DETAILED SYLLABUS FOR THE POST OF JUNIOR SCIENTIFIC OFFICER IN HEALTH SERVICES

CATEGORY NO.422/2024

<u>M.Sc. MICROBIOLOGY (30 Marks)</u>

MODULE 1.General Microbiology
MODULE2 .Immunology
MODULE 3. Systemic bacteriology
MODULE4. Virology
MODULE 5.DNA viruses
MODULE 6.RNA viruses
MODULE 7.Other group of viruses- Hepatitis (A, B,C,D,E,G)
MODULE 8. Mycology
MODULE 9. Parasitology
MODULE 10. Applied Microbiology

Modules	Mark distribution
MODULE 1.General Microbiology MODULE2 .Immunology	10
MODULE 3. Systemic bacteriology MODULE4. Virology MODULE 5.DNA viruses MODULE 6.RNA viruses MODULE 7.Other group of viruses- Hepatitis (A, B,C,D,E,G) MODULE 8. Mycology MODULE 9. Parasitology	10
MODULE 10. Applied Microbiology	10

MODULE 1.General Microbiology

a) **Introduction and history of Microbiology**
Competency 1 a: Discuss notable historical events, scientific developments and contributions of key scientists in evolution of microbiology

b) **Morphology and physiology of bacteria**
Competency 1b: Discuss basic morphology, physiology/ characteristics and classification of bacteria

c) **Culture media and methods**
Competency 1c: Detail on the different culture media used to identify bacteria to the species level.
Competency 1.1c: Detail on the various aerobic and anaerobic culture methods and preservation of organisms.

d) **Identification of bacteria**
Competency 1d: Discuss on the different conventional and automated culture methods for identification of bacteria

e) **Microbial genetics and molecular diagnostic techniques**
Competency 1e: Basic principles of molecular biology and concept of molecular genetics
Competency 1.1e: Discuss on molecular techniques and other automated systems for microbial identification

f) **Microbial pathogenicity and normal human microbiota**
Competency 1f: Discuss the role of microbes in health and disease

g) **Antimicrobial agents, antimicrobial resistance and susceptibility testing**
Competency 1g: Detail on different mechanisms of antimicrobial resistance and antimicrobial susceptibility methods

h) **Sterilization and disinfection in laboratory practice**
Competency 1h: Classify and describe the different methods of sterilization and disinfection
Competency 1i: Discuss quality control of different sterilization methods in laboratory practice
Competency 1.1i: Overview of CSSD
Competency1.2i: Biomedical waste management

MODULE 2 .Immunology

a) **Innate and Acquired immunity**
Competency 2a: Discuss the role of immunological mechanisms in health and disease

b) **Components of immune system**
Competency 2b: Explain the structure and function of immune system and its components- Lymphoreticular system, antigens, antibodies, complement systems

c) **Antigen, antibody, antigen antibody reactions**
Competency 2c: Discuss the principles and applications of laboratory tests used in diagnostic microbiology based on host immune response

MODULE 3. **Systemic bacteriology**

a. **Gram positive bacteria**

Staphylococcus, streptococcus, enterococcus and Pneumococcus, Neisseria, Moraxella, Corynebacterium, Bacillus, Anaerobic spore forming (Clostridium and non spore forming bacteria, Mycobacteria and Non tuberculous mycobacteria
Competency 3a: Explain the virulence factors, aetiopathogenesis, laboratory diagnosis and common infections

b.Gram negative bacteria

Enterobacteriaceae (E.coli, Shigella, Klebsiella, Proteus and others),

Salmonella, V.cholerae, Pseudomonas and other non fermenters, Haemophilus and HACEK group, Bordetella, Brucella, Miscellaneous gram negative bacilli (H.pylori, Legionella, Campylobacter and others, Spirochates, Rickettsiae, Coxiella, Bartonella, Chlamydiae, Mycoplasma-
Competency 3b :Explain the virulence factors, aetiopathogenesis, laboratory diagnosis and common infections

MODULE4. Virology

a) Introduction to virology and General properties of viruses

Competency 4a: General characteristics of viruses, properties of viruses, viral multiplication and inclusion bodies, viral cultivation, cytopathogenic effects, antiviral vaccines

MODULE 5.DNA viruses

Herpes viruses(herpes simples, Varicella zoster virus, cytomegalovirus, Ebstein barr virus and others),Other DNA viruses(Parvovirus, Pox virus, Adenovirus, Bacteriophages)
Competency 5: Discuss the pathogenesis, lab diagnosis and infections

MODULE 6.RNA viruses

Myxoviruses and Rubella viruses- Influenza, Parainfluenza, Mumps, Measles, Respiratory syncytial virus, Nipah virus
Picorna viruses (Polio and Coxsackie virus), Arboviruses (Dengue virus, Chikungunya virus, Japanese encephalitis virus, yellow fever virus, KFD virus), Rhabdo viruses, HIV, Miscellaneous virus(Hanta virus, Ebola and Marburg virus, Corona virus, Prions, Rota virus) Competency 6: Discuss the aetio pathogenesis, lab diagnosis and infections

MODULE 7.Other group of viruses- Hepatitis (A, B,C,D,E,G)

Competency 7: Discuss the pathogenesis, lab diagnosis and infections

MODULE 8. Mycology

a) Introduction to Mycology

Competency 8a:- Describe basic morphology, physiology/characteristics and classification of fungi causing infection in man

b) Superficial and subcutaneous mycoses- Tinea versicolor, T. nigra, Piedra, Dermatophytes, Mycetoma, chromoblastomycosis, sporotrichosis
Competency 8b:- Discuss the pathogenesis and lab diagnosis

c) Systemic and opportunistic mycoses- Histoplasmosis, Blastomycosis, paracoccidioidomycosis, coccidioidomycosis, Aspergillosis, Zygomycosis, Candidiasis, cryptococcosis, Pneumocyctis Jirovecii
Competency 8c:- Discuss the pathogenesis and lab diagnosis

d) Miscellaneous- Mycotic poisoning

MODULE 9. Parasitology

a) Introduction to parasitology

Competency 9a:- Describe basic morphology, physiology/characteristics and classification of parasites causing infection in man

b) Protozoa- Classification

Competency 9b:- Describe the morphology, life cycle and laboratory diagnosis of Entamoeba histolytica

Competency 9.1b:- Describe the morphology, life cycle and laboratory diagnosis of free living amoebae

Competency 9.2b:- Describe the morphology, life cycle and laboratory diagnosis of flagellate- giardia lamblia, trichomonas vaginalis

Competency 9.3b:-Describe the morphology, life cycle and laboratory diagnosis of haemoflagellates- Trypanosoma, Leishmania

Competency 9.4b:- Describe the morphology, life cycle and laboratory diagnosis of Malaria

c)Miscellaneous sporozoa- Toxoplasma gondii. Cytoisospora belli, cryptosporidium parvum, cyclospora

Competency 9c:- Describe the laboratory diagnosis

d) Cestodes- classification

Competency 9d :- Describe the morphology, life cycle and laboratory diagnosis of Tapeworms causing infection in man- T. saginata, solium, Diphyllobothrium latum, Echinococcus, H.nana

e)Tremtodes- classification

Competency 9e:- Describe the morphology, life cycle and laboratory diagnosis of flukes causing infection in man- Schistosoma,liver flukes, intestinal flukes, lung flukes

Nematodes- classification

Competency 9.1e:- Describe the morphology, life cycle and laboratory diagnosis of intestinal nematodes causing infection in man- Ascaris lumbricoides, Trichuris trichuria, strongyloides stercoralis, Hook worm, Enterobious vermicularis.

Competency 9.2e:- Describe the morphology, life cycle and laboratory diagnosis of Filarial worms causing lymphatic filariasis

Competency 9,3e:- Discuss briefly on other subcutaneous filariasis- loa. Loa, onchocerca volvulus, Mansonella

Competency 9.4e:- Describe the morphology, life cycle and laboratory diagnosis of Guinea worm

MODULE 10. Applied Microbiology

a) Bacteriology of milk, water, food and air and environmental surveillance

Competency 10a:- Discuss in detail on microbiology of milk, water and air

Competency 10.1a:- Describe the methods, use and significance of assessing the microbial contamination of milk, water, food and air.

b) Zoonoses

Competency 10b:- Define and classify zoonotic infections

Competency 10.1b:- Discuss etiological agents, vectors, modes of transmission, laboratory diagnosis, preventive measures and control strategies of different zoonotic infections caused by bacterial, viral, fungal and parasitic agents

c) Standard precautions in infection control

d) Outbreak investigation

Competency 10d:- Collect appropriate clinical and environmental samples; ensure proper handling, transport, and communication with laboratories**.**

e) Screening for multidrug resistant organisms

Competency 10e:- Collect screening samples correctly and safely

Competency 10.1e:- Ensure correct specimen packaging and timely delivery to laboratory

Competency 10.2e:-Perform or understand laboratory tests used for MDRO detection

Competency 10.3e:-Interpret and validate MDRO screening results

Competency 10.4e- Use internal and external QC programs to ensure test accuracy

f) Sample collection and transport in microbiology

BIOCHEMISTRY (30 MARKS)

I) General Biochemistry, Physical Chemistry (2 marks)

- Cell, Biomembranes, Subcellular organelles: Structure and functions
- Water as a universal solvent; Types of water and preparation of high quality water, pH and buffers, electrolytes, pH meter, biological buffers.
- Viscosity, surface tension, osmosis, Donnan membrane equilibrium, dialysis, diffusion, adsorption, partition coefficient; homogenization, cell disruption, sonication, centrifugation and ultra centrifugation, ,fractional distillation, solvent extraction , lyophilisation.
- Radioactivity: radioisotopes, ionizing radiations, measurement of radioactivity, applications of radioisotopes in clinical biochemistry and research
- Common laboratory wares including glass wares and plastic wares, analytical balances,pipettes,burettes,,dessicators, distillation apparatus and their care and maintenance. Preparation of reagents: Normal and molar solutions;percent solutions;standard solutions; Dilution principle.
- Biomedical waste disposal

II) Techniques and Instrumentation, Biostatistics. (3 Marks)

- Techniques and Instrumentation: Photometry, Spectrophotometry, Nephelometry, Turbidimetry, fluorimetry, flame photometry,Reflectance photometry,Atomic absorption spectrophotometry, osmometry, electrophoresis, chromatography, electrochemistry, biosensors, Immunological techniues, Immuno electrophoresis, double diffusion technique , immunofixation, Immunoassay of enzymes ,RIA,ELISA, chemiluminesence; electrochemiluminesence, flow cytometry,ID-MS.
- Biostatistics : Reference intervals; Clinical decision limits, Evaluation of methods.

III) Chemistry and metabolism of Carbohydrates, Lipids, Proteins and associated inborn errors. (6 marks)

b) Carbohydrates: Classification, Chemistry and properties; glycolysis, gluconeogenesis, uronic acid pathway, TCA cycle, HMP pathway, glycogen metabolism, galactose metabolism, fructose metabolism, Regulation of blood glucose, TCA cycle, Biological Oxidation and Electron Transport Chain; Inborn errors in carbohydrate metabolism.

c) Lipids: Classification, Chemistry and properties, Fatty acid synthesis, fatty acid oxidation, ketogenesis. Metabolism of triglycerides, phospholipids, sphingolipids, and cholesterol. Lipoprotein metabolism, obesity, fatty liver, lipotropic factors and ketosis, atherosclerosis and coronary heart disease, Inborn errors in lipid metabolism

d) Proteins : Classification, properties and chemistry of amino acids and proteins, structure of proteins amino acid sequencing of proteins. Transamination, deamination, oxidative deamination, ammonia transport, urea formation Metabolism of individual aminoacids ,Biosynthesis of catacholamines, melanin formation, Nitrogen balance;Inborn errors of urea cycle and aminoacid metabolism.

IV) Enzymology; Chemistry and metabolism of Nucleotides, Hemoglobin (4 marks)

- Classification, co-enzymes, cofactors, mechanisms of enzyme action, factors affecting enzyme action, enzyme kinetics, enzyme inhibition, regulatory enzymes, Clinical enzymology and applications of Enzymology
- Biosynthesis of purine and pyrimidine nucleotides. Degradation of purine and pyrimidine nucleotides; Associated inborn errors

- Heme synthesis, formation of hemoglobin, metabolism of bilirubin, urobilinogen, and other bile pigments; Inborn errors of heme synthesis and bilirubin metabolism

V) Vitamins and Minerals (2 marks)

- Chemistry, properties, biological importance and deficiency manifestations of fat soluble vitamins. Chemistry, properties, biological importance, deficiency manifestations and coenzyme functions of water soluble vitamins.
- Metabolism of calcium, phosphorus, magnesium, sodium, potassium, chloride, iron, copper, iodine, manganese, zinc, molybdenum, fluorine, selenium

VI) Molecular Biology & Biochemistry of cancer (3 marks)

- Structure of DNA; DNA replication, DNA Polymerase, Cell cycle, DNA repair.
- Transcription, inhibition of transcription, genetic code, post transcriptional processing, reverse transcriptase. Protein biosynthesis, post translational processing, inhibitors of protein synthesis.
- Molecular genetics and gene expression, principles of breeding, autosomal, recessive, x- linked recessive, population genetics, gene location on chromosomes, mutations, recombination, mutagens, repression, operon, gene amplification, gene switching, transposition of genes, somatic recombination, enhancer, viruses.
- Recombinant DNA technology. Restriction endonuclease, DNA ligase, vectors, chimeric molecules, cloning, gene library, cloning strategies, insitu-hybridization, blot techniques and applications, RFLP, Gene Therapy, Transgenesis, DNA finger printing, DNA sequencing, PCR, DNA probes, hybridoma technology. Pre-natal diagnosis of genetic disorders.
- Cell cycle;Pathophysiology of Cancer, Oncogens, Tumor suppressor genes, Apoptosis. Tumor markers- their biochemical and pathological significance , use in management of benign and malignant tumors. Anti cancer drugs

VII) Immunology (2marks)

- Principles of immunology, antigen, antibodies and their reactions; Immunoglobulins, MHC, Complement system, Interleukins ,Interferons and Cytokines. Cellular immunity, immune responses and cells involved , autoimmunity, immuno deficiency diseases.

VIII) Clinical Chemistry (3marks)

- Phelobotomy,Specimen collection, preservation and preparation of blood for analysis, interferences in the collection process; Anticoagulants and preservatives; Biological variation; Biochemical analysis of CSF & other body fluids
- Automation in Clinical Chemistry; POCT
- Total Quality management: Chemicals, reagents and apparatus- their selection, sources of supply and techniques for assessing the quality Internal quality control; Reference materials and calibrating definitive methods; Sources of variation in laboratory test results, Quality control charts, Levy-Jenning and Cusum charts; External quality control and proficiency testing programs

IX) Diagnostic Biochemistry (3 marks)

- Diagnostic tests for liver diseases,
- Pathophysiology of diabetes mellitus and related disorders, diagnostic tests for DM; Tests for diagnosis of renal diseases
- Composition and analysis of calculi – salivary, renal and biliary system
- Pancreatic Function test, Intestinal function test, Gastric function test Thyroid function test, Cardiac function test ,Feto-Placental function test
- Acid-base balance and diagnostic test for acid-base disorders
- Acute phase proteins
- Biochemistry of AIDS, Laboratory analysis

X) Endocrinology & Toxicology (2 marks)

- Classification of hormones, mechanism of hormone action, regulation of hormone secretion. Chemistry, metabolism, biological functions and disorders of- Hypothalamus & Pituitary hormones Thyroid hormones Parathyroid hormones Pancreatic hormones Adrenal hormones Gonadal hormones
- Toxicology Analysis – Action, detection and quantification of common drugs in therapy and toxic agents. Digoxin, lithium, salicylates, paracetamol, barbiturates, alcohol, morphine derivatives, amphetamines, lead, iron, mercury, carbon monoxide, organophosphates, carbamates and cyanide.

<u>M.Sc. MLT (40 Marks)</u>

Module -1 **(5 marks)**

General Microbiology -Sterilization and disinfection, Microscopes, Staining methods in bacteriology, Culture Media in bacteriology, Biochemical tests for Identification
Systemic Bacteriology - medical importance- Gram positive cocci, Gram negative cocci, Gram positive bacilli, Gram negative bacilli, Mycobacteria
Diagnostic Bacteriology - Guidelines for the collection, Transport, Processing analysis, isolation of bacterial pathogens and reporting of cultures from specimens for bacterial infections
Bacterial serology-New rapid serological diagnostic methods for bacterial infections.
ABST – methods for ABST, antibiotic resistance, stewardship.

Module -2 **(4 marks)**

Medical parasitology – Protozoa, Cestodes, Trematodes, Nematodes, Diagnostic parasitology
Medical Mycology - Superficial Mycosis, Subcutaneous Mycosis, Systemic Mycosis, Opportunistic Mycosis, mycotoxins, Laboratory Diagnosis of Fungal Infections
Medical Virology- viral cultivation, Detection, Systematic Virology- medically important viruses, Emergence and re-emergence of viral infections, Laboratory Diagnosis of viral infections.

Module -3 **(3 marks)**

Immunology- immunity, immune system, immunoglobulin, Monoclonal antibodies, immune responses, hypersensitivity reactions, autoimmune diseases, immuno deficiency, vaccines, Clinical laboratory methods for detection of antigens and antibodies
Applied Medical Microbiology- Nosocomial infections, public health Microbiology - Bacteriology of water, air, food automated techniques in microbiology.

Pathology

Module -4 **(4 marks)**

Hematology- Haemopoiesis, Anaemia, Haemostasis & its investigations, Routine and special Haematological Investigations Blood and Bone Marrow preparations, Automation in Haemtology,

Clinical pathology - Collection, transport, preservation and processing of various clinical specimens-Urine, stool, sputum, CSF, other body fluids, semen.

Module -5 **(4 marks)**

Cytogenetics – Karyotyping methods, Banding techniques**,**

Cytology - Collection, Preservation, Fixation and Processing of various Cytological Specimen, routine and special Staining techniques in cytology, FNAC, Flow cytometry Automation in Cytology

Histopathology - Tissue processing and Microtomy, Decalcification, routine and special stains used in Histopathology, Immunohistochemistry,

Module -6 **(3 marks)**

Blood banking - Blood group systems, Blood grouping techniques, Blood collection and processing, Preservation and storage of blood, Blood component preparation, Screening tests, Transfusion reactions

Biochemistry

Module -7 **(5 marks)**

Chemistry of Biomolecules- Proteins, Carbohydrates, Lipids, Bio-membranes, Nucleic acids

Methodology- Photometry, spectrophotometers, fluorimetry, flame photometry, Atomic absorption spectrophotometry, nephelometry. Chromatography, electrophoresis**,** Biosensors, Chemiluminescence

Enzymology – Enzymes, enzyme action, Enzyme assays

Vitamins and Hormones – Classification, metabolic functions, deficiency manifestations, assays

Metabolism – Carbohydrate, Amino acid, Lipid, Purine- Pyrimidine, Hemoglobin, Mineral, Inborn errors of metabolism

Module -8 **(6 marks)**

Biochemical analysis – CSF, Urine, Amniotic fluid, peritoneal fluid, Pleural fluid, Synovial fluid, Semen

Diagnostic Biochemistry - diagnostic tests for- liver diseases, renal diseases, acid-base disorders, Function tests- Pancreatic, Gastric, Thyroid, Cardiac, Feto-Placental,

Renal and pancreatic calculi, Acute phase proteins, Toxicology Analysis

Analytical Systems, Automatic Clinical Chemistry Analyzers, Point Of Care Test (POCT)

Molecular Diagnostic methods

Module -9 **(3 marks)**

PCR and its modifications including nested PCR, Multiplex PCR. Real-time PCR. hybridization techniques, recombinant DNA technology, Molecular probes, DNA finger printing, DNA sequence analysis

Laboratory organization

Module -10 **(3 marks)**

Different levels of laboratories, Basic requirements and functions of a laboratory, Purchasing of equipment and chemicals, National and international accreditation of laboratories, CLSI standards, Laboratory safety, Quality control, Laboratory management, ethics, universal safety precautions, Biomedical waste managements.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.