid and Electrolyte balance, osmolality, methodology of Blood pH and Gases estimation.

4 . AUTOMATION 8 hrs

- Definition, functions, principle. Different parts and functions, merits and demerits of different auto analyzers. Continuous flow analyzers,
- Discrete Analyzers

1)Batch Analyzers – i) Semi auto analyzer, ii) Fully automated analyzer

2)Stat Analyzer. – i) Centrifugal Analyzer, ii) Dry chemistry analyzer

- Recent trends in automation of clinical chemistry.
- Introduction and importance of calibration and validation of clinical laboratory instruments- Auto analysers
- Laboratory Informatics.

5.QUALITY CONTROL 8 hrs

- Errors in clinical analysis, Definition of precision, Accuracy, Standard deviation
- Pre –analytical variables and Analytical variables , Quality control charts, control sera, Tests of significance
- Selecting an analytical method, Evaluation of an analytical method,Evaluation of a diagnostic test
- Quality control programme-Internal quality control and External quality control
- Establishment and use of reference values, Analytical and Statistical procedures used in establishing reference values.

6. HORMONES 16 hrs

- General properties of hormones. Hormone action, pituitary hormones, hypothalamic hormones, Hormones of Pancreas, Thyroid, Parathyroid hormones, Hormones of adrenal medulla, adrenal cortex and Gonad.
- Different methods for estimation of hormones and hormone metabolites in blood and Urine. Steroid hormones.
- Chemistry & Metabolism. General techniques in steroid determination. 17-Oxo steroids and Oxogenic steroids, progesterone
- Determination of Oestrogens, in plasma and Urine Urinary oestriol , Determination of Catecholamines Urinary VMA ,
- Determination of urinary 5 HIAA

7. Toxicology and drug assay in clinical biochemistry. 5 hrs

- Phases of liver detoxification, cytochrome P450 enzymes, samples for toxicology

analysis, General methods of analysis and screening test for common drugs used in therapy :-Barbiturate , paracetamol , Phenobarbital, and benzodiazepines

- Drug abuse – Alcohol, Cocaine and Opioid
- Toxic elements - mercury, arsenic, cadmium, and lead
- Sedative Abuse Phenytoine, lithium, lead, salicylate, mercury, digitalist

8. Organization and management of the Clinical biochemistry laboratory 2 hrs

9. Biochemistry of cancer – Etiology , Oncogenes , oncosuppressor genes , Tumor markers 3 hrs

10. Molecular Biology :- replication of DNA – DNA damage and repair 15 hrs

- Transcription – Genetic code , Translation- steps, factors , inhibitors, post translational modification, protein , folding & protein targeting
- Molecular genetics, gene expression , Gene therapy , Techniques in Molecular Biology-recombinant DNA technology, Blotting techniques, PCR , Genomic library , Human genome project , Cloning., FISH

PRATICALS 180 Hours

1. Estimation of calcium, Inorganic phosphorus, magnesium, Iron and Copper, Sodium and Potassium
2. Diagnosis of diseases with clinical correlation and Biochemical analysis of blood and Urine.
3. Determination of clearance-urea and creatinine
4. Gastric juice analysis -Titrable acidity , Test for malabsorption studies, D-Xylose, Stool fat, Occult blood in faeces.
5. Blood gas analysis, pH, PO2, PCO2. ,Estimation of bicarbonate
6. Determination of LH, FSH , Prolactin, Progesterone, Estrogens, Corticosteroids, Testosterone, and HCG.
7. Estimation of hormone metabolites in Urine - 17-Ketosteroids,17-Ketogenic Steroids, Urinary oestriol, Urinary VMA, 5 HIAA
8. Familiarization and usage of all types of auto analysers- CLIA, ECLIA ,LCMS. Addition of newer parameters to semi and fully automated analysers and its validation
9. Calculation of mean ; standard deviation and Plotting of quality control charts- L J chart and Cusum chart
10. Isolation of DNA from blood, Estimation of DNA (diphenyl method),UV

absorption spectra of native and denatured DNA, Estimation of RNA (Orcinol method)

11. Demonstration of - Agarose gel Electrophoresis of DNA, DNA amplification by PCR

RECOMMENDED TEXT BOOK-BIOCHEMISTRY-PAPER IV

1. Harper's Biochemistry: R. K. Murray and Grannor
2. Test book of Biochemistry: Vasudevan , Sreekumari and Kannan Vaidyanathan
3. Practical – Clinical Biochemistry - Volume 1 & II : Harold Yarkey
4. Clinical Biochemistry - Principles and Practice: Praful B. Godkar
5. Gradwohls Clinical Laboratory methods and diagnosis: Alex c Sonnenweth and Leonard Jarett
6. Text book of clinical chemistry -Nobert. W. Teitz
7. Lecture notes on clinical chemistry L.G. Whitby
8. 8.Principles of molecular biology -Burton E Tropp
9. 9.Biochemistry by U.Satyanarayana and U Chakrapani
10. 10.Hormones by Anthony W Normann and Helen L Henry

REFERENCE BOOKS

1.Lehninger: Principles of Biochemistry , Nelson, D.L. and Cox, M.M., W.H.

2. Textbook of Biochemistry with Clinical Correlations, Devlin, T.M., John Wiley & Sons, Inc.

3.Molecular cell biology by Lodish Berk Kaiser Krieger etal

4.Molecular biology principles and practice - MIichael M Cox, Jennifer A Doudna & Michael O Donnell

5.Basics Quality Assurance and Quality control in the Clinical Laboratory - Bruce A Wayne

6 Biochemistry a care oriented approach- Montgomiry

7.Biochemistry in clinical practice -William's and Marks

8.Handbook f Cloinical Toxicology -Mary Drrant

9 Clinical chemistry- Kaplan

10 Clinical Chemistry in diagnosis and treatment Philip .D. Mayne

11.Clinical biochemistry metabolic and clinical aspects William.J.marshall ephen k.Bangert

12. The Cell by Geoffrey Cooper

13. Genetics , A molecular approach by Peter J Russell

14. Benjamin Lewin. GENES X

PAPER XIV

MYCOLOGY, VIROLOGY AND APPLIED MICROBIOLOGY - 90 hours

Topics

MYCOLOGY - 30 hours

• Introduction to Mycology

A brief study of classification of fungi

• Morphology of fungus, yeasts, yeast like fungi, Dimorphic fungi, Filamentous fungi Reproduction of fungus

Medically important fungi

- Basic knowledge of medically important fungi and actinomycetes-
- Candida species, Cryptococcus, Sporothrix,Blastomyces, Paracoccidioides brasiliensis,Coccidioides immitis, Histoplasma
- Agents of Chromomycosis, Penicillium, Fusarium,Cladosporium, Curvularia, Rhizopus, mucor, Aspergillus,Trichoderma species, streptomyces, Syncephalastrum, Cephalosporium and other medically important fungi.
- Dermatophytes, Agents of piedra, Alternaria, Rhinosporidium Torulopsis, Nocardia, Fonsecaea,Phialophora, Basidiobolus.
- Mycotoxins and mycetimus (Emphasis should be given to its morphology. Growth characteristics on Routine culture media and special media if any, tests used for its identification, pathogenicity, laboratory diagnosis and epidemiology prophylaxis.)

Fungal infections

- Basic knowledge of different types of fungal infections its causative agents and its epidemiology.
  - o Superficial mycoses
  - o Subcutaneous mycoses
  - o Systemic mycoses
  - o Opportunistic pathogens and its infections
  - o Ophthalmic infection(occulomycoses) and otomycoses.

• Common media and stains used in Mycology

• Culture technique for fungal identification

• Laboratory animals in Mycology

• Types of specimens, its collection, transportation, preservation and processing for the

diagnosis of fungal infections

• Antifungal Susceptibility and its recent developments

• Serological methods for the diagnosis of fungal infection.

• Preservation of fungus

VIROLOGY - 30 hours

INTRODUCTION TO VIROLOGY

- General properties of viruses-Morphology, Replication, Virus host cell interaction.
- Principles of virus, Taxonomy and classification.
- An elementary knowledge of medically important DNA and RNA viruses(Classification, Morphology, Pathogenicity, Host range, Methods of Laboratory diagnosis, prophylaxis, and epidemiology).
- More emphasis should be given to HBV, HIV, Flavi virus, Covid-19, Nipah and other common viral infections in India.
- Emerging viral diseases in Kerala

Cultivation of viruses

- Different methods of cultivation and isolation of viruses.
- Use and management of animals in virology.
- Embryonated egg inoculation-Anatomy of embryonated egg, Techniques of various routes of inoculation
- Tissue culture techniques

- Classification with examples

- Cell culture containers and cleaning

- Preparation of media, reagents and solutions

- Propagation, maintenance, preservation of various cell cultures

- Description of common cell culture

- Contamination in cell culture

- Detection of viral growth in cell culture

- C.P.E, Metabolic inhibition,Haemadsorption,Interference, Immunofluorescence

- Cytological and Cytochemical diagnostic methods

- Inclusion bodies- methods of staining and demonstration

Diagnostic virology

- Collections, preservation, Transportation, Processing, Isolation and
- identification of the following specimens for viral diagnosis.

  - Skin lesion, Vesicle fluid,

  - Biopsy and autopsy specimens,

- C.S.F and other sterile body fluids, pus, buffy coat,
- Nasopharyngeal secretions, sputum,
- Urogenital specimens
- Faeces or rectal swab.

- Biosafety in virology laboratory.

Serological diagnosis of viral infection

- Paul Bunnel test
- Haemagglutination and Haemagglutination inhibition test
- Viral neutralization tests
- Immuno fluroscence
- Immuno electron microscopy

APPLIED MICROBIOLOGY - 30 hours

Nosocomial infections

- Diagnosis and its control
- Infection associated with blood transfusion
- Infection associated with intravascular canula
- Post operative infections
- UTI
- Surgical and trauma related infections
- Respiratory infections and other hospital acquired infections
- Antibiotic resistance in hospitalized patients
- Collection of specimens for sterility tests, its transportation and processing
- Epidemiological aspects of controlling infections and diseases
- Epidemiological markers in bacterial infections
- Typing methods in Bacteriology
- Microbial bio-film-prevention, control and removal
- Role of microbiology lab for infection control in hospital. Emerging infectious diseases
- Collection, transportation and processing of specimens for the diagnosis of Hospital acquired infection

Bacteriology of air

Examination of Air-a brief review of microorganisms causing air borne diseases.

Examination of air in operation theatre or cabinets- different methods in detail.

Water bacteriology –

• Bacteriology of drinking water

• Brief review of microorganisms causing water borne infections

• Examination of water- methods of collection of water and processing

• Presumptive coliform count and confirmatory tests

• Membrane filtration methods

Microbiology of milk and milk products

• Milk borne infections

• Examination of milk and milk products

• Preparation of media and reagents for the study of water, food, milk and air

• Methylene blue reduction test, phosphatase test, colony count test, Milk ring test, Turbidity test, whey agglutination test

Bacteriology of food and food borne diseases

• Examination of food and food products

• A brief review of microorganisms causing food borne diseases

• Collection of samples and its processing –Frozen food, canned food and preserved food

Automation in diagnostic microbiology

• Principles and its applications in diagnostic approach Microbiology Laboratory- Physical design, management and organization. Quality in the clinical

Microbiology Laboratory

Genetically modified microorganisms

Principles of luminescence assay

Molecular Diagnostic methods

• Molecular diagnostic techniques relevant to medical microbiology-CBNAAT, TRUENAT, Gen expert

Illustrative knowledge of restriction fragment length polymorphism

• PCR and its modifications including nested PCR, Multiplex PCR. Special emphasis to Real-time PCR.

• Principles of different hybridization techniques

Principles of recombinant DNA technology

Blotting techniques

• Vaccines for infectious diseases.

• Role of genetic engineering in vaccine developments

Serology

Rheumatoid factor tests - Rosewaaler test, Latex agglutination test.

- Antinuclear antibody tests.
- Detection of C-Reactive protein

PRACTICALS 180 Hours

Virology

- Demonstration of different type of cell lines.
- Demonstration of egg inoculation,
- Demonstration of CPE, Inclusion bodies,
- Demonstration of Viral Haemagglutination test
- Viral Haemagglutination inhibition test
- Viral neutralization test.
- Demonstration of immunofluorescence technique, observation of electron microscopy

Mycology

- Study of growth characteristics, microscopic examination and identification of medically important fungi, collection, transportation and processing of specimens for mycological examination.
- Slide culture technique
- Germ tube test for yeast identification

Serology

- Latex agglutination test.
- Antinuclear antibody tests.
- Detection of C-Reactive protein
- ELISA

Applied Microbiology

- Examination of water- methods of collection of water and processing
- Presumptive coliform count and confirmatory tests
- Membrane filtration methods
- Examination of milk and milk products
- Preparation media and reagents for the study of water, food, milk and air
- Methylene blue test or phosphatase test, colony count test
- Milk ring test, Turbidity test, whey agglutination test
- Examination of food and food products- Collection of samples and its processing – Frozen food,canned food and preserved food

- PCR technique and its modifications

Text Books

1. Medical mycology – Rippon
2. Text Book of Microbiology – Anantha Narayanan& Jayaram Panicker
3. Medical mycology-Jagdish Chander
4. Mackie & Macartney Practical Medical Microbiology
5. Medical microbiology - Collee, Fraser, Marmion, Simmons
6. Bailey and Scott's Diagnostic Microbiology - Forbes Sahm, Weissfeld
7. Medical Virology - Fenner and White

REFERENCE BOOKS

1. Principles and Practice of Infectious diseases Mandell, Bennett, Dolin Vol- 1
2. Medical Microbiology David Greenwood, Slack,
3. Mycology for the Clinical Laboratory
4. Manual of Clinical Mycology Conant.N.F., Smith, Baker. R.D
5. Human Infections and Fungi I. Roger Der
6. Fields virology- Bernac N. Fields

Paper XV – HISTOTECHNOLOGY & CYTOGENETICS 90 – HOURS

HISTOTECHNOLOGY 70 Hours

Histopathological Techniques

- General understanding of the terms – Histology, Histopathology and Histopathological techniques. -1hr
- General organization of a Histopathology laboratory and basic requirements for a histopathology laboratory. Role of Histopathology laboratory in the diagnosis of diseases. -1hr
- Reception of specimens, identification and recording in the Registers, General introduction to the processing of tissues. -1hr
- Methods of examination of Fresh tissue specimens-Teased preparations, squash preparations, impression smears and frozen sections. -1hr

Fixation

- Aim of fixation. Qualities of fixatives. Classification of fixatives. Formalin fixative. Advantages and disadvantages of formalin fixatives. Methods of removing formalin

pigment and deposits from cut sections. Use, advantages and disadvantages of other simple fixatives like mercuric chloride, potassium dichromate, chromic acid, osmium tetroxide, picric acid, Acetic acid Ethyl alcohol and Trichloroacetic Acid, Composition, uses, advantages, and disadvantages of 10% Formol Saline, Buffered Neutral Formalin, Mercuric chloride. -3 hrs

- Choice of Fixatives, Composition uses advantages and disadvantages of Zenker's fluid, Bouins fluid Carnoys fixatives, Helly's fluid, Heidenheim's Susa, Clark's fluid, Flemming's fluid, Champy's fluid, Zenker's formol and Mullers fluid 50 different histochemical fixatives, their merits and demerits-2 hrs
- Post Chromatization, Secondary fixation. -1hr

Tissue Processing-

- Dehydration, aim of dehydration, various dehydrating agents employed, their merits and demerits. Technique of dehydration clearing – aim of clearing, various clearing agents, their advantages and disadvantages-2 hrs
- Impregnation – need and time requirement for impregnation and technique of paraffin wax impregnation. Principles, operation, parts and care of automatic tissue processors-2 hrs
- Special processing techniques: Fixation, processing and section cutting of bones, cartilages, connective tissue, CNS, pancreas, skin, teeth and eyeball. -2 hrs

Decalcification

- Aim of decalcification, selection of tissue, Fixation of tissue, various decalcifying agents used, decalcification techniques – end point determination & qualities of ideal decalcifying agents. -2 hrs

Embedding

- Different types of embedding media, advantages disadvantages. Method of embedding, principles uses advantages of vacuum embedding. Uses, advantages and disadvantages of Ester wax embedding, gelatin embedding, Celloidin embedding, double embedding and embedding using water. Resin embedding. -3 hrs

Casting/Blocking-

- Types of moulds used. Technique of casting Sectioning -1hrs
- Different types of Microtome: - Rocking, Rotary, sledge, sliding and freezing microtome. Their operations and specifications. Different types of microtome knives, knife angle. Choice and care of knives. Sharpening of microtome knives, honing and different types of hone employed and honing technique. Stropping and different types of strops employed and techniques of stropping. Parts care and

operation of automatic knives sharpening machine. -4 hrs

- Cutting of paraffin wax embedded sections: - Trimming of blocks, fixing the block on the microtome. Technique of sections cutting. Cutting serial sections recognition and correction of faults in paraffin sections. -2 hrs
- Fixation of sections to slides- water bath method, hot stage method and warmed slide method. -1 hrs
- Cutting of celloidin embedded section – Fixing of celloidin embedded sections on slides.-1hr
- Preparation and use of albuminised and starched slides. -1hr

Staining

- Principles and Theory of staining, biological staining, Basic staining technique. Classification of dyes. Principle of dye chemistry. Mordents, accentuators and accelerators. Uses of controls in staining procedure. -2 hrs
- Haematoxylin : - composition, preparation, uses, staining results advantages 51 and disadvantages of all the different haematoxylin.-2 hrs
- Principle, preparation, storage, staining technique observation and interpretation of Haematoxylin and eosin stain. Staining methods of following in tissue sections.-2 hrs
- Carbohydrates -Glycogen -Mucins – acid & neutral. -1 hrs
- Lipid – myelin. -1 hr
- Pigments Endogenous – haemosiderin, bile pigment, melanine, lipofuscins. Artifact - formalin, malarial, schistosome, mercury, chromic oxide. -2 hr
- Minerals – Calcium, Copper. -1 hr
- Connective tissues – collagen, reticular, elastic. -2 hr
- Fibrin. -1hr
- Muscle striations. -1hr
- Microorganisms – bacteria, AFB, fungi, viral inclusion-HBs Ag –2 hrs

- Advanced techniques in Histopathology,Cryostat and their uses. Principle, care and operation of cryostat.-2hrs
- Automation in histopathology -2 hrs
- Immuno cytochemistry and its application. -4 hrs
-
- Enzyme histochemistry, Immunofluorescent techniques in tissue sections. -3 hrs
- In situ hybridization. -3 hrs

- Electron microscopy- processing and Techniques. -3 hrs

Postmortem room Technique

- Collection and preservation of tissue, collection of materials for laboratory studies-2 hrs

Museum Technique

General introduction, organization of a museum. Source of materials, need for preservation and mounting, Reception, preparation, labeling, fixation of various specimens and organs, storage of specimen, mounting of museum specimens, museum jars, perplex and glasses, their advantages and dis advantages, Demonstration of Bone, calculi, Transparent specimen (Fetal skeleton) amyloid. Modern methods in museum technique. – 5 hrs

CYTOGENETICS - 20 hours

- Human sex chromosomes. -1 hr
- Sampling staining and demonstration of Barr body. Reporting and interpreting Barr test-2 hrs
- Demonstration of Y-chromosome, Origin and demonstration of drumstick, small clubs, sessile nodule and balloons. Drumstick count and its interpretation. -2 hrs

Karyotyping

- Methods of Chromosome analysis-3 hrs
- Banding techniques-2 hrs
- Chromosome analysis with blood and bone marrow. Morphology of chromosome and their identification. Criteria for chromosome identification. Identification criteria of group to group of chromosomes. Conventional designation. Chromosome Defects -3hrs

- Physiologic factors are influencing the etiology of chromosome defects, Types of chromosome defects- Structural abnormalities and human autosomal syndromes. Philadelphia chromosome and chromosome changes in Neoplasia, abnormalities of sex chromosome at birth, at puberty and inadults.Turner's syndrome, Down's syndrome, Klinefelter syndrome,- 4hrs
- Advanced methods in cytogenetic – FISH, SKY. -2 hrs
- Clinical utility of Bone Marrow culture-1 hrs

Practical 180 HOURS

- Preparation of commonly used fixatives- Formalin, Bouins, Zenkers, Carnoys
- Automatic tissue processors
- Decalcification
- Embedding
- Section cutting
- Cryostat section cutting
- Preparation of haematoxylin stains- Harris, Ehrlich's, Mayers, Weigert's, PTAH,Verhoeff's
- Special stains- PAS, Perl's, Reticulin, Vangieson, Masson Trichrome, Verhoeff's elastic stain, Masson Fontana, Alcian blue, AFB, Wade- Fite, Methenamine stain,Von Kossa, PTAH, Oil red O stain, Mucicarmine stain.
- Chromosome preparation
- Karyotyping
- Preparation of karyotype from bone marrow specimen
- Barr body demonstration

TEXT BOOK

Hand book of histopathological techniques- CFA culling

BOOKS RECOMMENDED FOR REFERENCE

1	Basic Histology	L.C. Junqueria
2	Manual of Histological staining AFTP Fasicle 3rd EditionReprinted 1982	
3	Lynch's Medical Laboratory Technology	Raphael
4	Self Assessment in Histological Techniques	Bancroft
5	Manual of Histological Techniques	Bancroft
6	Histopathology – A step-by-step approach	Lewis
7	Basic Histopathology	Wheather
8	Colour Atlas of Histopathology	Curran
9	Cellular pathology technique	5th Edition

BOOKS RECOMMENDED FOR CYTOGENETICS

1. Human Chromosomes- Manual of basic techniques – Ram . S. Verma, Arvid Babu.
2. Cytogenetics, FISH and molecular testing in hematologic malignancies – Wojiciech

Gorczyca

Paper XVI 150 Hours

Project

Submission of a Project work is a compulsory requirement for the B Sc MLT –course. Each student can choose a topic for the project in any one of the subjects – Microbiology/Biochemistry/Pathology which would be approved by his/her supervising teacher. The topics for project shall be divided equally among total number of students from the three main subjects Microbiology/Biochemistry/Pathology.

The option for topics selection for the project will be based on the following criteria

- Total marks obtained in all the previous university examinations up to 3rd year.
- If total marks obtained equal for more than one student then marks obtained for the optional subject may be considered.

The supervising Teacher should have minimum 3 years full time teaching experience in the concerned subject. The student should be under the guidance of the supervising staff, carry out the work on the topic selected and prepare a project report including results and references. The project report duly certified by the supervising staff and head of the department of MLT one month prior to fourth year university practical examination should be submitted to the fourth year B Sc MLT University practical examination of concerned subject.

The project report evaluation will be conducted by the concerned subject internal and external examiners together in the Fourth year B Sc MLT University practical examination.

2.11. No: of hours per subject

As given under clause "Teaching learning methods "& "Content of each subject in each year "

2.12. Practical training

As given under clause "Teaching learning methods "& "Content of each subject in each year "

2.13 Records

To be maintained for all Practical Work

2.14. Dissertation:

Not Applicable

2.15. Speciality training if any

As given under clause "Teaching learning methods "& "Content of each subject in each year "

2.16. Project work to be done if any

Project

Synopsis

A project work based on clinical laboratory work on a current topic of relevance, consisting of about 30 pages (Times New Roman, Font size 14, line space 1.5), bound.

Submission

The project should be certified by the supervising staff and submitted to the Head of the Department one month prior to fourth year university practical examination and a soft copy of the certified project should be submitted to the controller of examinations of KUHS during the time of registration for fourth year BSc (MLT) examination.

Valuation of Project

The project report evaluation will be conducted by the internal and external examiners together in the concerned subject of Fourth year B Sc MLT University practical examination. Soft Copy of the project should be sent to the examiners at least one week before the date of examination by KUHS.

Candidate who has secured a minimum of 50% marks in the University examination (theory and practical separately) and 50% marks in Total for theory block (University theory examination and internal assessment) and 50% in practical block (University Practical, Viva & Internal assessment) separately in any subject or subjects shall be declared to have passed in that subject / subjects. There will be no minimum marks for viva examination. A candidate who fails in any subject or subjects in the examination may need to appear the theory, practical and viva for that subject or subjects in the subsequent supplementary or regular university examination. Five marks may be given as grace mark (or as per KUHS regulations) either in a subject alone or distribute it among subjects so as to make the candidate eligible for a pass.

2.17. Any other requirements

A certified practical Record is compulsory for each subject and that will be evaluated at the time of concerned Practical Examination. A maximum of 10 marks shall be given for the record.

2.18. Prescribed/recommended textbooks for each subject

As given under clause “Teaching learning methods “&“Content of each subject in each year”

2.19. Reference books

As given under clause “Teaching learning methods “& “Content of each subject in each year “

2.20. Journals

As decided by the HOD

2.21. Logbook

To be maintained for all academic work and shall be countersigned by the concerned HOD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3. EXAMINATIONS

3.1 Eligibility to appear for Examination

a) Attendance and condonation option.

No candidates shall be admitted to any year of BSc (MLT) examination unless he/she has a minimum of 80% attendance with the provision for one time condonation up to 10% on medical grounds (condonable limit 70%). Condonation for shortage of attendance shall be vested with a committee constituted by the Principal/ Head of the respective college, with the Principal/ Head as the Chairman and five members (senior teachers) in the committee.

If a candidate who has not attained 80% attendance and the shortage is beyond the condonable limit then he/ she shall not be eligible to continue the course with the same batch of students. He/ She may obtain special sanction from the institution and the university to continue with the junior batch of students.

b) Internal Assessment marks.

The internal assessment marks in theory/Practical shall be restricted to a maximum of 25% of the University Examinations –in Theory/Practical separately. The internal assessment marks in theory/Practical shall be on the basis of the assessment made by the teachers from the candidate's performance in the: Three (3) sessional examinations (evenly placed) conducted by the department, Laboratory work and seminars during the course of study. The third sessional examination should be conducted as model examination as that of University. The best of first two sessional examinations marks and the third sessional model examination (compulsory) should be included for calculating internal assessment marks. The marks secured by the candidates in each paper/subject shall be forwarded to the university at the end of the course for university examinations. The class average of the sessional marks should not exceed 75%. The candidates who failed in the university examination will be allowed a separate internal assessment for both theory and practical including viva. The minimum requirement of internal assessment for appearing university examination shall be 50%. If a candidate not securing minimum internal assessment, he / she should appear for next university examination (supple or regular) after securing minimum internal assessment. But student shall be promoted to the subsequent years. A regular record of theory and practical sessional marks shall be maintained foreach student in the institution.

A separate internal assessment examination shall be conducted for theory and practical for the failed candidates who appear for the supplementary examination and that marks will be taken as the internal marks of that candidate for that subject.

c) University Examinations.

There shall be university regular examination at the end of each Academic year; in case of failed/not appeared candidates a supplementary examination will be conducted within six months

after the previous regular examination result publication. Candidates who fail in one or more papers in an examination need to appear for only those papers for securing complete passin the examination. Candidate who fail either in theory or practical of a paper shall have to appear for both theory and practical examination of that paper . There will be no University practical and viva examination for Paper –I Anatomy & Physiology and for paper XII- Research methodology, Computer application &Laboratory management. Also there will be no practical internal assessment, but practical classes should be conducted for these papers as per the hour distribution table..

d) Practical record.

A certified practical Record is compulsory for each subject and that will be evaluated at the time of concerned Practical Examination. A maximum of 10 marks shall be given for the record.

3.2 . Schedule of Regular/Supplementary exams

There will be one regular and one Supplementary examination. Regular Examination shall beconducted within 6 months after from the date of declaration of results

3.3. Scheme of examination

a) The following rule may be followed when distributing mark

Paper 1		
Theory	Paper I A (Anatomy)	50 Marks
	Paper I B (Physiology)	50Marks
Sessional marks		
Internal Marks Theory	Paper I A (Anatomy)	---12 Marks
	Paper I B (Physiology)	--- 13 Marks
Other Papers		
Theory		--100 marks
Practical		First year and second year—100 Third year and fourth year - 150 marks (10 marks for Record)
Oral		--50 marks
Sessional marks		
Theory		--25 marks
Practical		--25 marks

b) The detailed scheme of mark distribution in each subject is shown in the table

Paper	Theory						Practical							Grand Total	
	University		Session		Total		University		Session		viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		Max	Min	Max	Min
Paper-I	100	50	25	12.5	125	62.5	-	-	-	-	-	-	-	125	62.5
Paper-II	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
Paper-III	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
Paper-IV	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
Total Marks														1025	512.5

Second Year BSc MLT

Paper	Theory						Practical							Grand Total	
	University		Session		Total		University		Session		viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		Max	Min	Max	Min
Paper-V	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
Paper-VI	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
Paper-VII	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
Paper-VIII	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
Total Marks														1200	600

Third Year BSc MLT

Paper	Theory						Practical							Grand Total	
	University		Session		Total		University		Session		viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		Max	Min	Max	Min
Paper-IX	100	50	25	12.5	125	62.5	150	75	25	12.5	50	225	112.5	350	175
Paper-X	100	50	25	121.5	125	62.5	150	75	25	12.5	50	225	112.5	350	175
Paper-XI	100	50	25	12.5	125	62.5	150	75	25	12.5	50	225	112.5	350	175
Paper-XII	100	50	25	12.5	125	62.5	-	-	-	-	-	-	-	125	62.5
Total Marks														1175	587.5

Final Year BSc MLT

Paper	Theory						Practical							Grand Total	
	University		Session		Total		University		Session		viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		Max	Min	Max	Min
Paper -XIII	100	50	25	12.5	125	62.5	150	75	25	12.5	50	225	112.5	350	175
Paper-XIV	100	50	25	12.5	125	62.5	150	75	25	12.5	50	225	112.5	350	175
Paper-XV	100	50	25	12.5	125	6.52	150	75	25	12.5	50	225	112.5	350	175
Paper XVI Project							50							50	25
Total Marks														1100	550

3.4 Papers in each year:

As given under clause “Teaching learning methods “& “Content of each subject in each year “

3.5 Duration of theory and practical exams

c) Scheme & Schedule of Examination

Year of study	Paper	Subject	Duration of exam		Description
			Theory (Hours)	Practical (Days)	For practical examination one batch comprises maximum of 25 candidates.
First Year	Paper-I A	Anatomy including Histology	2	-	No practical exam for anatomy & physiology. Theory examination-1 day for anatomy & another day for physiology.
	Paper-I B	Physiology	2	-	
	Paper-II	Biochemistry-I	3	1	
	Paper-III	Basic Microbiology &Immunology	3	1	
	Paper-IV	Basic Medical Laboratory Science & Haematology - I	3	1	
Second year	Paper-V	Biochemistry-II	3	1	
	Paper-VI	General Microbiology	3	2	In case of two batches,Practical exam in paper- VI can be completed in 3 days. (1st & 2nd day for first batch and 2nd & 3rd day for second batch.)
	Paper-VII	Parasitology & Entomology	3	1	
	Paper-VIII	Haematology-II & Clinical Pathology	3	1	
Third year	Paper-IX	Biochemistry -III	3	2	
	Paper-X	Bacteriology	3	3	In case of two batches,Practical exam in paper - X can be completed in 4 days. (1st, 2nd & 3rd day for first batch and 2nd, 3rd & 4th day for second batch.)
	Paper-XI	Cytology and Transfusion technology	3	2	
	Paper-XII	Computer Application, Research methodology & Laboratory management.	3	-	No practical exam for Paper- XII
Fourth year	Paper-XIII	Biochemistry-IV	3	3	
	Paper - XIV	Mycology, Virology & Applied Microbiology	3	3	In case of two batches, Practical exam in paper - XIV can be completed in 4 days. (1st, 2nd & 3rd day for first batch and 2nd, 3rd & 4th day for second batch.)
	Paper XV	Histotechnology & Cytogenetics.	3	2	
	Paper XVI	Project			Power point presentation &viva of the project for a minimum 15 minutes per student.

Question Paper setting and evaluation

d) Question Paper pattern

All the question paper should be of standard type. Each theory paper will be of 3 hours duration and shall consist of twenty-two questions with a maximum of 100 marks. Theory paper in all the subjects shall consist of Two essay type questions with 10 marks each, Ten brief answer type questionscarrying 5 marks each, Ten short answer type questions carrying 3 marks each except in Paper - I.

Paper I (Anatomy and Physiology) consist of two divisions named as Paper I A - Anatomy includingHistology and Paper I B - Physiology. Each division carries 50 marks and shall consist of one essay typequestion with 10 marks, five brief answer type questions carrying 5 marks, five short answer type questions carrying 3 marks.

Also examination in paper I A and Paper I B will be conducted separately in 2 days. The Maximumduration allowed for Paper I A and Paper I B is 2 hours each.

e) Scheme of valuation

The theory paper should be double valued and there will be third valuation if the average marks offirst and second valuation is at or between 45% and 49% marks and the discrepancy of not less than 15% marks. There will be no provision for re[illegible]ation.

Valuation of Project

The project report evaluation will be conducted by the internal and external examiners together in theconcerned subject of Fourth year B Sc MLT University practical examination. Soft Copy of the project should be sent to the examiners at least one week before the date of examination by KUHS.

Candidate who has secured a minimum of 50% marks in the University examination (theory andpractical separately) and 50% marks in Total for theory block (University theory examination and internal assessment) and 50% in practical block (University Practical, Viva & Internal assessment) separately in any subject or subjects shall be declared to have passed in that subject / subjects. There will be no minimum marks for viva examination. A candidate who fails in any subject or subjects or theory block or Practical block in the examination may need to appear only for that subject or block in the subsequent supplementary or regular university examination.

Five marks (or as per university regulations) may be given as grace mark either in a subject alone or distribute it among subjects so as to make the candidate eligible for a pass

Model question paper for each subject with question paper pattern

QP CODE:101012

First Year B.Sc MLT Degree Examinations,Paper I A - ANATOMY
Time: 2 Hours **Total Marks: 50**

Answer all Questions. Draw Diagrams wherever necessary. •Write the Answers in books containing 32 Pages.

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Essay

1. Describe the respiratory system under the following headings:

● Parts ● Relations ● anatomy of lungs

●Bronchopulmonary segments (2+3+2+3=10)

Short notes (5x5=25)

2. Liver 3. Synovial joint

4. Right atrium 5. Prostate 6.pituitary gland

Answer briefly (5x3=15)

7. Fallopian tube 8. Thymus

9. Neuron 10. Vermiform appendix

11.Deltoid muscle.

QP CODE:102012

First Year B.Sc MLT Degree Examinations

Paper I B - PHYSIOLOGY

Time: 2 Hours Total Marks: 50

Answer all Questions. Draw Diagrams wherever necessary. •Write the Answers in books containing 32 Pages.

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Essay **(10 marks)**

1. Define blood pressure. Explain the short term regulation of blood pressure. Describe any one method of determination of blood pressure (2+5+3=10)

Short notes **(5X5=25 marks)**

2. Oxygen dissociation curve
3. Pain pathway
4. Water re-absorption in renal tubule
5. T-lymphocytes
6. Describe erythropoiesis

Answer briefly **(5x3=15marks)**

7. Pregnancy test 8. Parathormone
9. Plasma proteins
10. Functions of placenta
11. tidal volume

iii) QP CODE: 103012 Reg No: ……

First BSc MLT Degree Examinations, September 2016

PAPER II. BIOCHEMISTRY

Time: 3 Hours **Total Marks: 100**

- Answer all Questions.
- Draw Diagrams wherever necessary.

Essay **(2x10=20)**

1.Enumerate the various hazards that can occur in a clinical lab and discuss aboutthe hazards from dangerous chemicals . (3 + 7 = 10)

2.What are the different levels of organization of proteins. Discuss the primary structure of proteins with suitable example . (2 + 8 =10)

Short notes **(10x5=50)**

3.Flourimetry
4.Functions of lipids.
5.Flame photometry.
6.Glucose transporters.
7.Denaturation of proteins.
8.Structure of biomembrane.
9.Structure and functions of t RNA.
10.Active transport across cell membrane.
11.Preparation of 500ml of 0.1M silver nitrate.
12.Preparation of cleaning solution for biochemical glass wares in a clinical lab.

Answer briefly **(10x3=30)**

13.Histones.
14.Lysosomes
15.Distilled water.
16.Rancidity of fat.
17.Oxidation of glucose.
18.Anomerism in sugars
19.Units of radio activity.
20.Composition of borosilicate glass wares.
21.Muta rotation and its practical importance.
22.Define normality. Mention the procedure for preparation of 1N HCl.

QP CODE: 104012 **Reg No:**

Paper III- Basic Microbiology & Immunology

Time: 2 Hours Total Marks: 100

Answer all questions

Draw diagrams wherever necessary

Essay (2x10=20)

1.Define sterilization. What are the different methods of sterilization? Write in detail about moist heat sterilization (1+3+6=10 Marks)

2.Classify Immunoglobulins. Discuss the structure and functions of immunoglobulins. (1+9=10Marks)

Short notes (10x5=50)

3. Robert Koch
4. Safety cabinets
5. Bacterial flagella.
6. ELISA
7. Differentiate Gram positive and negative cell wall
8. Vaccines.
9. Monoclonal antibody
10. Classical complement pathway.
11. Hypersensitivity reactions
12. Lymphocyte subsets

Answer Briefly (10x3=15)

13. Sintered glass filters
14. Negative staining
15. In-use test
16. Different types of Membrane filters
17. Chemosterilizer
18. Super antigens
19. Agglutination reactions
20. AFB staining
21. Neutralisation test
22. interferon

QP CODE: 105012 Reg No:

First Year B.Sc. MLT Degree Examinations.2016

Paper IV. Basic Medical Laboratory Science & Haematology – I

Time: 2 Hours **Total Marks: 100**

Answer all questions

Draw diagrams wherever necessary

Essay **(2x10=20)**

1 Define differential leucocyte count. Write the preparation & uses of different types of blood smears (2+8=10 marks)

2. Mention different types of microscopes. Describe aberrations of light microscope. Describe the principle working & applications of Dark ground microscope(2+3+5=10marks)

Short notes **(10x5=50)**

3..Community participation in health care delivery system

4.Concept of siddha medicine

5.Methods of epidemiological studies

6.Romanowsky stains

7.Cardiopulmonary resuscitation

8.Goals &Scopes of Medical ethics

9.Laboratory hazards

10Micrometry

11.Total WBC count

12.Cyan methaemoglobin method (10x5=50marks)

Answer Briefly **(10x3=15)**

13.Recent developments in medical record keeping

14.Reticulocyte

15.Citrate as anticoagulant

16.Red cell indices

17.Buffy coat smears

18.Demonstration of HbF

19.Principles of automated cell counters

20.Preparation of bone marrow smears

21.Vacutainers

22.Megakaryocyte (10x3=30marks)

QP Code:201012 **Reg. No.**

SECOND YEAR BSc MLT EXAMINATION

(Model Question Paper)

Paper- V. Biochemistry - II

Time: 3 hrs **Maximum marks: 100**

Answer all questions

Draw diagrams wherever necessary

Essays **(2x10=20)**

1. Discuss briefly the Deno vo synthesis of purine nucleotides (10)
2. Discuss various method of cholesterol estimation. Write any one method in detail (4+6=10)

Short Notes **(10x5=50)**

3. CSF analysis
4. Gluconeogenesis
5. Urea cycle
6. Phenyl ketonuria
7. Energetics of TCA cycle
8. Importance compound synthesized from tryosi
9. Fatty liver
10. Bile acid synthesis
11. Biuret method of total protein estimation
12. Functions of vitamin A

Answer Briefly **(10x3=30)**

13. Cori's cycle
14. Significance of HMP pathway
15. Galactosemia
16. Polyamine synthesis
17. Role of vitamin K in coagulation
18. Functions of vitamin C
19. Niemann - pick disease
20. Biosynthesis of phosphotidyl serine
21. Role of biotin in fatty acid synthesis
22. Glucuronic acid pathway

QP CODE: 104012 **Reg No:**

First Year B.Sc. MLT Degree Examinations.2016

Paper III- Basic Microbiology & Immunology

Time: 2 Hours Total Marks: 100

Answer all questions Draw diagrams wherever necessary

Essay **(2x10=20)**

1) Define sterilization. What are the different methods of sterilization? Write in detail about moist heat sterilization. (1+3+6=10Marks)

2) Classify Immunoglobulins. Discuss the structure and functions of immunoglobulins.(1+9=10Marks)

Short notes **(10x5=50)**

3)Robert Koch

4) Safety cabinets

5) Bacterial flagella.

6) ELISA

7) Differentiate Gram positive and negative cell wall

8) Vaccines.

9) Monoclonal antibody

10) Classical complement pathway.

11) Hypersensitivity reactions

12) Lymphocyte subsets

Answer Briefly **(10x3=15)**

13) Sintered glass filters

14) Negative staining

15) In-use test

16) Different types of Membrane filters

17) Chemosterilizer

18) Super antigens

19) Agglutination reactions

20) AFB staining

21) Neutralisation test

22) interfe

QP Code: 202012 **Reg. No.:**

SECOND YEAR BSc MLT EXAMINATION

(Model Question Paper)

Paper- VI. General Microbiology

Time: 3 hrs **Maximum marks: 100**

Answer all questions

Draw diagrams wherever necessary

Essays **(2x10=20)**

1. Enumerate bacterial enzymes detected in your lab. Discuss in detail. (2+8=10)

2. Enumerate the different methods of transmission of genetic material in bacteria. Describe each. (2+8=10)

Short notes **(10x5=50)**

3. TSI

4. Modern anaerobic culture methods

5. typing of bacteria

6. selective media

7. classification of microorganisms

8. Germ free animals

9. Guinea pig

10. Euthanasia in lab animals

11. Lac operon

12. Turbidometric method of measuring bacterial growth

Answer briefly **(10 x3=30)**

13. RCM

14. Enrichment media

15. Chocolate agar

16. Of test

17. PPA test

18. Postmortem examination of animals

19. Disposal of carcasses

20. Solidifying agents in culture media

21. Isolation of bacterial mutants

22. Genotypic and phenotypic variations in bacteria

QP Code: 203012 **Reg. No.**

SECOND YEAR BSc MLT EXAMINATION

(Model Question Paper)

Paper- VII. Parasitology and Entomology

Time: 3 hrs **Maximum marks: 100**

Answer all questions

Draw diagrams wherever necessary

Essays **(2x10=20)**

1. Describe the morphology life cycle pathogenesis clinical features and laboratory diagnosisof malaria (10)

2. Classification of insects of medical importance. Discuss briefly binomics of anopheles (7+3=10)

Short Notes **(10x5=50)**

3. Hydatid cyst

4. Schistosoma haematobium

5. Toxoplasma gondii

6. Pathogenic free living amoeba

7. Laboratory diagnosis of kala-azar

8. Transmission of infection by insects

9. Insectisides and resistance

10. Cyclopes and its control

11. Sarcoptes scabiei

12. Mosquito control measures

Answer Briefly **(10x3=30)**

13. Bile stained ova

14. Diphyllopobothrium latum

15. Balantidium coli

16. Trichomonas vaginalis

17. Xeno diagnisis

18. Integrated vector control

19. Head louse

20. Biological control

21. Life cycle of hardtick

22. Rat flea

QP CODE: 105012 **Reg No:**

First Year B.Sc. MLT Degree Examinations.2016

Paper IV. Basic Medical Laboratory Science & Haematology – I

Time: 2 Hours **Total Marks: 100**

Answer all questions

Draw diagrams wherever necessary

Essay **(2x10=20)**

1 Define differential leucocyte count. Write the preparation & uses of different types of blood smears (2+8=10 marks)

2.Mention different types of microscopes. Describe aberrations of light microscope. Describe the principle working & applications of Dark ground microscope(2+3+5=10marks)

Short notes **(10x5=50)**

3 .Community participation in health care delivery system

4. Concept of siddha medicine

5. Methods of epidemiological studies

6. Romanowsky stain

7. Cardiopulmonary resuscitation

8. Goals &Scopes of Medical ethics

9. Laboratory hazards

10. Micrometry

11. Total WBC count

12. Cyan methaemoglobin method (10x5=50marks)

Answer Briefly **(10x3=15)**

13. Recent developments in medical record keeping

14. Reticulocyte

15. Citrate as anticoagulant

16. Red cell indices

17. Buffy coat smears

18. Demonstration of HbF

19. Principles of automated cell counters

20. Preparation of bone marrow smears

21. Vacutainers

22.Megakaryocyte (10x3=30marks)t

QP Code:201012 **Reg. No.**

SECOND YEAR BSc MLT EXAMINATION

(Model Question Paper)

Paper- V. Biochemistry - II

Time: 3 hrs **Maximum marks: 100**

Answer all questions

Draw diagrams wherever necessary

Essays **(2x10=20)**

1. Discuss briefly the Deno vo synthesis of purine nucleotides (10)
2. Discuss various method of cholesterol estimation. Write any one method in detail (4+6=10)

Short Notes **(10x5=50)**

3. CSF analysis
4. Gluconeogenesis
5. Urea cycle
6. Phenyl ketonuria
7. Energetics of TCA cycle
8. Importance compound synthesized from tryosi
9. Fatty liver
10. Bile acid synthesis
11. Biuret method of total protein estimation
12. Functions of vitamin A

Answer Briefly **(10x3=30)**

13. Cori's cycle
14. Significance of HMP pathway
15. Galactosemia
16. Polyamine synthesis
17. Role of vitamin K in coagulation
18. Functions of vitamin C
19. Niemann - pick disease
20. Biosynthesis of phosphotidyl serine
21. Role of biotin in fatty acid synthesis
22. Glucuronic acid pathway

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QP Code: 202012 Reg. No.:

SECOND YEAR BSc MLT EXAMINATION

(Model Question Paper)

Paper- VI. General Microbiology

Time: 3 hrs **Maximum marks: 100**

Answer all questions

Draw diagrams wherever necessary

Essays **(2x10=20)**

1. Enumerate bacterial enzymes detected in your lab. Discuss in detail. (2+8=10)

2. Enumerate the different methods of transmission of genetic material in bacteria. Describe each. (2+8=10)

Short notes **(10x5=50)**

3. TSI

4. Modern anaerobic culture methods

5. typing of bacteria

6. selective media

7. classification of microorganisms

8. Germ free animals

9. Guinea pig

10. Euthanasia in lab animals

11. Lac operon

12. Turbidometric method of measuring bacterial growth

Answer briefly **(10 x3=30)**

13. RCM

14. Enrichment media

15. Chocolate agar

16. Of test

17. PPA test

18. Postmortem examination of animals

19. Disposal of carcasses

20. Solidifying agents in culture media

21. Isolation of bacterial mutants

22. Genotypic and phenotypic variations in bacteria

QP Code: 203012 Reg. No.

SECOND YEAR BSc MLT EXAMINATION

(Model Question Paper)

Paper- VII. Parasitology and Entomology

Time: 3 hrs **Maximum marks: 100**

Answer all questions

Draw diagrams wherever necessary

Essays **(2x10=20)**

1. Describe the morphology life cycle pathogenesis clinical features and laboratory diagnosis of malaria (10)

2. Classification of insects of medical importance. Discuss briefly binomics of anopheles (7+3=10)

Short Notes **(10x5=50)**

3. Hydatid cyst

4. Schistosoma haematobium

5. Toxoplasma gondii

6. Pathogenic free living amoeba

7. Laboratory diagnosis of kala-azar

8. Transmission of infection by insects

9. Insectisides and resistance

10. Cyclopes and its control

11. Sarcoptes scabiei

12. Mosquito control measures

Answer Briefly **(10x3=30)**

13. Bile stained ova

14. Diphyllopobothrium latum

15. Balantidium coli

16. Trichomonas vaginalis

17. Xeno diagnisis

18. Integrated vector control

19. Head louse

20. Biological control

21. Life cycle of hardtick

22. Rat flea

QP Code:204012 **Reg. No.:……**

SECOND YEAR BSc MLT EXAMINATION

(Model Question Paper)

Paper- VIII. Haematology and Clinical Pathology **Time: 3 hrs**

Maximum marks: 100

• *Answer all questions*

• *Draw diagrams wherever necessary*

Essays **(2x10=20)**

1. Define leukemia. Classify it. Explain the blood and bone marrow findings in CML (2+3+5=10)

2. What is HCG. Mention HCG levels at various stages of pregnancy. Explain different cardtests used for the detection of pregnancy. (1+4+5=10)

Short Notes **(10x5=50)**

3. Urine preservatives

4. Prothrombin time

5. Bence jones protein

6. Examination of blood for parasites

7. Hbs

8. Fibrin degradation products

9. Laboratory diagnosis of iron deficiency anaemia

10. Semen analysis

11. Leukaemiod reactions

12. Myeloperoxidase stain

Answer briefly **(10x3=30)**

13. Detection of ketone bodies in urine

14. Bleeding time

15. Fouchet's test

16. CSF cell count

17. Measurement of faecal fat

18. Haemoplilia

19. Occult blood in stool

20. Organised sediments of urine

21. Automated blood cell counter

22. Ham's test

Q.P.Code:301012 **Reg.no ……**

Third year BSc MLT Degree Examinations 2016

Paper IX . BIOCHEMISTRY III

Time:3Hours **TotalMarks:100**

- Answer all questions
- Draw diagrams wherever necessary

Essays: **(2x10=20)**

1. Discuss the basic principle of Chromatography. Write the detailed procedure for separation of urinary Aminoacid by Chromatography. (2 +8=10)

2. Describe the biosynthesis of Heme synthesis. Add a note on its regulation (8+2=10)

Short notes: **(10x5=50)**

3. Bohr effect
4. Isoenzymes of Alkaline phosphatase
5. SDS-PAGE
6. Estimation of serum Bilirubin
7. Co-enzymes
8. Acute intermittent porphyria
9. Factors affecting the electrophoretic mobility
10. Common laboratory investigations for porphyrias
11. Affinity Chromatography
12. Urinary calculi analysis

Answer briefly: **(10x3=30)**

13. Glucose -6-phosphate dehydrogenase
14. K m Value of enzymes
15. Active site of enzymes
16. Suicide inhibition
17. Creatine kinase
18. Isoelectric focussing
19. Foetal Haemogloin
20. Significances of Transaminases
21. Crigler-Naajar syndrome
22. Fluorescent immunoassay

Q.P.Code: 302012 **Reg.no.:……**

Third year BSc MLT Degree Examinations 2016

Paper X. BACTERIOLOGY

Time:3 Hours **Total Marks:100**

- Answer all questions
- Draw diagrams wherever necessary

Essays: **(2x10=20)**

1. Enumerate the bacteria causing pyogenic meningitis.Write in detail the Laboratory diagnosis of Pneumococcalmeningitis (2+8=10)
2. Classify the serological tests used to diagnose syphilis. How do you diagnose a case of syphilis in a

laboratory(2+8=10)

Short notes: **(10x5=50)**

3. CAMP test
4. Gas gangrene
5. Diarrhoegenic Escherichia coli
6. Disc diffusion method of sensitivity tests
7. Laboratory diagnosis of Cholera
8. Processing of sputum for isolating Mycobacterium tuberculosis
9. Helicobacter pylori
10. Selective and Enrichment media for salmonella and Shigella
11. Preservation of bacteria.
12. Mycoplasma pneumoniae.

Answer briefly: **(10x3=30)**

13. McFaydean reaction.
14. Diene Phenomenon
15. .Significant bacteriuria
16. Chigger borne typhus
17. Rat bite fever
18. Sulphur granules
19. Lyme disease
20. Cell wall active antimicrobial agents
21. Lepromin test
22. ASO test

Q.P.Code: 303012 **Reg.no.:……**

Third year BSc MLT Degree Examinations 2016

Paper XI . CYTOLOGY & TRANSFUSION TECHNOLOGY

Time:3Hours **Total-marks:100**

- Answer all questions
- Draw diagrams wherever necessary

Essays: **(2x10=20)**

1. Explain the techniques of collection of various samples from respiratory tracts. Enumerate the advantages &disadvantages of each sample. (5+5=10)
2. Mention different components used in blood bank. Explain preparation & use of FFP (3+ 7=10)

Short notes: **(10x5=50)**

3. Cell block

4. Storage of blood in blood bank

5. FNAC

6. Fixatives used in cytology

7. Plasma pheresis

8. Papanicolaou staining

9. Bombay blood group

10. Cross matching

11. .Blood grouping sera

12. Quality control in cytology

Answer briefly: **(10x3=30)**

13.Lectins used in blood bank

14. Cell cycle

15.Mailing of smears in cytology

16.LISS

17. DU Antigen

18. Processing of fluids in cytology

19.Transfusion transmitted diseases

20 Pre-fixation of cytological specimens

21.Dangerous O group

22.Cytocentrifuge

Model of scheme for Biochemistry Practical examination.

Year& Paper	Exercise	Marks
1st year –Biochemistry-1	1.Record	10
	2.Identification of Carbohydrate /protein/ NPN substances	45
	3.Volumetric analysis of (Titrations against primary standards for the preparation of 0.1 N solutions of)) $NaOH/HCL/H_2SO4/Na_2CO_3/KMNO_4/AgNO_3$.(***Any one of the tests may be given to each student on random basis)***	35
	4. Spotters (10 spotters from equipments, Glasswares, chemicals, reagents, scientists, pictograms etc)	10
	Total	100
2nd Year- Biochemistry-2	1.Record	10
	2. Standard curve preparation with test analysis- Glucose/Urea/Creatinine/Uricacid/Cholesterol/Protiens. (***Any one of the tests may be given to each student on random basis)***	50
	3.GTT/ GCT/ Urine analysis- abnormal/CSF biochemistry. (***Any one of the tests may be given to each student onrandom basis)***	40

	Total	100
3rd year- Biochemistry-3	1.Record	10
	2.Paper chromatography/ Thin layer Chromatography/cellulose acetate electrophoresis/ Agar gelelectrophoresis. (***Any one of the tests may be given to each student on random basis)***	50
	3.Estimation of serum bilirubin /estimation of urinary porphyrin/estimation of urinary porphobilinogen/urinarycalculi analysis/urea clearance/ creatinine clearance/ Vitamin.C /Vitamin.A. (***Any one of the tests may be given to each student on random basis)***	40
	4. Estimation of serum level of AST/ ALT/ALP/ ACP/Amylase/LDH/ CPK/ G6PD/ Ceruloplasmin. (***Any one of the tests may be given to each student onrandom basis)***	50
	Total	**150**
4th Year- Biochemistry-4	1.Record	10
	2. Function tests based on case study-Acute renal failure/chronic renal failure/nephrotic syndrome/ obstructive jaundice/ hemolytic jaundice/viralhepatitis/ Diabetes mellitus/pancreatitis/myocardial infarction. (***Any one of the case may be given to each student onrandom basis)***	60
	3. Estimation of hormone metabolites in urine- VMA/ 5-HIAA/ 17- ketosteroids/ 17- ketogenic steroids/urinary estriol. (***Any one of the tests may be given to each student onrandom basis)***	40
	4.Estimation of serum calcium/ serum phosphorus/ serum iron/ serum copper/ serum magnesium/ serum sodium & potassium. (***Any one of the tests may be given to each student on random basis)***	40
	Total	**150**

4th year project evaluation	Project content, Methods & findings
	Presentation
	Open viva
	Total

Model of scheme for Pathology Practical examination.

Year& Paper	Exercise	Marks
1st year –Basic Laboratory Sciences and Hematology -1	1.Record	10
	2.Preparation of blood smear , Leishman staining ,Differential count 3. RBC Count/ WBC count/PLT count/AEC/ Reticulocyte count (***Any one of the tests may be given to each student on random basis)***	30 20
	4..Hb estimation by Sahli's method/ Hb by Cyan meth/ PCV/ESR (***Any one of the tests may be given to each student on random basis)***	20
	5. Spotters(10 spotters)	20
	Total	**100**
2nd Year- Clinical Pathology and Haematology-II	1.Record	10
	2. Peripheral smear preparation and examination 3. MPOstaining/ SBB staining/ PAS staining/ Perl's stain 4. Urine analysis/Semen analysis/CSF analysis/Faces analysis/Pleural fluid/Peritoneal fluid/synovial fluid (***Any one of the tests may be given to each student on random basis)***	20 10 25
	5. BT & CT/ PT/ APTT/ Sickling test (***Any one of the tests may be given to each student on random basis)***	15
	6. Spotters(10 spotters)	20
	Total	**100**
3rd year- Cytology and Transfusion technology	1.Record	10
	2.ABO cell and serum grouping/ Secretory status 3.Cross matching / D^U typing/ Titration of Antisera (***Any one of the tests may be given to each student onrandom basis)***	30 30
	4. Pap Staining / MGG staining / Shorr's stain (***Any one of the tests may be given to each student on random basis)***	30
	5. DCT/ ICT/ Examination of normal and inflammatory smear (***Any one of the tests may be given to each student on random basis)***	20
	6.Spotters(15 spotters)	30

	Total	**150**
4th Year- Histo technology and cytogenetics	1.Record	10
	2. Section cutting	30
	3. PAS staining/ Van Gieson's staining/ Gomori's reticulin/ Perl's Prussian Blue staining (***Any one of the tests may be given to each student on random basis)***	30
	4. Barr bodydemonstration in buccal smear / /Metaphase spread preparation frombone marrow / Demonstration of drumstick appendages. 5.H & E staining /Honing and stropping (***Any one of the tests may be given to each student on random basis)***	20 30
	6.Spotters(15 spotters)	30
	Total	**150**
4th year project evaluation	Project content, Methods & findings	25
	Presentation	10
	Open viva	15
	Total	**50**

Model of scheme for Microbiology Practical examination.

Year& Paper	Exercise	Marks
1st year –Basic Microbiology	1.Record	10
	2.Gram staining	20
	3.AFB Staining	20
	4.Motility testing	15
	5.Special staining techniques (capsule, spore, volutin granules,spirochetes) (***Any one of the tests may be given to each student on random basis)***	15
	Spotters	20
	Total	100
2nd Year- General Microbiology	1.Record	10
	2.Adjustment of pH of culture medium	10
	3.Media Preparation (Pouring & sterility test)	20
	4.Isolation of mixed culture	10
	5.Spotters	20

	6.Biochemical tests (***Any six tests may be given to each student on random basis-6*5)***	30
	Total	100
2nd year –Parasitology & Entomology	1.Record	10
	2.Macroscopic & microscopic examination of stool.	2 5
	3. Concentration techniques for intestinal parasites in stool.	15
	4.Staining, Examination and identification of blood smear for parasites	20
	5. Collection and preparation of permanent mounts of arthropods of medical importance	10
	6.spotters	20
	Total	100
3rd year- Bacteriology	1.Record	10
	2.Case study (Samples) a) Preliminary reporting b) Selection of media, isolation and reporting c) Grams stain, Motility (hanging drop) , Biochemical reactions and identification d)ABST e) Final reporting (**A specimen collected from a patient suspecting bacterial infection shall be given to each candidate with a requisition form indicating the possibility of bacterial infection for the laboratory diagnosis. ABST also to be included wherever necessary**) (The candidates are supposed to do the preliminary test, relevant biochemical tests or special tests for its laboratory diagnosis	10 20 25 20 5
	3. Serology a) Widal test b) ASO/ RPR / VDRL test (***Any two tests may be given to each student on random basis-)*** 4.Spotters	
	Total	**150**
4th Year- Virology, Mycology and Applied microbiology	1. Record	10
	2. Identification fungus- A fungal growth in slope media (SDA/BHI Agar) are given to each student for its identification & report within 3 days.	50
	3. ELISA 4. Case study (specimen) for Hospital acquired infection (A specimen collected from a patient suspecting hospital acquired infection shall be given to each candidate with a requisition form indicating the possibility of hospital acquired infection for the laboratory diagnosis. ABST also to be included wherever necessary)	
	5. Water bacteriology – testing & reporting 6. Milk-MBRT	30 10

	7. Spotters	20
	Total	**150**
4th year project evaluation	Project content, Methods & findings	25
	Presentation	10
	Open viva	15
	Total	**50**

3.7 . Practical Examination: A certified practical Record is compulsory for each subject and that will beevaluated at the time of concerned Practical Examination.

A maximum of 10 marks shall be given for the record.

3.8 Details of practical/clinical practical exams

As given under "Details of theory exams "

3.9 Number of examiners needed (Internal & External) and their qualifications

One set of Examiners will be sufficient (one external and one internal) to conduct the practical and viva examination in all the subjects.

There shall be two examiners for practical and viva –one internal and one external. The external examiner shall be drawn from other institutions where a similar course is being conducted. Both internal and external examiners should have MD in the concerned subject or MSc MLT in the concerned subject and those who are full time teachers of Medical Laboratory Technology with at least three years of full-time teaching experience in medical laboratory technology after the acquisition of MD or MSc MLT in the concerned subject. The theory papers should also be evaluated by teachers with the above qualifications. The examiner/Evaluator in paper XII should be having MSc MLT with Biochemistry, Microbiology or Pathology specialization.

3.10 Details of viva: division of marks

As given under "Scheme of examination showing maximum and minimum marks"

4. INTERNSHIP

No internship for BSc(MLT) course or otherwise by Govt.order

5. ANNEXURES

5.1 **Check Lists for Monitoring**: Log Book, Seminar Assessment etc. to be formulated by the curriculum committee of the concerned Institution

5.2 Any details which are not mentioned in the above will be decided by the KUHS after considering the KUHS ACT and Statues, Governing Council decisions, Guidelines of the respective Councils, the government and directives of the Hon'ble Courts.

5.3 Rules for Supplementary batch.

No supplementary batch will be conducted for BSc (MLT) course but supplementary examinationwill be conducted within 6 months after each regular examination.

c) Criteria for Promotion.

Student shall be promoted up to fourth year irrespective of whether the candidate has passed the First, Second or Third year university examinations provided the student has attained 80% attendance and appeared in all the sessional examinations for both theory and practical in the respective year. But a candidate before appearing the fourth year BSc (MLT) examination shall havepassed in all the subjects of first, second- and third-year BSc (MLT) examinations. If the candidate appeared for first or second- or third-year examinations but fails in one or more subjects shall be promoted up to fourth year. Though, the candidate before appearing the fourth year BSc (MLT) examination shall have passed in all the subjects of first, Second- and third-year BSc (MLT) examinations.