

Health Department

Drugs Control Laboratory Bihar

Syllabus for Assistant Microbiologist

Format of Examination-

1. All questions will be multiple choice questions (MCQ) type.
2. Each multiple-choice questions (MCQ) will carry four (04) marks for each correct answer.
3. There will be negative marking for incorrect answer, one (01) mark will be deducted for each incorrect answer.
4. Total duration- 02 hours.

Sr. No.	Topics	Marks	Questions
1	General Microbiology	40	10
2	Biochemistry	40	10
3	Molecular Biology	40	10
4	Immunology	40	10
5	Medical Microbiology	80	20
6	Fermentation Technology	80	20
7	Bio-Instrumentation	80	20
Total		400	100

*****Note: Marks distribution may vary from each unit.**

1. General Microbiology:

History and scope of microbiology. Overview of microorganisms, Extremophiles, Classification of bacteria. Bergey's Manual of Systematic Bacteriology, Microbial diversity. Microbial culture collections.

Morphology and structure of bacteria, Cultivation of bacteria- culture media and methods. Aerobic and Anaerobic culture methods. Identification of bacteria. Staining reactions. Cultural, physiological and biochemical properties. Molecular methods for identification. Culture preservation techniques, General structure of viruses. Cultivation of viruses-methods. Viral replication. Fungi - properties and classification.

Microbial growth and factors affecting microbial growth, Microbial growth curve, Continuous and batch culture, Diauxic and synchronous growth. Measurement of bacterial growth, nutritional types of bacteria. Microbial locomotion- flagellar motility, gliding motility and amoeboid motion. Chemotaxis, Phototaxis and other taxes. Microbial photosynthesis.

Sterilisation- Principle and methods, physical and chemical methods. Disinfectants- mode of action. Testing of disinfectants. Antibiotics- mechanism of action. Drug resistance in bacteria and the mechanisms. Antibiotic sensitivity tests.

2. Biochemistry:

Structure and functions of monosaccharides, disaccharides and oligosaccharides. Polysaccharides- homoglycans and heteroglycans, Glycolipids, Glycoproteins and Lectins.

Classification of lipids, structure and functions of lipids, Complex lipids- phospholipids. Ceramides and sphingomyelins. Eicosanoids, prostaglandins, thromboxanes, leukotrienes, Types and functions of plasma lipoproteins. Amphipathic lipids -membranes, micelles, emulsions and liposomes. Steroids -cholesterol structure and biological role bile acids, bile salts. Sterols in Plant system, Brassinosteroids, Sterols in microbial system.

Classification and functions of amino acids and proteins, Isolation, fractionation and purification of proteins. Denaturation and renaturation of proteins. Primary, Secondary tertiary and quaternary structures of proteins, Ramachandran plot, Structure and function of Collagen and Hemoglobin, Enzymes- Different classes and functions. Enzyme structure, Classification of enzymes, mechanism of enzyme action, Enzyme kinetics, Estimation of enzyme activity, enzyme assays. specific activity, Allosteric enzyme. Enzyme Inhibition and Types of Inhibition.

Structure of DNA, types of DNA, Higher order organization of DNA. isolation and purification of DNA, Cot value curve, Reassociation kinetics, Structure and types of RNA, Structure and function of mRNA, tRNA and rRNA, Si RNA and micro RNA. DNA sequencing methods, next generation sequencing technologies.

Types, structure and biochemical functions of Vitamins, deficiency diseases and daily requirements. Hormones- types, structure and biological role. Disorders. Mechanism of action of peptide and steroid hormones.

3. Molecular Biology:

DNA replication, Okazaki fragments, DNA polymerases of eukaryotes and prokaryotes, Primosome, SSB, Helicase, Ligase, repetitive DNA sequences. DNA protein interaction, DNA Linking number and topoisomerase, Inhibition of replication.

Transcription, RNA polymerases of prokaryotes and eukaryotes, sigma factor, Rho dependant and Rho independent termination. Enhancers, Transcription factors, Differences in transcription between prokaryotes and Eukaryotes, post transcriptional modifications- Polyadenylation, capping, r-RNA processing, Splicing-Spliceosome, Ribozyme, inhibitors of Transcription. Gene regulation in prokaryotes, Transcriptional regulation in prokaryotes; Inducible and repressible system, Operon concept, structure of Lac, Trp, Ara operon, Catabolic repression, Attenuation. Role of Hormones in gene regulation.

Translation, genetic code, ribosomes in eukaryotes and prokaryotes, aminoacyl t-RNA synthetases, initiation complex, peptidyl transferase, releasing factors, prokaryotic and eukaryotic translation, inhibition of translation. Post translation modifications, Protein targeting.

Recombinant DNA Technology, enzymes used in genetic engineering, TA cloning, and homopolymer tailing, prokaryotic vectors, Construction of genomic libraries and cDNA libraries, recombinant selection and library screening, PCR and types of PCR, synthesis of DNA. Plant genetic transformation methods, Use of transgenic Technology for improving quality, quantity and storage life of fruits and vegetables. Engineering metabolic pathways, Animal cell culture and methods used, Animal cloning, Ethics of cloning.

4. Immunology:

Infection- types of infection. Immunity- types of immunity. Organs and cells with immune functions, Phagocytosis, innate and adaptive immunity - mechanisms, PAMPs and PRR

Antigens, Epitopes, Antigenicity and Immunogenicity. Antibodies and paratopes, Immunoglobulin- structure, classes and functions. Antigen-antibody reactions, Agglutination, Precipitation, immunofluorescence. Complement fixation, Radioimmuno assay. ELISA, Western blotting.

Humoral and cell mediated immune response, T cell receptor and B cell receptor, MHC, Antibody production, Primary and secondary immune response, Clonal selection theory. Monoclonal antibodies- production and application, Antibody engineering. Complement system, Complement activation. Biological effects of complements, Antigen processing and presentation, Cytokines. Human microbiome and immunity

Immunology of organ and tissue transplantation, Immunology of malignancy, Tumor antigens, Immunotherapy of cancer, Immunohematology, ABO and Rh blood group system, Immunology of blood transfusion. Hemolytic disease of new born

5. Medical Microbiology:

Properties, Pathogenicity and laboratory identification of bacteria - Staphylococci, Streptococci, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium, E.coli, Proteus, Klebsiella, Shigella, Salmonella, Vibrio, Mycobacterium and Treponema

Properties, Pathogenicity and laboratory identification of - Pseudomonas, Haemophilus, Brucella, Bordetella, Yersinia, Helicobacter, Leptospira and Actinomycetes

Properties, pathogenesis and laboratory diagnosis of diseases caused by important human viruses- V-Z virus, Polio, Rabies, Influenza, Hepatitis, HIV, Dengue and SARS-CoV-2.

Mycoses, pathogenesis and laboratory diagnosis of superficial, cutaneous, subcutaneous and systemic fungal infections. Opportunistic fungal infections. Life cycle and pathogenesis of protozoan diseases- Amoebiasis, Malaria and Leishmaniasis

6. Fermentation technology:

Microbial growth and growth kinetics- Batch culture, specific growth rate, substrate saturation constant, yield coefficient, Monod kinetics, substrate affinity, Continuous culture, Dilution rate, Washing out, Fed batch culture maintenance coefficient, Product yield, growth depended products non growth linked products. industrial sterilization, Direct, indirect methods, Death Kinetics

Bioreactor Parts - function of each part, probes, valves, agitators, aerators, baffles. Reactor performance, oxygen transfer in reactor system, Resistances against oxygen transfer, KLa, methods to estimate KLa. Heat transfer in Bioreactor systems. Overall heat transfer coefficient. Heat exchangers, Instrumentation of bioreactor online and offline control. pH probe, temperature probe, DO probe, Tachometer. Load cells Control of Bioreactor, Types of control, feed forward control, cascade control, adaptive control, complex control systems, PID control systems. Computer application on the control of Bioreactor

Isolation and purification of enzymes, Characterization of enzymes, Application of enzymes in bioprocess. Diagnostic and therapeutic enzymes.

7. Bioinstrumentation:

Principle, Instrument Design, Methods and Applications of UV-Visible spectroscopy, Infrared spectroscopy, Raman Spectroscopy, Fluorescence spectroscopy, Nuclear magnetic Resonance Spectroscopy.

Principle, Instrument Design, methods and Applications of Chromatography- Paper chromatography, Thin layer chromatography, High Performance Thin layer Chromatography, Gel filtration chromatography, Affinity chromatography, Ion-exchange chromatography, High Pressure Liquid Chromatography. Reversed phase chromatography, Hydrophobic interaction chromatography, Chiral chromatography, Counter current chromatography, Fast protein liquid chromatography, Two dimensional chromatography. GC-MS, LC-MS/MS

Principle, Instrument design, Methodology and Applications of Electrophoresis- Gel electrophoresis, Poly Acrylamide gel electrophoresis, SDS PAGE, Capillary electrophoresis, Isoelectric focusing, Potentiometry, pH meter, Conductometry. Centrifugation and Ultracentrifugation- Basic principles, Centrifugation, techniques-principle, types and applications.

Principle and working of Compound microscope, Phase contrast microscope, Interference microscope, Fluorescence microscope, Polarizing microscope, Scanning and Transmission Electron Microscopy, Atomic force microscopy and Confocal microscopy.