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

Bachelor of Science in Medical Microbiology

Course Code 19

(2024-25 Academic year onwards)

2. COURSE CONTENT

2.1 Title of course:

Bachelor of Science in Medical Microbiology (B. Sc. Medical Microbiology)

2.2 Objectives of course

The B. Sc. Medical Microbiology course covers a broad range of topics relating to Medicine and Health issues. It is a 4-year course which gives particular emphasis on practical training and developing transferable skills that will be invaluable in a wide range of professional settings. The course starts with Human Anatomy, Physiology and the foundations of Chemistry and leads the students' right up to the cutting-edge research questions in the Final year.

1. Acquisition of adequate theoretical and practical knowledge of foundation in the basic Medical Subjects.
2. Aware of the principle underlying the organization of a Clinical Laboratory.
3. Able to do routine and special investigative procedures pertaining to Medical Microbiology Laboratory Practice.
4. Provide a good theoretical and practical education for who plan to work within the field of Medical Microbiology.
5. Develop knowledge and skill in accordance with the society's demand in Medical Microbiology.
6. Qualify the students for official approval as Medical Microbiologist.
7. Able to operate and maintain all equipment used in Microbiology Laboratory.
8. Able to establish and manage a Clinical or Research Laboratory.

9. Acquisition of Moral and Ethical Codes and Conduct of Professional Practice ina dedicated manner with the patient welfare as the primary responsibility.

2.3 Medium of instruction:

The medium of instruction for the course shall be English.

2.4 Course outline

It is a four-year Professional Degree course with a total course duration 5760 hours including 1000 hours of training in Clinical Laboratories and a Project Work in the Final year.

There will be three Internal Examinations conducted by the Institute and University Examination at the end of each Academic Year.

The course consists of mainly:

Theory classes

Includes scheduled teaching in Lectures, Tutorials, Assignments & Seminars to ensure active participation of the students.

Practical classes:

Laboratory based Practical Work is an integral part of the course which is inevitable for thecareers in Hospital Clinical Laboratories and Research field.

Clinical Laboratory Training:

Clinical Laboratory is the place where materials of human origin and / or human healthcare environment are collected, stored, processed and / or analyzed and reported for the purposeof screening, diagnosis, prognosis, treatment or prevention of diseases and for Clinical Research. Regular Clinical Training is unavoidable for developing qualified laboratory personnel who is competent for interpreting and reporting.

Project:

A laboratory-based project work is included in the Final year which gives the students an idea to document the work and its results in a thesis like report. The principal aim is to make the students independent as a future graduate in the research field. The supervising teacher gives guidance for carrying out project work.

2.5 Duration

The duration of the course shall be four academic years.

2.6 Syllabus

I B. Sc. Medical Microbiology

- Paper I - Anatomy
- Paper II - Physiology
- Paper III - General Biochemistry
- Paper IV - General Methodology
- Paper V- Community Medicine, Health Education and Communicative English

II B. Sc. Medical Microbiology

- Paper VI- Fundamentals of Microbiology and Molecular Biology
- Paper VII- Parasitology and Entomology
- Paper VIII- Methodology and Instrumentation
- Paper IX – Information Technology, Bioinformatics and AI in Healthcare

III B. Sc. Medical Microbiology

- Paper X- Systematic Bacteriology
- Paper XI- Immunology, Immunochemistry and Serology
- Paper XII – Biostatistics and Research Methodology

IV B. Sc. Medical Microbiology

- Paper XIII- Virology and Mycology
- Paper XIV - Clinical Microbiology
- Paper XV – Applied Microbiology and Clinical Laboratory Management
- Paper XVI- Project

The concept of health care counseling shall be incorporated in all relevant areas.

2.7 Total number of hours

The student has to attend a minimum of 240 working days in an academic year. Total course duration 5760 hours including 1000 hours of training in clinical laboratories.

No. of hours for each subject is as mentioned in the syllabus

2.8 Branches if any with definition

See clause 2.10

2.9 Teaching learning methods

Lecture and practical classes, regular clinical laboratory posting to pick up practical skill and practice techniques on laboratory responsibility and supervision. Students should present seminars in various clinical subjects in Medical Microbiology to attain presentation skill.

2.10 Content of each subject in each year

SYLLABUS

I B. Sc. Medical Microbiology

Paper I – Anatomy –

Theory - 120 hrs

Objective: The Subject 'Anatomy' is designed to enable students to approach the study of human body in an organized way. The subject covers topics such as structure, cytology, histology and provides essential knowledge about the human body and its systems.

- **Introduction**: to the course and the subject of anatomy. (2 hrs)
- **Orientation to**: the systems of the body; anatomical terminologies; learning methodologies in anatomy; embryology. Introduction of genetics. (6 hrs)
- **Microscopic Anatomy**: structure of cell, cell cycle and division, types of tissues – it's features. (10 hrs)
- **Respiratory system**: embryology, parts of the system, gross and microscopic structures of the lungs and trachea. Gross features of nasal cavity, pleura, diaphragm - applied aspects. (12 hrs)
- **Cardiovascular system**: gross and microscopic structure of heart, pericardium, embryology with emphasis on fetal circulation, parts and microscopic anatomy of vessels, bloodvessels- both arteries and veins in relation, attachment and relations of major vessels to the heart, distribution and tributaries of major arteries and veins, applied aspects. (12 hrs)
- **Digestive system**: embryology, location, parts and functions of the system – tongue, stomach, intestine, liver, pancreas, gall bladder and spleen - grossand microscopic structure. Location of digestive glands - gross and microscopic structure. Applied aspects. (12 hrs)
- **Urogenital system**: a) Reproductive system: developmental considerations of the male and female systems, gross and microscopic parts of both male and female systems, primary and secondary sexual organs and function, applied aspects. (12 hrs)

  b) Urinary system: developmental considerations, parts, gross and microscopic

structure of kidney, ureter and urinary bladder, applied aspects. (10 hrs)

- **Musculoskeletal systems**: classification, location of the bones and muscles in the body, gross features of bones and parts, microscopic features of muscle and bone, joints, classification, bones involved, applied aspects. (12 hrs)
- **Nervous systems**: developmental considerations, parts and division into central nervous system, peripheral nervous system, autonomic nervous system, gross and microscopy of brain and spinal cord, cerebellum, brain stem, naming of cranial nerves, functions served by each of them, brief account of degeneration and regeneration of nerves, applied aspects. (12 hrs)
- **Endocrinology**: brief outline of location and function of the endocrine glands. Gross and microscopic structure of thyroid, parathyroid, pituitary glands and adrenal gland. (10 hrs)
- **Special senses**: eye, ear, nose, tongue, skin and appendages. (10 hrs)

Practical (80 hrs)

- Demonstration of systems of the body.
- Microscopic demonstration for histology
- Osteology demonstration
- Practical and applied anatomy demonstration depending on the topic.

Recommended books

- B.D. Chaurasia's Human Anatomy (Vol 1- 3) Regional and Applied
- Gray's Anatomy for students
  Richard. L. Drake, A. Wayne Vogl, Adam W.M. Mitchell (Reference)
- Text book of Human Histology with color Atlas
  Inderbir Singh

PAPER II - PHYSIOLOGY

Theory – 120 hrs

Objective: The Subject 'Physiology' is designed to enable students to study regular functions in human body. The Subject covers mechanisms and processes that occur within human body.

1. **BLOOD**: Composition of blood; Structure and function of RBC, WBC and platelets; blood coagulation; blood groups; Reticuloendothelial system - Structure and function of spleen; Jaundice and Anaemia (12 hrs)

2. **CARDIOVASCULAR SYSTEM**: Structure and properties of cardiac muscles; nerve supply to heart; Structure and function of blood vessel; Cardiac cycle and pressure changes; heart sounds; cardiac output; heart rate; cardiovascular reflexes; Blood pressure; haemorrhage; ECG; changes in muscular exercises (12 hrs)

3. **RESPIRATORY SYSTEM:** Physiological anatomy; mechanism of respiration; lung volume and capacities; breath sound; types of respiration; artificial respiration; transport of blood gases; regulation of respiration; hypoxia; effects of exercise (12 hrs)

4. **DIGESTIVE SYSTEM**: Digestion in mouth, stomach and intestine; digestion of carbohydrates, fats and protein; control of secretion; absorption; structure and function of liver (12 hrs)

5. **EXCRETORY SYSTEM**: Gross and minute structure of kidney; GFR; formation of urine; tubular function, renal function test, micturition (12 hrs)

6. **MUSCLE**: Structure and types of muscles; muscle contraction (12 hrs)

7. **NERVOUS SYSTEM**: Structure of neurons; nerve impulse; structure and function of spinal cord; spinal reflexes and pathways; structure and functions of different parts of brain; autonomic nervous system; neurohumoral transmission; CSF; Physiology of touch,

smell, taste, hearing and vision; reflexes (12 hrs)

8. **ENDOCRINE SYSTEM**: Structure and functions of pituitary, thyroid, adrenal glands; Thymus and pancreas (12 hrs)

9. **REPRODUCTIVE SYSTEM**: Sex determination and development; puberty; structure and function of male and female reproductive system; pregnancy; parturition; lactation; foetal circulation (12 hrs)

10. **SKIN AND TEMPERATURE REGULATION –** Functions of skin; Normal body temperature, factors affecting body temperature, temperature regulating mechanisms (12 hrs)

PRACTICALS (80 hrs)

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

RECOMMENDED BOOKS

1. Essentials of Medical Physiology
K. Sembulingam, Prema sembulingam
2. Concise Medical Physiology
Sujith K chaudari

3. Ganong's Review of Medical Physiology
   (Reference)
4. Textbook of Medical Physiology
   Arthur C Guyton, John E Hall

Paper III - General Biochemistry

Theory – 120 hrs

Objective: The Subject 'General Biochemistry' is designed to enable students to focus on contributions of biochemistry toward an understanding of structure and functions of human body. The Subject includes chemistry and functions of constituents of cells and tissues, the basis for the structure of nucleic acids, proteins and carbohydrates and basic enzymology.

- **Introduction**: Cell - eukaryotic and prokaryotic cell structure, cell organelles and biological membranes - its structure and functions. (6 hrs)

- **Carbohydrates**: Classification, Functions, structure and Properties of mono -, di - and polysaccharides. (12 hrs)

- **Proteins**: Structure and classification of amino acids, Chemical reaction of amino acids. Essential and Non-essential amino acids. Classification, functions & structure of proteins, plasma proteins. (12 hrs)

- **Lipids**: classification and functions of lipids, fatty acids - classification and properties, Structure, types and functions of lipoproteins – Chylomicrons, VLDL, LDL and HDL. (12 hrs)

- **Nucleic acids**: Structure of purines and pyrimidines; Nucleosides, nucleotides, cyclic nucleotides, structure and functions of DNA – Watson & Crick Model, Properties of major classes of RNA. (12 hrs)

- **Vitamins:** classification, functions in brief, dietary sources, daily requirements, deficiency manifestations. (6 hrs)

- **Minerals:** classification, functions, sources, daily requirements, disorders related. (6 hrs)

- **Enzymes:** Classification and properties. (6 hrs)

- **Physical chemistry**: Colloids, Donnan membrane equilibrium, diffusion, dialysis, osmosis, reverse osmosis, surface tension, viscosity, adsorption. (12hrs)

- **Acids and bases**: definition, ionization of acids, ionic product of water, H^+ concentration, strong acids and bases, weak acids and bases, strength of acids, Properties of commonly used acids and bases - sulphuric acid, nitric acid, phosphoric acid, HCl, acetic acid, KOH, NaOH, sodium carbonate, ammonia. (12 hrs)

- **P^H -** definition, P^H scale, calculation of P^H, Henderson - Hasselbalch equation. (6 hrs)

- **Buffers**- definition, components, mechanism of action, buffer capacity, pK of buffers, preparation of buffers, buffers in biological system, commonly used buffers in laboratory - phosphate buffer, tris buffer. (6 hrs)

- **Properties of commonly used salts**- ammonium chloride, ammonium sulphate, sodium carbonate, sodium chloride. (6 hrs)

- **Properties of commonly used solvents**- methanol, ethanol, acetone. (6 hrs)

Practical (80 hrs)

- **Reactionsofcarbohydrates:**

  Monosaccharides- glucose, fructose, galactose

  Disaccharides- maltose, lactose, sucrose

  Polysaccharides- starch, dextrin

- **Qualitative analysis of unknown carbohydrate solution**
- **Reactionsofproteins:**

  Colour reactions and precipitation reactions of albumin, Peptone, gelatine and casein.

- **Qualitative analysis of unknown protein solution**
- **Reactionsoflipids:**

  Qualitative tests –

  solubility test

  Acrolein test

  Tests for fatty acids

  Tests for unsaturation of fatty acids

Recommended books:

- Text book of Biochemistry for medical students

  D M Vasudevan, S Sreekumari & Vaidyanathan Kannan

- Biochemistry by U. Satyanarayana

  U. Satyanarayana and U. Chakrapani

- Harper's Illustrated Biochemistry (Reference)

  Robert Murray, Victor Rodwell, David Bender, KathleenM Botham, P. Anthony Weil, Peter J. Kennelly

PAPER IV: GENERAL METHODOLOGY

Theory - 120 hrs

Objective: The Subject 'General Methodology' is designed to enable students to acquire

Foundational laboratory skills necessary for accurate and reliable laboratory work. The Subject covers calibration, dilution and proper use of common laboratory equipment.

1. **General introduction to clinical laboratory** – Role of Laboratory in Health care delivery, Levels of laboratories, Departments, or sections. Structure – collection, examination and reporting area, Procedures - Labelling and registering of specimens, Personnel required by laboratories. (6 hrs)

2. **Laboratory hazards** - physical, chemical, biological; first aid in laboratory hazards. (6hrs)

3. **Safety in Laboratory:** General safety measures, Fire safety, Electrical Safety, Biosafety precautions; Biological Safety Cabinets, PPEs, Levels of Biosafety Laboratories. (6 hrs)

4. **Laboratory equipment and wares**: General laboratory equipment – Analytical balance, Centrifuge, Autoclave, Incubator, Water bath, Hot air oven, Refrigerator. Laboratory glass wares and plastic ware-Types, uses, cleaning and care, Calibration of pipettes. (12hrs)

5. **Chemical and Reagents:** grades of purity, storage and handling of chemicals and reagents. Primary and secondary standard chemicals, indicators. (6 hrs)

6. **Preparations of standard solutions** – normal, molar, molal and percentage solutions. Dilutions of solutions - inter conversion of concentrations, preparation of normal saline. (8 hrs)

7. **Preparation and storage of distilled, double distilled and deionised water**. (8 hrs)

8. **Collection of blood:** Methods of blood collection – Capillary, venous and arterial; preparation of blood smear. (6 hrs)

9. **Anti-coagulants & preservatives:** anti-coagulants for blood collection - types, action and uses;

Colour codes of anticoagulants. Urine preservatives. (8 hrs)

10. **Basics of Microbiology:** Evolution and history of microbiology, Safety precautions in microbiology laboratory. Classification of microorganisms, morphology of bacteria. Bacterial growth and nutrition. (12 hrs)

11. **Microscopy:** parts, use and care of microscopes - optical microscopy, phase contrast microscope, dark field microscope, interference microscope, polarisation microscope and electron microscope; Staining methods - simple staining, differential staining and special staining. (12 hrs)

12. **Sterilisation and disinfection** - methods of sterilization; disinfectants - different types, methods, applications. (10 hrs)

13. **Culture media** - introduction, classification, preparation; Methods of cultivation of bacteria, anaerobic culture methods. (8 hrs)

14. **Care and management of laboratory animals** - the basic knowledge of the feeding, housing, breeding, care and immunisation of following animals - mouse, guinea pig and rat; collection of blood samples, killing of animals and post-mortem examination; different routes of animal inoculation, Disposal of carcasses. (12 hrs)

PRACTICALS (80 hrs)

- Measurement of liquids, Weighing solids
- Calibration of pipettes and other volumetric glass wares
- Titration of acids and bases
- Preparation of cleaning solution
- Preparation of normal, molar and percentage solutions
- Preparation of normal saline
- Preparation of saturated and half saturated solution
- Preparation of buffer solution, pH measurement

- Preparation of distilled and deionized water
- Preparation of anticoagulants and preservatives for specimen collection
- Blood collection
- Blood smear preparation
- Use and care of simple autoclave, incubators, hot airoven, water bath and centrifuge
- Staining methods - simple and differential
- Cleaning and preparation of glassware for media preparation and sterilization
- Preparation of culture media
- Demonstration of culture methods
- Handling of laboratory animals

Recommended books:

- Prescott / Harley Klein's Microbiology
  Joanne Willey, Linda Sherwood, Chris Woolverton
- Mackie and McCartney Practical Medical Microbiology
  J. Gerald Collee, Andrew G. Fraser, Barrie P Marmion, Anthony Simmons
- Ananthanarayanan and Paniker's Text book of Microbiology
  R. Ananthanarayan and C. K. Jayaram Paniker
- Essentials of Medical Microbiology
  Apurba S Sastry, Sandhya Bhat
- Medical Laboratory Technology (Vol 1-3)
  Kanai L. Mukherjee
- Text book of Medical Laboratory Technology
  by Praful B Godkar, Darshan P Godkar
- Practical Clinical Biochemistry –
  Harold Varley

Paper V: Community Medicine, Health Education and Communicative English

Theory – 120 hrs (Internal Assessment only)

COMMUNITY MEDICINE

Objective: The Subject 'Community Medicine' is designed to enable students to focus on healthcare issues affecting the community as a whole. The Subject deals with the history of specific diseases, the influence of the environment on health and the prevention of diseases.

- General concepts of health and diseases with reference to natural history of diseases with pre pathogenic and pathogenic phases. The role of socio economic and cultural environment in health and diseases. Epidemiology and scope.
- Public health administration - an overall view of the health administration setup - central and state level
- The national health programme. Highlighting the role of social, economic and cultural factors in the implementation of the national programme.
- Physical growth and development, Nutrition, Safe water and sanitation
- Health problems of vulnerable groups-pregnant and lactating women, infantsand school going children, occupational groups, geriatrics.
- Occupational health - definition, scope, occupational diseases, prevention of occupational diseases and hazards.
- Social security and other measures for the protection of occupational hazards accidents and diseases. Details of compensation acts.
- Family planning - objectives of national family planning methods – a general idea of advantages and disadvantages of the method.
- Mental health - community aspects, role of physiotherapists, therapists in mental

health problems such as mental retardation.

- Environmental health – assessing and managing environmental factors that impact health.
- Communicable diseases - an overall view, classification, principal mode of classification, role of insects and other vectors.
- International health agencies and interventions

HEALTH EDUCATION

Objective: The Subject 'Health Education' is designed to enable students to acquire Foundational knowledge necessary for health education. The Subject covers evidence-based health education, concepts, philosophy, principles, planning and evaluation, communication skills and methods of health education.

- Review of benefits, values, norms, habits and taboos among practices. More in human groups and their importance; learning and change process.
- Review of concepts on perception, attitudes, socialisation process, learning and theories of learning, social change and change process, motivation, needs and drives.
- Principles and process of communication in health-related discussions
- Health education philosophy - main principles and objectives. Health education vs. propagandas
- Methods and tools of health education - individual and group method. A criticalevaluation of theories, tool and health education
- The role of profession in health education – role of other personal in health education, coordination and corporation in health education with other members of thehealth team.

- Elements of planning a health education programme. Safety, first aid and emergency procedures

COMMUNICATIVE ENGLISH:

Objective: The Subject 'Communicative English' is designed to enable students to use the language in realistic situations, with a focus on real life communication and interaction. The Subject covers practicing the writing skills and vocabulary in Spoken English through role playing, group discussions and interacting activities.

Writing skills

- Composition - Writing effective paragraphs, ability to describe objects, people, process and ideas and narrating incidents- note taking / making summaries. Writing advertisements, preparing laboratory reports.
- Letter writing - business letters - applying for a job, for higher studies, preparing curriculum vitae, subscribing to a journal, requesting for information, ordering equipment, letters to the editor.

Foundation English

- Revision of basic grammar, common errors in English, language functions in medical writing - use of passive voice particularly in scientific and official writing, expressing obligation - use of must, should, ought; expression of possibility, likelihood, certainty; degrees of comparison, expression of necessity - must, have to, need to; expression of generalisation and emphasis

Vocabulary

- The language of doctor and patient. General description and medical description; medical terminology - roots, prefixes and suffixes, medical abbreviations.

Spoken English

- Fixing appointments - getting information - Managing medical representatives - telephoning in hospital. Fluent conversation. Specific expression typical of familiar situations in medical practice. Technique of discussion at medical meeting, making presentation.

II B. Sc. Medical Microbiology

Paper VI: Fundamentals of Microbiology and Molecular Biology

Theory – 120 hrs

Objective: The Subject 'Fundamentals of Microbiology and Molecular Biology' is designed to enable students to introduce to the field of microbiology and molecular biology. The Subject covers the fundamentals of microbiology and molecular biology.

- **Introduction**: historical review and scope of microbiology - Development of microbiology as a discipline, Spontaneous generation, Contributions of Anton Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Paul Ehrlich, Alexander Fleming etc., Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques. (5 hrs)

- **Morphology of bacteria**: structure of a typical bacterial cell - size, shape, arrangement; ultra-structures - cell-wall - Composition and detailed structure of gram positive and gram-negative cell walls, function and demonstration; cytoplasmic membrane - Structure, chemical composition, function and demonstration; Cytoplasm and cytoplasmic inclusions: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids; prokaryotic cellular reserve materials; capsule – chemical composition, function and demonstration; flagella - composition, function and demonstration; pili - composition, function and demonstration; spheroplasts, protoplasts, L – forms and endospores -

Structure, function, formation, stages of sporulation, germination of spore. (15 hrs)

- **Growth and nutrition of bacteria**: bacterial reproduction, generation time, continuous culture and batch culture, bacterial growth curve, measurement of growth - total count, viable count; nutritional classification, growth factors: physical factors influencing growth - oxygen, carbon dioxide, pH, moisture, osmotic pressure, light, mechanical and sonic stress; nutrient requirements- carbon, nitrogen, hydrogen, oxygen, sulphur, phosphorous and other elements. (12 hrs)

- **Microbial metabolism:** Metabolic diversity, oxidation reduction reactions, Cellular respiration - energy production by aerobic process – Sugar degradation pathways i.e. Glycolysis, EMP, ED, Pentose phosphate pathway; Kreb's cycle, ETC – the components of the respiratory chain; the mechanism of ATP synthesis. energy production by anaerobic process – Alcoholic fermentation, Lactic acid fermentation. (10 hrs)

- **Culture media** - classification, common ingredients, preparation, important culture media used in microbiology. (10 hrs)

- **Cultivation of microorganisms** - Different types of culture methods - streak, stroke, lawn, stab, pour plate etc., Anaerobic culture methods; maintenance and preservation of pure cultures. (10 hrs)

- **Control of microorganisms**: sterilization and disinfection- definition, factors influencing, mechanism of killing; Physical methods - different methods of sterilization by dry heat and moist heat, sterilization control; filtration - types of filters - techniques of filtration, radiations used - ionising and non ionising, mode of action; Chemical methods - definitions- characteristics of an ideal chemical agent, examples and modes of action of important disinfectants; Application of

disinfectants, Testing of disinfectants- In- use test,Rideal- walker test or Chick-Martin test for phenol co- efficient determination, antiseptics and sterilants. Sterilization and Disinfection in a Healthcare setting – Spaulding's classification; New methods of sterilization – plasma sterilization. (20 hrs)

- **Antimicrobial therapy** – chemotherapeutic agents and antibiotics, characteristics, mechanism of action of commonly used antibiotics, methods of testing antibiotic sensitivity, evaluation of anti-microbial potency, drug resistance; bacteriocins and bacteriocin typing. (10 hrs)

- **Identification of bacteria**- depending upon morphology of bacteria, staining reactions, cultural characters, fermentation and other biochemical reactions. Principle of biochemical tests. (12 hrs)

- **Bacterial taxonomy** - systems of classification - phylogenetic, adansonian, genetic and intra species classification; nomenclature; Type cultures. (6 hrs)

- **Molecular Biology**: Introduction and basic principles of Molecular Biology – central dogma; terms related to genetics – codon, gene, plasmids, phenotype and genotype; Bacterial genetics - prokaryotic genome - DNA structure, physical and chemical properties of DNA, brief account of DNA replication - Bidirectional and unidirectional replication, semi- conservative, semi-discontinuous replication, Enzymes and proteins involved – DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends; structure of RNA; Gene expression and regulation – transcription and translation. (20 hrs)

- **Bacterial variation**- mutation – definition and types of mutation, mutants, Effects of mutation, Uses of mutations, Ames test; DNA repair; transmission of genetic material- transformation, transduction, conjugation, transposable genetic elements, extra chromosomal genetic elements. (10 hrs)

- **Molecular Genetics** - Genetic Engineering – Introduction and Historical

development. Application of genomics - Basics and steps in DNA technology. Recombinant DNA technology. Hybridization techniques. Detection methods – DNA probes, Blotting techniques – Southern blotting, Northern blotting, Western Blotting; DNA Amplification techniques - PCR – Theory, principle, applications, Different types of PCR; LAMP, DNA Microarray; Sequencing based Assays – Genetic mapping; Next Generation sequencing. (20 hrs)

Practical (120 hrs)

- Staining methods- simple staining, grams staining, capsule staining, volutin granule staining, spore staining, spirochete staining, AFB staining
- Methods of motility testing: hanging drop preparation
- Preparation of common culture media
- Sterilization methods
- Culture methods
- Study of culture characters of bacteria
- Biochemical test used for identification of bacteria
- Anaerobic culture methods
- Preparation of McFarland's standard and Antibiotic sensitivity tests
- PCR and gel electrophoresis

Recommended books

- Prescott / Harley Klein's Microbiology
  Joanne Willey, Linda Sherwood, Chris Woolverton
- Mackie and McCartney Practical Medical Microbiology
  J. Gerald Collee, Andrew G. Fraser, Barrie P Marmion, Anthony Simmons
- Microbiology: An Introduction
  Gerard J. Tortora Berdell R. Funke, Christine L. Case
- Microbiology: Principles and Exploration :
  Jacquelyn G. Black

- General Microbiology :
  Roger Y. Stanier
- Microbiology :
  Michael J Pelczar
- Ananthanarayanan and Paniker's Text book of Microbiology
  R. Ananthanarayan and C. K. Jayaram Paniker
- Essentials of Medical Microbiology
  Apurba S Sastry, Sandhya Bhat

Paper VII- Parasitology and Entomology

Theory – 120 hrs

Objective: The Subject 'Parasitology and Entomology' is designed to enable students to explore the major parasitic diseases of humans and their vectors. The Subject includes life cycle, pathogenesis, identification, chemotherapy and control of major parasites and their vectors or intermediate hosts.

Parasitology (80 hrs)

- An elementary study of types of animal associations – terms employed, types of parasites; classificationof protozoa and helminths. (2 hrs)
- An elementary knowledge of the structure, life history of parasites belonging to the following genera with reference to forms seen in human pathological material, pathogenicity and the methods used to identify them
  - Protozoa – Amoeba - Entamoeba, Dientamoeba, Iodamoeba, Acaanthamoeba, Naegleria and Balamuthia. (10 hrs)
  - Flagellates – Giardia, Trichomonas, Chilomastix, Enteromonas, Trypanosome, Leishmania. (10 hrs)
  - Sporozoa - Plasmodium, Isospora, Eimeria, Balantidium, Toxoplasma,

Pneumocystis, Cryptosporidium, Babesia. (10 hrs)

- Platyhelminthes – Diphyllobothrium, sparganum, Taenia, Echinococcus, Hymenolepis, Schistosoma, Fasciola, Fasciolopsis, Clonorchis, Paragonimus. (12 hrs)
- Nemathelminthes – Ascaris, Ancylostoma, Necator, Strongyloides, Trichinella, Trichuris, Enterobius, Wuchereria, Brugia, Loa loa, Onchocerca, Dracunculus. (12 hrs)

- Collection and preservation of specimens for parasitological examinations, preservation of specimens of parasitic egg and embryos, preserving fluids, transport of specimen. (6 hrs)
- Detection of intestinal parasites - detection and identification of amoeba and other intestinal protozoans and parasites. (6 hrs)
- Examination of blood for parasites: thick and thin smear preparations for malaria and filarial, other parasites and concentration methods. (6 hrs)
- Examination of biopsy material and other body fluids: brief account of spleen puncture for diagnosis of kala azar, bone marrow biopsy, lymph node puncture, andskin biopsy, for parasites, examination of vaginal swabs. (6 hrs)

Entomology (40 hrs)

- Introduction: classification of arthropods of public health importance. (2 hrs)
- Role of arthropods in the transmission of diseases. (2 hrs)
- Mosquito: morphology, life cycle, bionomics and public health importance of anopheles, culex, aedes, and mansonia. (6 hrs)
- Insecticides used for the control of arthropods of public health importance. (2 hrs)

- Mosquito borne diseases and their control. (2 hrs)
- Phebotomus (sand fly)- morphology, life history, public health importance and control. (2 hrs)
- House fly: morphology, life history, disease relationship, public health importance and control. (6 hrs)
- Black fly (Simulium)- morphology, life history, public health importance and control. (2 hrs)
- Tse –tse fly (Glossina)- morphology, life cycle and public health importance. (2 hrs)
- Fleas- morphology, life cycle, disease transmitted and control. (2 hrs)
- Louse: morphology, life cycle, disease transmitted and control. (4 hrs)
- Bed bug- morphology, life cycle, disease transmitted and control. (2 hrs)
- Ticks- morphology, life cycle, disease transmitted and control. (2 hrs)
- Sarcoptes scabei- morphology, life cycle, disease transmitted and control. (2 hrs)
- Cyclops- morphology, life cycle, disease transmitted and control. (2 hrs)

Practical (120 hrs)

- Identification of parasites: microscopic and macroscopic
- Identification of parasitic cysts, ova, larva etc.
- Laboratory diagnostic procedures in parasitic diseases
- Collection, transport and processing of specimens
- Microscopy, macroscopy and cultivation procedures
- Identification of arthropods of medical importance dealt in theory
- Collection and preservation of arthropods

Recommended Books

1. Medical Parasitology
   R L Ichhpujani, Rajesh Bhatia
2. Medical Parasitology
   C. K Jayaram Paniker
3. Text Book of Medical Parasitology
   P Chakraborty
4. Parasitology :
   K.D. Chatterjee
5. Topley and Wilson's Microbiology and Microbial infections, Parasitology
6. District Laboratory Practice in Tropical Countries, Part I
   MonicaCheesbrough

PAPER VIII - METHODOLOGY AND INSTRUMENTATION

Theory (120 hrs)

Objective: The Subject 'Methodology and Instrumentation' is designed to equip students with the analytical and interpretative skills critical for working in the laboratory. The Subject provides an overview of maintenance, operation and troubleshooting of laboratory instruments.

- **Study of common equipment used in microbiology lab**: Incubators, Hot air oven, Autoclave and other sterilizers, Cold room, anaerobic cultivation apparatus, Refrigerator and Biological safety Cabinet. (16 hrs)

- **Microscopy:** Principle, resolving power, magnification, types of microscope, staining and specimen preparation for electron microscope. (16 hrs)

- **Centrifugation:** Principle, RCF, RPM, types of centrifuges, different types of rotors; Density gradient centrifugation – rate zonal and isopycnic centrifugation, differential centrifugation, ultra - centrifugation, Analytical

centrifugation, Applications of centrifugation; Safety aspects in the use of centrifuges. (16 hrs)

- **Chromatography:** general principle, partition and adsorption principle - Paper, Thin layer, Gas - liquid, Ion – exchange, molecular exclusion, Affinity, HPLC. (16 hrs)

- **Electrophoresis:** Theory, factors affecting electrophoretic mobility; principle, technique and application of paper electrophoresis; gel electrophoresis - types of gels, solubilizers, electrophoretic procedure and applications; immune electrophoresis, iso electric focusing and capillary electrophoresis. (16 hrs)

- **Enzyme Linked Immunosorbent Assay**: Principle, different methods – direct, indirect, sandwich and competitive, common enzyme labels and substrates,application; ELISPOT test, ELFA. (10 hrs)

- **Radioactivity and Radio isotopic techniques**- Radioisotopes, Different types of radiations, Measurement of radioactivity – Scintillation and GM counters. Use of radioactive isotopes in Medicine, Biological effects of radiation, General Laboratory rules for handling radioactive isotopes; Radiation protection and disposal of radioactive waste; Radio Immuno Assay: Principle, different methods;labelled probes and applications. (10 hrs)

- **Colorimetry and spectrophotometry:** properties of light, electromagnetic spectrum, mono and poly chromatic light, absorption and transmission of light, Principle of colorimetry, Beer - Lamberts law, Flame spectrophotometry – instrumentation for atomic absorption spectrophotometry and emission flame photometry; fluorimetry, nephelometry and turbidimetry. (16 hrs)

- **pH meters and pH measurements:** principle, technique and application (4 hrs)

Practical (80 hrs)

- Use and care of common equipment used in microbiology lab
- Microscopy
- Centrifugation
- Chromatography – Paper, TLC
- Protein Electrophoresis
- ELISA
- Spectrophotometry, Colorimetry,
- pH meter

Recommended books:

- Text book of Biochemistry for medical students
  D M Vasudevan, S Sreekumari & Vaidyanathan Kannan
- Biochemistry by U. Satyanarayana :
  U. Satyanarayana and U. Chakrapani
- Harper's Illustrated Biochemistry :
  Robert Murray, Victor Rodwell, David Bender, Kathleen M Botham, P. Anthony Weil, Peter J Kennelly
- Practical Clinical Biochemistry:
  Harold Varley

Paper IX: Information Technology, Bioinformatics and AI in Health care

Theory: 120 hrs (Internal Assessment only)

Objective: The Subject 'Information Technology, Bioinformatics and AI in Health care' is designed to train students in computing technology, using it to analyze biological data and explores AI applications in diagnostics and research. The Subject includes operating systems, its applications in disease diagnosis and a collaboration between healthcare and technology disciplines.

- History of computers
- Operating system
- MS windows - Introduction to MS - Word, Excel, power-point etc.
- Programming in basics - Introduction to computer programming application software
- Software architecture – software design patterns, architectural styles and system components
- Multi terminal operational system (UNIX / ZENIX)
- DBMS (DBASE < FoxBASR etc.)
- Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), components of network
- Internet and its Applications: definition, brief history, basic services (E-Mail, the World Wide Web (WWW)), www browsers, use of the internet.
- Computer Graphics – create and manipulate visual content using computers, 2D and 3D graphics and animation
- Cybersecurity – network security and ethical hacking
- Application of Computers in clinical settings, health education, training and administration
- **Artificial Intelligence** – machine learning and robotics, application in Healthcare
- **Bioinformatics** - sequence analysis, genomics, proteomics and gene expression analysis, drug design and discovery

III B. Sc. Medical Microbiology

PAPER X- SYSTEMATIC BACTERIOLOGY

Theory – 120 hrs

Objective: The Subject 'Systematic Bacteriology' is designed to enable students to learn the basic principles of Medical Microbiology and infectious diseases. The Subject includes the morphology, cultural characteristics, biochemical reactions, pathogenesis, disease caused, laboratory diagnosis of various bacterial groups and their prevention and control strategies such as chemotherapy and vaccines.

Systematic study of different bacterial species of medical importance: their morphology, staining reaction, cultural characters, biochemical reaction, antigenic characters and toxins, pathogenicity and pathogenesis, methods of isolation and identification of

1. Staphylococci – Staphylococcus aureus including MRSA, Other Coagulase positive Staphylococci, Coagulase negative Staphylococci, Micrococci. (10 hrs)
2. Streptococci – Streptococcus pyogenes, other hemolytic Streptococci, Streptococcus pneumoniae and Nutritionally variant streptococci. (10 hrs)
3. Enterococci – E. faecalis, E. faecium and E. durans; VRE. (4 hrs)
4. Neisseria and Moraxella – N. meningitidis, N. gonorrhoeae, Commensal Neisseria and Moraxella (10 hrs)
5. Anaerobic cocci – Peptostreptococcus, Peptococcus and Veillionellae (4 hrs)
6. Corynebacterium – C. diphtheriae and other pathogenic Corynebacteria, Diphtheroids (10 hrs)
7. Bacillus – B. anthracis and B. cereus (6 hrs)
8. Clostridium – Cl. perfringens, Cl. septicum, Cl. novyi, Cl. histolyticum, Cl. tetani and

Cl. botulinum (10 hrs)

9. Clostridioides difficile (2 hrs)

10. Nonsporing anaerobes – Eubacterium, Propionibacterium, Lactobacillus, Bacteroides etc. (4 hrs)

11. Enterobacteriaceae: E. coli, Shigella, Salmonella, Citrobacter, Klebsiella, Enterobacter, Hafnia, Serratia, Proteus, Morganella, Providencia. (12 hrs)

12. Vibrionaceae – V. cholerae and halophilic vibrios (4 hrs)

13. Pseudomonads and Other Non–fermenters – Pseudomonas aeruginosa, Burkholderia, Acinetobacter, Alcaligenes and Stenotrophomonas (4 hrs)

14. Yersinia, Pasteurella, Francisella (8 hrs)

15. Haemophilus and HACEK group Bacteria – H. influenzae, H. aegypticus, H. ducreyi and Other Haemophilus sp.; HACEK group Bacteria (4 hrs)

16. Bordetella – B. pertussis, B. parapertussis and B. bronchiseptica (2 hrs)

17. Brucella – B. abortus and B. melitensis (2 hrs)

18. Mycobacterium tuberculosis (4 hrs)

19. Non tuberculous mycobacteria (2 hrs)

20. M. leprae (4 hrs)

21. Spirochete: Treponema, Borrelia and Leptospira (10 hrs)

22. Mycoplasma and Ureaplasma – M. pneumoniae, M. hominis and U. urealyticum (4 hrs)

23. Actinomycetes - Actinomyces and Nocardia (4 hrs)

24. Miscellaneous bacteria: Listeria, Erysipelothrix, Campylobacter, Helicobacter, Legionella, Kingella etc. (10 hrs)

25. Rickettsiaceae – Rickettsia, Orientia, Ehrlichia, Coxiella and Bartonella (10 hrs)

26. Chlamydiae – C. trachomatis, C. psittaci and C. pneumoniae (6 hrs)

PRACTICALS (320 hrs)

Study of cultural characters and biochemical characters of common bacteria

Recommended books

- Ananathanarayan and Paniker's Text Book of Microbiology
  R. Ananthanarayan & C.K. Jayaram Paniker
- Jawetz, Melnick & adelberg's Medical Microbiology
  Geo. Brooks, Karen C. Caroll, Janet Butel, Stephen Morse
- Medical Microbiology
  David Greenwood, Richard C. B. Slack, John F. Peutherer, Michael R. Barer
- Mackie & McCartney Practical Medical Microbiology
  J. Gerald Collee, Andrew G. Fraser, Barrie P. Marmion, Anthony Simmons
- Topley and Wilson's Microbiology and Microbial infections
  S. Peter Borriello, Patrick R. Murray, Guido Funke
- Infectious diseases
  Sherwood L. Gorbach, John G. Bartlett, Neil R. Blacklow
- Bergey's Manual of Systematic Bacteriology
- Essentials of Medical Microbiology
  Apurba S Sastry, Sandhya Bhat

PAPER XI - IMMUNOLOGY, IMMUNOCHEMISTRY AND SEROLOGY

Theory – 120 hrs

Objective: The Subject 'Immunology, Immunochemistry and Serology' is designed to enable students to explore the body's immune system and its responses to various pathogens, infections and diseases. The Subject includes basic immunology, clinical immunology, vaccines and immunotherapy and advanced topics like cancer immunology and transplant immunology.

- **Introduction to Immunology**: Infection - definition, classification, sources, methods of transmission, pathogenicity and virulence, factors predisposing to microbial pathogenicity, types of infectious diseases (10 hrs)
- **Immunity:** Types, Mechanisms of innate immunity, acquired immunity; Measurement of immunity, Local immunity, Herd immunity. (10 hrs)
- **Structure and functions of the immune system**: Central and peripheral lymphoid organs, Cells of the lympho reticular system, T and B cell maturation, Types of T cells and B cells, Null cells, Phagocytic cells, MHCand MHC restriction (10 hrs)
- **Antigens:** definition, types, Determinants of antigenicity, Antigenic specificity, biological classes, Super antigens (10 hrs)
- **Antibodies:** Structure, classes, abnormal immunoglobulins, immunoglobulin specificities, antibody diversity, class switching; Monoclonal antibodies (10 hrs)
- **Antigen - Antibody reaction**: Uses, Stages, General features, measurement, serological reactions – Precipitation Reaction – mechanism, types, Applications; Agglutination Reactions – mechanism, types, Applications; CFT, Neutralisation test; RIA; EIA – ELISA - principle, types – Direct, Indirect, Sandwich, Competitive, Capture, Casette, ELISPOT Test, advantages, Disadvantages and Applications; ELFA; CLIA; Immunoelectroblot techniques,

Rapid tests - Immunochromatographic test, immunoelectron microscopic test, Immunofluorescence, Flowcytometry. (20 hrs)

- **Complement system**: General properties, components, complement activation; classical, alternative and lectin pathways; Regulation, Biological effects, quantitation, biosynthesis and deficiency of complement system (10 hrs)

- **Immune response:** Types of immune response; Humoral immune response – antigen presentation, production of antibody, Factors influencing; Cellular immune response - Cytokines, Induction, Scope and detection of CMI; Transfer factor, Immunological tolerance, Theories of immune response (10 hrs)

- **Vaccines:** history, types, properties of good vaccine, complications associated with vaccination, Application of vaccine; Newer vaccines – Advantages and disadvantages (10 hrs)

- **Immunodeficiency diseases:** Classification; Primary and secondary immunodeficiencies – Primary – Disorders of specific immunity, disorders of complement, disorders of phagocytosis; Secondary – Humoral and Cell mediated. Laboratory methods for detection (10 hrs)

- **Hypersensitivity:** Classification
  - Type I: Mechanism, types, components, mediators, detection and treatment
  - Type II: Mechanism and types
  - Type III: Mechanism and types
  - Type IV: mechanism, Types and Detection
  - Schwartzman Reaction – clinical implications (10 hrs)

  - **Autoimmunity:** definition, Mechanism, classification and pathogenesis of autoimmune diseases; Laboratory tests for detection and Management (5 hrs)

- **Immunology of transplantation and malignancy:** Classification of transplant, types of grafts, allograft reaction, histocompatibility antigens, Histocompatibility testing, graft versus host reaction, prevention of graft rejection; Tumor antigen, Immune response in malignancy, immunological surveillance and immunotherapy of cancer (10 hrs)

- **Immunohematology:** History, ABO, Rh and other blood group systems; medical application, Complication following transfusion, safe blood transfusion practices; HDN – Detection of Rh antibodies, identification of Rh incompatibility, prevention of Rh isoimmunisation, ABO hemolytic diseases; blood component therapy, blood groups and diseases. (10 hrs)

- **Immunology of AIDS –** Transmission, Immunologic consequences, Therapeutic agents, prevention of AIDS (5 hrs)

- **Immunity to bacterial, viral, fungal and parasitic infections –** features of host immunity, bacterial evasion, viral evasion, Immune response in COVID – 19, protozoal, helminth and fungal infections (10 hrs)

PRACTICALS (120 hrs)

- Serological reactions
- Precipitation reaction
- Agglutination reaction
- Coombs test
- ELISA
- Immunochromatographic tests

Recommended Books

- Kuby Immunology:
  Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, Janis Kuby

- Immunology :

  David Male, Jonathan Brostoff, David Roth and Ivan Roitt
- Medical Immunology:

  Tristr am G. Parslow, Daniel P. Stites, Abba I. Terr, John B. Imboden
- Essentials of Medical Microbiology

  Apurba S Sastry, Sandhya Bhat
- Ananathanarayan and Paniker's Text Book of Microbiology

  R. Ananthanarayan & C.K. Jayaram Paniker
- Roitt's Essential Immunology

  Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt

Paper XII – Biostatistics and Research Methodology

Theory – 120 hrs (Internal Assessment only)

Objective: The Subject 'Biostatistics and Research Methodology' is designed to enable students to understand the fundamental statistical concepts and their relevance in biomedical and public health research. The Subject includes different types of study designs, data collection, data analysis using statistical software, interpret statistical results and communicate findings effectively.

BIOSTATISTICS

- Introduction
- Measures of central tendency
- Statistical surveys and representation of data.
- Measures of dispersion and variability
- Significance tests 't' test, 'z' test and χ^2 values
- Probability, Sampling distribution and statistical inference; Estimation, Hypothesis testing & application;

- Correlation & regression analysis.
- Application of statistical principles in biology

Research methodology –

- Introduction to research methods,
- Identifying research problem, formulating a hypothesis,
- Ethical issues in research,
- Research design
- Research methodologies: Study population; Variables; Sampling; Sample size determination; sampling techniques, data collection methods, data analysis procedures, ethical considerations
- **Infectious disease modeling –** Transmission patterns, Incubation period and infectious period, population demographics, parameter estimation

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PAPER XIII- VIROLOGY AND MYCOLOGY

Theory – 120 hrs

Objective: The Subject 'Virology and Mycology' is designed to enable students to understand the structure, characteristics and classification of viruses and fungi and their impact on health and diseases. The Subject includes characteristics, classification, collection, transportation and storage of samples, staining techniques and processing of samples for viral and fungal infections.

VIROLOGY (60 hrs)

- **General properties of viruses:** Morphology, chemical properties, viral multiplication,

viral haemagglutination, cultivation and detection of growth, Viral assay, viral genetics, classification and nomenclature, viroids and prions (6 hrs)

- **Viral infection**: pathogenesis, host response, lab diagnosis, immunoprophylaxis and chemoprophylaxisof viral infections – Interferons and antiviral agents (4 hrs)
- **Bacteriophages:** morphology, life cycle, transmission and significance of phages - phage assay and typing; Phage therapy. (4 hrs)
- **Systematic study of important viruses -** their biological properties, pathogenicity, techniques for isolation and identification from clinical specimens, antiviral agents and immunoprophylaxis of
    - Pox virus – Variola, Vaccinia and Other Pox Virus Diaseases (2 hrs)
    - Herpes virus – Herpes Simplex virus, Varicella Zoster virus, Herpes Zoster, CMV, EBV, Human Herpes Virus and Herpesvirus simiae (6 hrs)
    - Adenovirus and Adeno associated virus (2 hrs)
    - Picorna virus – Enterovirus – Polio virus, Coxsackie virus, Echo virus, Rhino virus (4 hrs)
    - Orthomyxo virus – Influenza virus (2 hrs)
    - Paramyxovirus – Mumps virus, Parainfluenza virus, RSV, Measles virus and Nipah virus (4 hrs)
    - Arbovirus – Chikungunya virus, Japanese encephalitis virus, Yellow fever virus, Dengue virus, Zika virus, KFD, Ebola virus and other Arboviral diseases. (6 hrs)
    - Rhabdovirus – Rabies and Rabies related virus (2 hrs)
    - Rota virus and other diarrheagenic viruses (2 hrs)

- Hepatitis virus – Type A, B, C, D, E and G Hepatitis virus (4 hrs)
- Oncogenic virus – DNA and RNA viruses, Oncogenes, Anti-oncogenes and mechanism of viral oncogenesis (4 hrs)
- HIV – AIDS (4 hrs)
- Miscellaneous virus – Papilloma, Polyoma, Parvo, Rubella, Slow virus diseases, Viral haemorrhagic fever, Corona virus – SARS, MERS, COVID - 19 (2 hrs)
- Emerging viral infections in Kerala (2 hrs)

MYCOLOGY (60 hrs)

- **Introduction to Mycology**: Taxonomy of fungi, Classification of fungi, general properties, techniques used in examination of fungal cultures, maintenance of fungal cultures (6 hrs)
- **Morphological features:** Cell structures, reproduction, growth and nutrition, fungal dimorphism (6 hrs)
- **Superficial mycoses** - Malassezia infections, Tinea nigra, Piedra, Dermatophytosis (6 hrs)
- **Cutaneous and subcutaneous mycoses** - Mycetoma, Sporotrichosis, Chromoblastomycosis, Rhinosporidiosis, Lobomycosis (6 hrs)
- **Yeast of medical importance:** Candida, Cryptococcus, Geotrichum, Trichosporon, Torulopsis (6 hrs)
- **Systemic mycoses** - Histoplasmosis, Blastomycosis, Coccidioidomycosis, Paracoccidioidomycosis (6 hrs)
- **Opportunistic mycoses** - Candidiasis, Cryptococcosis, Pneumocystosis, Penicilliosis, Aspergillosis, Zygomycosis (8 hrs)
- **Specific mycoses** - Otomycosis and Oculomycosis (4 hrs)

- **Mycotoxins** – mycotoxicoses and Mycetismus (6 hrs)

- **Antifungal agents** – Classification, Antifungal resistance, Antifungal susceptibility testing (6hrs)

PRACTICALS (80 hrs)

- Egg inoculation methods
- Serological techniques
- Culture and study of common fungal pathogens

Recommended Books

- Ananathanarayan and Paniker's Text Book of Microbiology
  R. Ananthanarayan & C.K. Jayaram Paniker
- Field's Virology:
  Bernard N. Fields, David M. Knipe, Peter M. Howley, Robert M. Chanock,Thomas P. Monath, Joseph L. Melnick, Bernard Roizman, Stephen E. Straus
- Topley & Wilson's Microbiology and Microbial infections: Virology
- Medical Microbiology:
  Greenwood, Richard C. B. Slack, John F. Peutherer, Michael R. Barer
- Jawetz, Melnick & adelberg's Medical Microbiology
  Geo. Brooks, Karen C. Caroll, Janet Butel, Stephen Mors
- Medical Virology : D. E. White, Frank J. Fenner
- Infectious diseases: Sherwood L. Gorbach, John G. Bartlett, Neil R.Blacklow
- Text Book of Medical Mycology : Jagdish Chander
- Topley & Wilson's Microbiology and Microbial infections: Medical Mycology
- Medical Mycology : John Willard Rippon

PAPER XIV - CLINICAL MICROBIOLOGY

Theory – 120 hrs

Objective: The Subject 'Clinical Microbiology' is designed to enable students to study the medically important bacteria, protozoa, helminths, viruses and fungi. The Subject covers the spread of microorganisms, disease causation, diagnosis, treatment and advanced practical training.

1. **Normal microbiome of the human body** – Definition, Types, Roles of Normal Flora, Microbiology of Normal Flora, Applications (10 hrs)

2. **Epidemiology of communicable diseases**: definition, terminologies - host, reservoir, carrier, vector; Infective agents- modes and routes of infection, epidemiological triad and determinants of health, pathogenesis and symptoms, disease surveillance, epidemic investigations, control and eradications of infectious diseases, Health Programs (10 hrs)

3. **General principle in specimen collection, transport, storage and isolation of pathogen –** specimen collection from different sites, specimen containers and their transport, handling and selection of laboratory investigations (10 hrs)

4. **Detailed procedure in laboratory diagnosis of diseases** of multiple microbial etiology and antimicrobial agents used in the cases of

- Upper and Lower respiratory tract infections
- Urinary Tract Infection
- Gastrointestinal tract infection and food poisoning
- Genital tract infection
- Infections of the eye and ear
- PUO
- Infections of CNS
- Skin and soft tissue infection
- Pyogenic infection

- Blood stream infections and Septicemia
- Microbiological Diagnosis of Body fluids
- Congenital infections
- Zoonotic infections prevalent in India (30 hrs)

5. **Health care associated infections** – types, sources and reservoirs, measures to control HAI, Standard precautions, hand hygiene – five moments of hand hygiene and hand hygiene techniques; Biofilms – definition, formation and clinical importance, prevention and removal. (10 hrs)

6. **Laboratory procedures in the diagnosis of viral infections** – virus isolation, serology and molecular methods (10 hrs)

7. **Laboratory diagnosis of fungal infections** – direct microscopic examination, culture, antigen detection, serology and molecular methods (10 hrs)

8. **Maintenance & preservation of bacterial and fungal cultures** – refrigeration, agar slant cultures, paraffin methods, cryopreservation and lyophilization (10 hrs)

9. **Molecular techniques in microbiology** – hybridization, amplification and sequencing methods and their applications (10 hrs)

10. **Microbial typing** – Whole Genome Sequencing and Pulsed Field Gel Electrophoresis (10 hrs)

11. **Automation in microbiology** – Automated Blood culture systems, Automated Identification and Susceptibility testing (12 hrs)

12. **Bacteriology of air, water, milk and food**- examination and interpretation (10 hrs)

13. **Biomedical waste management** – definition, types, principle and practice – segregation, collection, storage, treatment, transport and disposal, BMW 2016 Guidelines; Use of Personal protective equipment (PPE). (8 hrs)

14. **Immunoprophylaxis** – Active immunization, Routine Immunisation schedules, Passive immunization, Combined immunization, Individual immunization, vaccination during outbreaks, immunomodulation, cold chain (8 hrs)

15. **Emerging and Reemerging Infections in India** (2 hrs)

PRACTICALS (320 hrs)

- Laboratory investigation on clinical specimens
- Bacteriology of air, water and milk - examination and interpretation
- Use of automated machines

Recommended Books

- Koneman's Color Atlas and text book of Diagnostic Microbiology
- Bailey & Scott's Diagnostic Microbiology
- Mackie & McCartney practical Medical Microbiology
- Microbiology in Clinical Practice - D. C. Shanson
- Essentials of Medical Microbiology – 3rd edition
  Apurba S Sastry, Sandhya Bhat

Paper XV - Applied Microbiology and Clinical Laboratory Management

Theory – 120 hrs

Objective: The Subject 'Applied Microbiology and Clinical laboratory Management' is designed to enable students to focus on the practical application of microbiological principles in various fields and prepares students for managerial roles in clinical laboratories. The Subject includes laboratory operations management, human resource management, financial management, Quality Management as well as industrial microbiology and environmental microbiology.

1. **Organisation of clinical laboratory** - Role & responsibilities of different personnel in Laboratory, SOP, GLP, LIS. Clinical laboratory - layout and design (10 hrs)

2. **Laboratory safety in microbiology**: general principle, level of safety cabinets, Safety precautions in microbiology laboratory - design, specifications, microbiology laboratory associated infection, safety codes of laboratory practice (10 hrs)

3. **Quality control in microbiology laboratory** - General introduction to quality control in different laboratory - Internal quality control and External quality control, record keeping, Quality assurance and management (10 hrs)

4. **Central Sterile Supply Department** – CSSD – equipment preparation, quality management, efficiency and safety (6 hrs)

5. **Sterility test** – sampling, tests, molecular methods (6 hrs)

6. **Animal & human ethics involved in microbiological work** – respect for animals, respect for autonomy, non-maleficence, beneficence and justice (6 hrs)

7. **Accreditation** – definition, national and international standards – Accreditation process, Introduction to NABL guidelines (6 hrs)

8. **Bioterrorism** – definition, Bioweapons, prevention and preparedness (6 hrs)

9. **Roles of microbiologist in public health** – public health policies, education and outreach (8 hrs)

10. **Pandemic management** – identifying and limiting outbreaks, preparedness and crisis management (6 hrs)

11. **Antimicrobial Stewardship** – Antibiotic policy, implementation by optimal selection, appropriate dosing, correct duration and monitoring (8 hrs)

12. **Hospital infection Control Committee** – definition, role and responsibilities (8 hrs)

13. **Microorganisms in soil and their role in agriculture**: nitrogen cycle, carbon cycle,

sulphur cycle, biofertilizers, waste water treatment, Bioremediation (10 hrs)

14. **Role of microorganisms in industry**- vinegar production, alcohol fermentation, antibiotic production (10 hrs)

15. **Professionalism**: Workplace Conflict Management and Resolution, Critical Thinking, Delivering Performance Appraisals, maintaining a Positive Attitude, Ensuring Promptness and Punctuality, Dressing Appropriately, Being Accountable for Actions, Demonstrating a Strong Work Ethic (10 hrs)

Recommended books

- Mackie & McCartney practical Medical Microbiology
- Ananathanarayan and Paniker's Text Book of Microbiology
  R. Ananthanarayan & C.K. Jayaram Paniker
- District Laboratory Practice in Tropical Countries,
  Monica Cheesbrough
- Medical Laboratory Technology (Vol 1-3)
  Kanai L. Mukherjee
- Text book of Medical Laboratory Technology
  Praful B Godkar, Darshan P Godkar
- Essentials of Medical Microbiology
  Apurba S Sastry, Sandhya Bhat
- Laboratory Management, Principles and Processes, Third Edition,
  Dr. Denise M. Harmening
- Linne & Ringsrud's Clinical Laboratory Science: Concepts, Procedures and Clinical Applications
  Turgeon
- Henry's Clinical Diagnosis and Management by Laboratory Methods, 22nd Edition,
  Richard A. McPherson, MD and Matthew R. Pincus

Paper XVI: Project

Submission of a Project work is a compulsory requirement for the B. Sc. Medical Microbiology course. Each student can choose a current topic of relevance for the project, which would be approved by his / her supervising teacher.

The supervising Teacher should have minimum 3 years full time teaching experience in Medical Microbiology. 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 consisting of about 30 pages (Times New Roman, Font size 12, line space 1.5), bound record should be duly certified by the supervising staff and head of the department one month prior to fourth year university practical examination and should be submitted to the fourth year B. Sc. Medical Microbiology University practical examination.

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

2.11 No: of hours per subject

Year	Paper	Subject	Theory	Practical	Tutorial	Total
First	**I**	Anatomy	120	80	120	**320**
	II	Physiology	120	80	120	**320**
	III	General Biochemistry	120	80	120	**320**
	IV	General Methodology	120	80	120	**320**
	V	Community Medicine, Health Education and Communicative English	120	-	40	**160**
		Total	**600**	**320**	**520**	**1440**
Second	**VI**	Foundations of Microbiology and Molecular Biology	120	120	120	360
	VII	Parasitology and Entomology	120	120	120	360
	VIII	Methodology and Instrumentation	120	80	120	320
	IX	Information Technology, Bioinformatics and AI in Healthcare	120	-	40	160
		Clinical Laboratory Training	-	240	-	240
		Total	**480**	**560**	**400**	**1440**
Third	**X**	Systematic Bacteriology	120	320	120	560
	XI	Immunology, Immunochemistry and Serology	120	120	120	360
	XII	Biostatistics and Research Methodology	120	-	40	160
		Clinical Laboratory Training	-	360	-	360
		Total	**360**	**800**	**280**	**1440**
Fourth	**XIII**	Virology and Mycology	120	80	120	320
	XIV	Clinical Microbiology	120	320	120	560
	XV	Applied Microbiology and Clinical Laboratory Management	120	-	40	160
	XVI	Project and Clinical Laboratory Training	-	400	-	400
		Total	**360**	**800**	**280**	**1440**

2.12 Practical training

As given in curriculum Clause 2.10 and clause 2.11

2.13 Records

Records should be maintained for each exercise done in the practical laboratory for every subject and duly signed by the supervising teacher should be submitted at thetime of University practical examination.

2.14 Dissertation:

Not Applicable

2.15 Speciality training if any

Not Applicable

2.16 Project work to be done if any

As stipulated by HOD from time to time

2.17 Any other requirements [CME, Paper Publishing etc.]

To present at least one paper in state/national conference [desirable]

2.18 Prescribed/recommended textbooks for each subject

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

2.19 Reference books

Paper I –Anatomy

- B.D. Chaurasia's Human Anatomy (vol 1- 3)- Regional and Applied
- Text book of Human Histology with colour Atlas- Inderbir Singh

PAPER II- PHYSIOLOGY

- Essentials of Medical Physiology
  K. Sembulingam, Prema sembulingam
- Concise Medical Physiology
  Sujith K chaudari

Paper III- General Biochemistry

- Text book of Biochemistry for medical students
  D M Vasudevan, S Sreekumari & Vaidyanathan Kannan
- Biochemistry by U. Satyanarayana
  U. Satyanarayana and U. Chakrapani

PAPER IV: GENERAL METHODOLOGY

- Ananthanarayanan and Paniker's Text book of Microbiology
  R. Ananthanarayan and C. K. Jayaram Paniker
- Medical Laboratory Technology (Vol 1-3) Kanai L. Mukherjee
- Practical Clinical Biochemistry - Harold Varley (Author)
- Essentials of Medical Microbiology
  Apurba S Sastry, Sandhya Bhat

Paper VI: Fundamentals of Microbiology and Molecular Biology

- Microbiology - Michael J Pelczar :
- Ananthanarayanan and Paniker's Text book of Microbiology
  R. Ananthanarayan and C. K. Jayaram Paniker
    - Essentials of Medical Microbiology
      Apurba S Satry, Sandhya Bhat

Paper VII- Parasitology and Entomology

- Medical Parasitology - C. K Jayaram Paniker
- Parasitology - K.D. Chatterjee

PAPER VIII - METHODOLOGY AND INSTRUMENTATION

- Practical Clinical Biochemistry: Harold Varley

PAPER X- SYSTEMATIC BACTERIOLOGY

- Ananathanarayan and Paniker's Text Book of Microbiology

R. Ananthanarayan & C.K. Jayaram Paniker

- Jawetz, Melnick & adelberg's Medical Microbiology Geo.

Brooks, Karen C. Caroll, Janet Butel, Stephen Morse

- Medical Microbiology

David Greenwood, Richard C. B. Slack, John F. Peutherer, Michael R. Barer

- Essentials of Medical Microbiology

Apurba S Sastry, Sandhya Bhat

PAPER XI - IMMUNOLOGY, IMMUNOCHEMISTRY AND SEROLOGY

- Kuby Immunology:

Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, Janis Kuby

- Ananathanarayan and Paniker's Text Book of Microbiology

R. Ananthanarayan & C.K. Jayaram Paniker

- Essentials of Medical Microbiology

Apurba S Sastry, Sandhya Bhat

PAPER XIII- VIROLOGY AND MYCOLOGY

- Ananathanarayan and Paniker's Text Book of Microbiology

R. Ananthanarayan & C.K. Jayaram Paniker

- Jawetz, Melnick & adelberg's Medical Microbiology

Geo. Brooks, Karen C. Caroll, Janet Butel, Stephen Mors

- Text Book of Medical Mycology

Jagdish Chander

PAPER XIV - CLINICAL MICROBIOLOGY

- Bailey & Scott's Diagnostic Microbiology

- Mackie & McCartney practical Medical Microbiology
- Microbiology in Clinical Practice- D. C. Shanson

- **Paper XV - Applied Microbiology and Clinical Laboratory Management**

    - Mackie & McCartney practical Medical Microbiology
    - Ananathanarayan and Paniker's Text Book of Microbiology
      R. Ananthanarayan & C.K. Jayaram Paniker
    - District Laboratory Practice in Tropical Countries, - MonicaCheesbrough
    - Medical Laboratory Technology (Vol 1-3)
      Kanai L. Mukherjee
    - Essentials of Medical Microbiology
      Apurba S Sastry, Sandhya Bhat

Reference books

Paper I –Anatomy

- Gray's Anatomy for students
  Richard. L. Drake, A. Wayne Vogl, Adam W.M. Mitchell

PAPER II- PHYSIOLOGY

- Ganong's Review of Medical Physiology
- Textbook of Medical Physiology : Arthur C Guyton, John E Hall

Paper III- General Biochemistry

- Harper's Illustrated Biochemistry

Robert Murray, Victor Rodwell, David Bender, Kathleen M Botham, P. Anthony Weil, Peter J Kennelly

PAPER IV: GENERAL METHODOLOGY

- Mackie and McCartney Practical Medical Microbiology
  J. Gerald Collee, Andrew G. Fraser, Barrie P Marmion, Anthony Simmons
- Microbiology: An Introduction
  Gerard J. Tortora Berdell R. Funke, Christine L. Case
- Microbiology: Principles and Exploration
  Jacquelyn G. Black

Paper VI: Fundamentals of Microbiology and Molecular Biology

- Prescott / Harley Klein's Microbiology
  Joanne Willey, Linda Sherwood, Chris Woolverton
- Mackie and McCartney Practical Medical Microbiology
  J. Gerald Collee, Andrew G. Fraser, Barrie P Marmion, Anthony Simmons
- Microbiology: An Introduction
  Gerard J. Tortora Berdell R. Funke, Christine L. Case
- Microbiology: Principles and Exploration :
  Jacquelyn G. Black

Paper VII- Parasitology and Entomology

- Topley and Wilson's Microbiology and Microbial infections, Parasitology
- District Laboratory Practice in Tropical Countries, Part I
  Monica Cheesbrough

PAPER VIII - METHODOLOGY AND INSTRUMENTATION

- Harper's Illustrated Biochemistry :
  Robert Murray, Victor Rodwell, David Bender, Kathleen M Botham, P. Anthony Weil, Peter J Kennelly

PAPER X- SYSTEMATIC BACTERIOLOGY

- Topley and Wilson's Microbiology and Microbial infections

S. Peter Borriello, Patrick R. Murray, Guido Funke

- Infectious diseases-Sherwood L. Gorbach, John G. Bartlett, Neil R. Blacklow
- Bergey's Manual of Systematic Bacteriology

PAPER XI - IMMUNOLOGY, IMMUNOCHEMISTRY AND SEROLOGY

- Roitt's Essential Immunology

  Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt

PAPER XIII - VIROLOGY AND MYCOLOGY

- Topley & Wilson's Microbiology and Microbial infections: Virology
- Medical Microbiology:

  Greenwood, Richard C. B. Slack, John F. Peutherer, Michael R. Barer
- Topley & Wilson's Microbiology and Microbial infections: Medical Mycology
- Medical Mycology : John Willard Rippon

PAPER XIV - CLINICAL MICROBIOLOGY

- Koneman's Color Atlas and text book of Diagnostic Microbiology

- **Paper XV - Applied Microbiology and Clinical Laboratory Management**

  - Text book of Medical Laboratory Technology

    Praful B Godkar, Darshan P Godkar

2.20 Journals

As decided by the concerned faculties / HoD

2.21 Logbook

To be maintained for all academic work which shall be counter signed byconcerned HOD

3. EXAMINATIONS

3.1 Eligibility to appear for exams [including Supplementary]

Minimum percentage of Attendance

No candidates shall be admitted to any year of B. Sc. Medical Microbiology Examinations unless he / she has a minimum of 80% attendance.

Regarding condonation of shortage of attendance clause 1.9 shall apply.

Minimum mark in Internal Assessment

The minimum requirement of internal assessment mark for appearing University examination shall be 50% for theory and 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 and conducted by the department,
- Seminars, assignments, attendance, laboratory work and record work during the course of study.

The third sessional examination should be conducted as model examination as that of University and is mandatory to appear for familiarization of the University Examination model. The average of best two Sessional examinations together with other internal assessment components like regularity, performance in seminars and assignments, laboratory performance etc. shall be considered for calculating the final internal assessment mark.

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.

If a candidate not securing minimum internal assessment marks, he / she should appear for next university examination (supplementary or regular) after securing the minimum internal assessment. A regular record of theory and practical sessional marks shall be maintained for each student in the institution. A separate internal assessment examination shall be conducted for theory and practical for the failed candidates to make them eligible to appear for the next university examination (supplementary or regular).

Candidates who fail in one or more papers in an examination need to reappear for only those papers for securing complete pass in the examination. Those who fails either in theory or practical of a subject shall have to appear for both theory and practical.

3.2 Schedule of Regular/Supplementary exams

Regular university examinations will be conducted at the end of each academic year and supplementary examinations will be conducted within six months after the publication of the result of regular examination.

3.3 Scheme of examination showing maximum marks and minimum marks

I B. Sc. Medical Microbiology Examination

Paper	**Theory**						**Practical**							**Grand Total**	
	University		Internal		Total		University		Internal		Viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Max	Min	Max	Min
I - Anatomy	50	25	25	12.5	75	37.5	50	25	25	12.5	50	125	62.5	200	100
II - Physiology	50	25	25	12.5	75	37.5	50	25	25	12.5	50	125	62.5	200	100
III – General Biochemistry	50	25	25	12.5	75	37.5	50	25	25	12.5	50	125	62.5	200	100
IV – General Methodology	50	25	25	12.5	75	37.5	50	25	25	12.5	50	125	62.5	200	100
V – Community Medicine, Health Education and Communicative English	-	-	50	25	50	25	-	-	-	-	-	-	-	50	25
Total Marks														**850**	**425**

II B. Sc. Medical Microbiology Examination

Paper	Theory						Practical							Grand Total	
	University		Internal		Total		University		Internal		Viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Max	Min	Max	Min
VI – Foundations of Microbiology and Molecular Biology	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
VII – Parasitology and entomology	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
VIII – Methodology and Instrumentation	100	50	25	12.5	125	62.5	50	25	25	12.5	50	125	62.5	250	125
IX – Information Technology, Bioinformatics and AI in Healthcare	-	-	50	25	50	25	-	-	-	-	-	-	-	50	25
Total Marks														**900**	**450**

III B. Sc. Medical Microbiology Examination

Paper	Theory						Practical							Grand Total	
	University		Internal		Total		University		Internal		Viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Max	Min	Max	Min
X – Systematic Bacteriology	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
XI – Immunology, Immunochemistry and Serology	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
XII – Biostatistics and Research Methodology	-	-	50	25	50	25	-	-	-	-	-	-	-	50	25
Total Marks														**650**	**325**

IV B. Sc. Medical Microbiology Examination

Paper	Theory						Practical							Grand Total	
	University		Internal		Total		University		Internal		Viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Max	Min	Max	Min
XIII – Virology and Mycology	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
XIV – Clinical Microbiology	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
XV – Applied Microbiology and Clinical Laboratory Management	100	50	25	12.5	125	62.5	-	-	-	-	-	-	-	125	62.5
XVI – Project	-	-	-	-	-	-	50	25	-	-	-	-	-	50	25
Total Marks														**775**	**387.5**

3.4 Papers in each year

I B. Sc. Medical Microbiology

- Paper I- Anatomy
- Paper II- Physiology
- Paper III- General Biochemistry
- Paper IV- General Methodology
- Paper V- Community Medicine, Health Education and Communicative English

II B. Sc. Medical Microbiology

- Paper VI- Fundamentals of Microbiology and Molecular Biology
- Paper VII- Parasitology and Entomology
- Paper VIII- Methodology and Instrumentation
- Paper IX – Information Technology, Bioinformatics and Healthcare

III B. Sc. Medical Microbiology

- Paper X- Systematic Bacteriology
- Paper XI- Immunology, Immunochemistry and Serology
- Paper XII – Biostatistics and Research Methodology

IV B. Sc. Medical Microbiology

- Paper XIII- Virology and Mycology
- Paper XIV - Clinical Microbiology
- Paper XV - Applied Microbiology and Clinical Laboratory Management
- Paper XVI-Project

3.5 Duration of theory and practical exams

I B. Sc. Medical Microbiology Examination

Paper	Subject	Duration
I	**Anatomy** Theory Practical	 2 hrs 3 hrs
II	**Physiology** Theory Practical	 2 hrs 3 hrs
III	**General Biochemistry** Theory Practical	 2 hrs 3 hrs
IV	**General Methodology** Theory Practical	 2 hrs 3 hrs
V	**Community Medicine, Health Education and Communicative English** Theory Practical	There will be no University examination

II B. Sc. Medical Microbiology Examination

Paper	Subject	Duration
VI	**Fundamentals of Microbiology and Molecular Microbiology** Theory Practical	 3 hrs 6 hrs x 2 days
VII	**Parasitology and Entomology** Theory Practical	 3 hrs 6 hrs
VIII	**Methodology and Instrumentation** Theory Practical	 3 hrs 6 hrs
IX	**Information Technology, Bioinformatics and AI in Healthcare** Theory Practical	 There will be no University examination

III B. Sc. Medical Microbiology Examination

Paper	Subject	Duration
X	**Systematic Bacteriology** Theory Practical	 3 hrs 6 hrs x 3 days
XI	**Immunology, Immunochemistry andSerology** Theory Practical	 3 hrs 6 hrs
XII	**Biostatistics and Research Methodology** Theory Practical	 There will be no University examination

IV B. Sc. Medical Microbiology Examination

Paper	Subject	Duration
XIII	**Virology and Mycology** Theory Practical	 3 hrs 6 hrs
XIV	**Clinical Microbiology** Theory Practical	 3 hrs 6 hrs x 3 days
XV	**Applied Microbiology and Clinical Laboratory Management** Theory Practical	 3 hrs There will be no University practical Examination
XVI	**Project** Evaluation	 12 minutes per candidate (Power point presentation for maximum 10 minutes and viva)

3.6 Details of theory exams

- **Question paper setters**

  Question paper setters shall be posted from among the qualified teachers as per norms of Kerala University of Health and Allied Sciences.

- **Question paper pattern**

Total marks- 100 Time- 3 hrs

- Q1. Essay- 2 no. s x 15 marks = 30 marks
- Q2. Brief essay- 2 no. s x 10 marks = 20 marks
- Q3. Short answers- 6 no. s x 5 marks = 30 marks
- Q4. comment on- 10 nos x 2 marks = 20 marks

Total marks- 50 Time - 2 hrs

- Q1. Essay- 2 no. x 10 marks = 20 marks
- Q2. Short answers - 2 no. x 5 marks = 10 marks
- Q3. comment on- 10 no. s x 2marks = 20 marks

Theory paper valuation

As per KUHS norms

- **Model question paper for each subject with question paper pattern**

I B. Sc. Medical Microbiology

Paper I- Anatomy

- **Total marks- 50** **Time- 2 hrs**

QI. Essay- **2 no. x 10 marks = 20 marks**

1. Define epithelium. Describe its functions and structure. Classify epithelium giving suitable examples.
2. Name the parts of the Urinary system and describe in detail the kidney

QII. Short answers **2 no. x 5 marks = 10 marks**

3. Name the parts of female reproductive system. Describe in detail the uterus.
4. Name the endocrine glands. Describe in detail the pituitary gland and thyroid gland.

QIII. Comment on **10 no. s x 2marks = 20 marks**

5. Sessmoid bones
6. Connective tissue cells
7. Islets of Langerhans
8. Spermatic cord
9. Parts of Respiratory system
10. Structure of heart
11. Location of Digestive glands
12. Peripheral Nervous system
13. Tongue
14. Microscopic structure of skin

Paper II- Physiology

Total marks- 50 **Time- 2 hrs**

QI. Essay- **2 no. x 10 marks = 20 marks**

1. Define Cardiac cycle. Give the normal value of duration of one Cardiac cycle. Explain the events occurring during the cardiac cycle.
2. Define Spermatogenesis. Explain the steps of spermatogenesis. Add a note on factors influencing Spermatogenesis.

QII. Short answers **2 no. x 5 marks = 10 marks**

3. Explain neural regulation of respiration.
4. Explain the steps of urine formation

QIII. Comment on **10no. s x 2marks = 20 marks**

5. Properties of Cardiac Muscle
6. Endocrine functions of kidney
7. Sarcomere
8. Chloride shift
9. Webers test
10. Functions of saliva
11. Erythroblastosis foetalis
12. Muscle contraction
13. Structure of neurons
14. Temperature Regulation

Paper III- General Biochemistry

- **Total marks- 50** **Time- 2 hrs**

QI. Essay- **2 no. x 10 marks = 20 marks**

1. Define Lipids. Classify lipids giving examples of each class

2. Write in detail about the sources, RDA, functions and deficiency of iron. Add a note on iron absorption.

QII. Short answers **2 no. x 5 marks = 10 marks**

3. Essential amino acids

4. Law of mass action

QIII. Comment on **10 no. s x 2marks = 20 marks**

5. Bicarbonate buffer

6. Structure of eukaryotic cell

7. Disaccharides

8. Hendreson- Hasselback equation

9. Zinc sulphate

10. Nyctalopia

11. Structure of t RNA

12. Formaline

13. Xylene

14. Indicators

Paper IV- General Methodology

- **Total marks - 50** **Time - 2 hrs**

QI. Brief Essay- **2 no. s x 10 marks = 20 marks**

1. Define culture media. Write a brief essay on different culture media.
2. General Procedures of Clinical laboratory.

QII. Short answers- **2 no. s x 5 marks = 50 marks**

3. Autoclave
4. Laboratory animals

QIII. comment on- **10 nos x 2 marks= 30 marks**

5. Thin blood smear
6. Gram staining
7. Universal safety precautions
8. Labelling and registering of specimens
9. Anticoagulants
10. properties of buffer
11. Capillary blood collection
12. Molal solution
13. Volumteric Analysis
14. Phase contrast Microscope

II B. Sc. Medical Microbiology

Paper VI- Fundamentals of Microbiology and Molecular Biology

- **Total marks- 100** **Time- 3 hrs**

QI. Essay- **2 no. s x 15 marks = 30 marks**

1. Describe the structure of a typical bacterial cell.
2. Define sterilization. Discuss the methods of sterlization by heat.

QII. Brief essay- **2 no. s x 10 marks = 20 m**arks

3. Write briefly about the anaerobic culture methods.
4. Describe briefly about phylogenetic classification of bacteria.

QIII. Short answers- **6 no. s x 5 marks = 30 marks**

5. Transduction
6. Differential stain
7. Koch's postulates
8. Kirby- Bauer method
9. Testing of disinfectants
10. Demonstration of motility

QIV. comment on- **10 nos x 2 marks= 20 marks**

11. phototrophs
12. enrichment media
13. catalase test
14. streak culture
15. PCR
16. Mutation
17. jumping gene
18. Electron transport chain
19. Cell wall synthesis inhibitors
20. Codons

Paper VII- Parasitology and Entomology

- **Total marks- 100** **Time- 3 hrs**

QI. Essay- **2 no. s x 15 marks = 30 marks**

1. Define the morphology and life cycle of Wuchereria bancrofti. Discuss the clinical manifestations and laboratory diagnosis of lymphatic filariasis.
2. Discuss on the morphology and life cycle of mosquito. Enumerate mosquito borne diseases and their control.

QII. Brief essay- **2 no. s x 10 marks = 20 marks**

3. Explain briefly on different techniques used for preservation of stool for parasitic examinations.
4. Explain the role of arthropods in transmission of diseases.

QIII. Short answers- **6 no. s x 5 marks = 30 marks**

5. Echinococcosis
6. Enterobius vermicularis
7. Morphology and public health significance of Xenopsylla cheopis
8. Fasciola hepatica
9. Amoebic dysentery
10. Ancylostoma duodenale

QIV. comment on- **10 nos x 2 marks= 20 marks**

11. LD bodies
12. Louse
13. Hermaphrodite
14. Life cycle of Plasmodium
15. Commensalism
16. Insecticides
17. Mechanical transmission
18. Cyclops
19. Auto infection
20. NIH swab

Paper VIII- Methodology and Instrumentation

- **Total marks- 100** **Time- 3 hrs**

QI. Essay- **2 no. s x 15 marks = 30 marks**

1. Describe the principle, types and application of ELISA.
2. What is the principle of electrophoresis? Discuss on factors influencing electrophoretic mobility. Add a note on PAGE.

QII. Brief essay- **2 no. s x 10 marks = 20 marks**

3. Describe on the principle and application of spectrophotometry.
4. Give an account of different types of centrifuges.

QIII. Short answers- **6 no. s x 5 marks = 30 marks**

5. RIA
6. Anaerobic cultivation apparatus
7. Ion exchange chromatography
8. Iso electric focusing
9. HPLC
10. Immuno electrophoresis

QIV. comment on **10 nos x 2 marks= 20 marks**

11. Application of centrifuges
12. Rotors
13. Types of gels
14. Solubilizers
15. Errors in paper chromatography
16. Beer –Lambert's Law
17. Partition coefficient
18. Resolving power
19. Cold room
20. pH meter

III B. Sc. Medical Microbiology

Paper X- Systematic Bacteriology

- **Total marks- 100** **Time- 3 hrs**

QI. Essay- **2 no. s x 15 marks = 30 marks**

1. Describe the morphology, pathogenesis, clinical features and laboratory diagnosis of Corynebacterium diphtheriae.
2. Explain the pathogenesis, clinical features and laboratory diagnosis of gonorrhea.

QII. Brief essay- **2 no. s x 10 marks = 20 marks**

3. Enumerate the medically important spirochetes. Explain the laboratory diagnosis of syphilis.
4. Explain the pathogenesis and laboratory diagnosis of enteric fever.

QIII. Short answers- **6 no. s x 5 marks = 30 marks**

5. Satellitism
6. Botulism
7. Bacillary dysentery
8. Q fever
9. Halophilic vibrios
10. Travellers diarrhea

QIV. comment on- **10 nos x 2 marks= 20 marks**

11. Psittacosis
12. Coagulase test
13. Bacitracin sensitivity test
14. Photochromogens
15. Milk ring test
16. Lepromin test
17. BCG
18. Wool sorters disease
19. Whooping cough
20. Blue pus

Paper XI - Immunology, Immunochemistry and Serology

- **Total marks- 100** **Time- 3 hrs**

QI. Essay- **2 no. s x 15 marks = 30 marks**

1. Define immune response. Discuss on primary and secondary immune response. Adda note on production of antibodies.
2. Define Hypersensitivity. Discuss the mechanism of delayed type hypersensitivity. Add a note on the diagnostic tests based on delayed type hypersensitivity.

QII. Brief essay- **2 no. s x 10 marks = 20 marks**

3. Define antibody and explain the structure of immunoglobulins.
4. Define AIDS. Discuss in detail the modes of transmission, immunopathology, and stages of AIDS.

QIII. Short answers- **6 no. s x 5 marks = 30 marks**

5. Vaccines
6. Sources of transmission of infections
7. Hemolytic disease of new born
8. ELISA
9. Immunity to fungal infections
10. Immunotherapy of cancer

QIV. comment on- **10 nos x 2 marks= 20 marks**

11. Monoclonal antibodies
12. Di George syndrome
13. Side chain theory
14. SLE
15. T independent antigens
16. Types of transplants
17. CIE
18. Adjuvant
19. Lectin Pathway
20. Lymph node

IV B. Sc. Medical Microbiology

Paper XIII - Virology and Mycology

- **Total marks- 100** **Time- 3 hrs**

QI. Essay- **2 no. s x 15 marks = 30 marks**

1. Discuss the structure, antigenic variation, pathogenesis and clinical features of influenza virus.
2. Classify Dermatophytes. Describe infections caused and laboratory diagnosis.

QII. Brief essay- **2 no. s x 10 marks = 20 marks**

3. Draw and explain the structure of HIV. Explain in detail the diagnosis of HIV infection.
4. Enumerate opportunistic mycoses. Describe the clinical features and laboratory identification of candidiasis.

QIII. Short answers- **6 no. s x 5 marks = 30 marks**

5. Define bacteriophage and explain lytic cycle
6. Arboviral infections in India
7. Mycetoma
8. Morphological classification of fungi
9. Histoplasmosis capsulati
10. Viral multiplication

QIV. comment on- **10 nos x 2 marks= 20 marks**

11. Polio vaccine
12. Mycotoxins
13. Kolpik's spots
14. Infectious hepatitis
15. Piedra
16. Oncogenic viruses
17. Penicilliosis marneffei
18. Prions
19. Woods lamp examination
20. Thermal dimorphism

Paper XIV - Clinical Microbiology

- **Total marks- 100** **Time- 3 hrs**

QI. Essay- **2 no. s x 15 marks = 30 marks**

1. Enumerate the organisms causing acute diarrheal diseases. Write briefly on the laboratory diagnosis of cholera.
2. Define nosocomial infections. Write briefly on the factors which contribute to post-operative wound infections, common organisms and its laboratory diagnosis.

QII. Brief essay- **2 no. s x 10 marks = 20 marks**

3. Mention the organism causing diphtheria. Describe the laboratory diagnosis.
4. Enumerate the organisms causing urinary tract infection. Describe the collection, transport and processing of urine samples in a routine bacteriology laboratory.

QIII. Short answers- **6 no. s x 5 marks = 30 marks**

5. Primary cell culture
6. VDRL test
7. Neonatal meningitis
8. Serological tests used in HIV infection
9. Zoonotic infections
10. Microbial typing

QIV. comment on- **10 nos x 2 marks= 20 marks**

11. Normal flora of skin
12. Vectors
13. Presumptive coliform test
14. Concentration methods for sputum sample
15. PUO
16. Slide culture
17. PCR
18. Septicemia
19. ESBL
20. Automation in Microbiology

Paper XV - Applied Microbiology and Clinical Laboratory Management

- **Total marks- 100** **Time- 3 hrs**

QI. Essay- **2 no. s x 15 marks = 30 marks**

1. Discuss on Organisation of Clinical laboratory and explain Role & responsibilities of different personnel in Laboratory
2. Discuss about the role of microorganisms in agriculture

QII. Brief essay- **2 no. s x 10 marks = 20 marks**

3. Describe the Universal safety Precautions.
4. Describe Quality control in microbiology laboratory.

QIII. Short answers- **6 no. s x 5 marks = 30 marks**

5. Vinegar production
6. CSSD
7. Human ethics involved in microbiological work
8. LAI
9. Maintenance & preservation of fungal cultures
10. Biomedical waste management

QIV. comment on- **10 nos x 2 marks= 20 marks**

11. Antimicrobial Stewardship
12. Hospital infection Control Committee
13. NABL
14. Role of microbiologist in public health
15. Bioterrorism
16. COVID 19
17. Safety cabinets
18. Nitrogen cycle
19. Sterility test
20. SOP

3.7 Internal assessment component

Internal assessment marks shall be awarded to the candidates in each paper as detailed in the scheme of examinations. The award shall be on the basis of the assessment made by the teachers from the candidate's performances in the

- Three sessional examinations evenly placed and conducted by the department of which the third one is university model and is mandatory and average of two best performances shall be taken into consideration,
- Seminars, assignments, attendance, laboratory work and record work during the course of study.
- The marks secured by the candidates in each paper shall be forwarded to the University at the end of the course for the University examinations. The candidates who failed in the University Examinations will be allowed a separate internal assessment for both theory and practical
- The class average of internal assessment marks of the whole class should not exceed 75% of maximum marks for regular examination and 80% for supplementary examination both in theory and practical examination.

3.8 Details of Practical Examination

As detailed in Clause 3.3 and 3.5

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

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

The examiner should be an Assistant Professor or above with MSc. Medical Microbiology and minimum 3 years Post PG teaching experience in the concerned subject. The evaluator should be an Assistant Professor or above with MSc. Medical Microbiology and minimum 3 years Post PG teaching experience.

3.10 Details of viva: division of marks

As Given in Clause 3.3 and 3.5

Project Evaluation

The project evaluation will be conducted by the internal and external examiners together in the Fourth year B Sc Medical Microbiology University practical examination. Soft Copy of the project in PDF format should be sent to the examiners at least one week before the date of University Examination.

4.INTERNSHIP

Not applicable

5. ANNEXURES

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