

DETAILED SYLLABUS FOR THE POST OF MICROBIOLOGIST (BACTERIOLOGIST) IN Kerala Water Authority)

Module 1: Fundamentals of Microbiology (10 marks)

Historical developments in microbiology, contributions of Leuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming and Edward Jenner. differences between eukaryotes and prokaryotes, Diversity of microbial world, types of microorganisms, classification of bacteria, Bergey's manual, biochemical and molecular identification of bacteria, archaebacteria and eubacteria. Ultrastructure of bacterial cell, parts of bacterial cell, cell wall components, cell membrane, inclusion bodies and surface structures. Antibiotics – classification, mode of action, drug resistance mechanisms, antibiotic sensitivity tests, Public health measures for the prevention and control of bacterial infections: sanitation, hygiene, surveillance. Importance of antimicrobial stewardship in healthcare settings.

Module 2: Culture Methods, Staining and Microscopy (10 marks)

Culture media and culture methods, isolation of pure cultures. Stains – acidic, basic, and neutral stains. Staining techniques - simple staining, differential staining- Gram stain and acid-fast stain. Structural staining- endospore, flagella, capsule granule and negative staining. Parts, working principle and applications of Bright field, Dark field, Phase contrast, Fluorescence, Confocal and Atomic Force Microscopy, Scanning Electron Microscopy and Transmission Electron Microscopy. Specimen preparation for electron microscopy- ultra sectioning, shadowing, negative staining and freeze etching.

Module 3: Bacterial Physiology and Metabolism (10 marks)

Bacterial Nutrition, nutritional types of bacteria, Preservation and transport of bacteria. Growth requirements and conditions influencing the bacterial growth, Bacterial growth curve- lag phase, log phase, stationary phase, death phase, growth kinetics, cell division, sporulation, germination. Enumeration and quantification of bacteria. Microbial photosynthesis. Microbial life in extreme environments. Enzymes, factors affecting enzyme activity, transition state in enzyme catalysed reactions, high energy compounds- ATP and GTP, role of NAD and NADPH. Bacterial metabolism- Carbohydrate metabolism- glycolysis, alcoholic fermentation, TCA cycle, electron transport chain, substrate level and oxidative phosphorylation, pentose phosphate pathway. Transamination and Nitrogen fixation.

Module 4: Immunology (10 marks)

Infection, Types of Immunity- innate immunity and acquired immunity, Cells and organs involved in immune response Antigens- types and properties, Haptens, Adjuvants, Immunoglobulins- Structure, types and properties. Complement- functions of complement, components and pathways, Major histocompatibility complex, Antigen-antibody reactions- precipitation and agglutination reactions, complement fixation, Neutralisation reactions, Immunofluorescence, ELISA, RIA and Western blot. Humoral Immune response, plasma cells and antibody secretion, Monoclonal antibodies, cell-mediated immune response- Cytokines, natural killer cells and antibody-dependent cell-mediated cytotoxicity, Immunohaematology- Blood groups. Blood transfusion- Rh incompatibilities, Hypersensitivity Reactions- Type I, II, III and IV. Transplantation Immunology- Types of grafts. Autoimmunity.

Module 5: Microbial Genetics (10 marks)

Bacterial chromosome- structure, Experiments to prove DNA as genetic material, DNA replication, Extrachromosomal genetic material, Plasmids – structure and replication, Transposons –types, mechanism of transposition. Genetic exchange mechanisms in bacteria, - Conjugation, Transformation and Transduction. Mechanisms of antibiotic resistance transfer in bacteria. Gene expression in prokaryotes - Central Dogma, Mechanisms and enzymes involved in transcription and translation. Control of gene expression in Prokaryotes – Induction, Repression, Positive Control, Negative Control –Lac operon. Mutation – Spontaneous and Induced, Mutagens- Physical and Chemical agents. Auxotrophs. Reversion and suppression. Ames test, DNA repair mechanisms in bacteria- Excision Repair and SOS repair. Methods to study unculturable bacteria – metagenome, Microbiome

Module 6: Bioinstrumentation and molecular biology techniques (10 marks)

Basic principles and applications of centrifugation. Basic principle and applications of different types of electrophoresis - AGE, PAGE and SDS-PAGE. Two-dimensional electrophoresis. Basic principles and applications of colorimetry and turbidometry, Spectrophotometry: Principles and application –UV, Visible Spectrophotometry, Beer Lambert's Law. PCR- components and principle, types of PCR- mechanisms and application, RT-PCR, Principles of ribotyping, RFLP, RAPD, DNA fingerprinting, DNA footprinting, and DNA sequencing.

Module 7: Industrial microbiology(10 marks)

General concepts of industrial microbiology. Fermentation, types of fermentation -single, batch, continuous, dual or multiple, solid- state and submerged fermentation. Industrial strains– characteristics and isolation techniques, primary and secondary screening methods, strain improvement. Fermentor- parts of stirred tank fermentor, Fermentation media,

sterilization, control of foaming, product recovery, and purification. Industrial products derived from microbes, organic acid—citric acid, industrial enzymes amylase and proteinase. amino acid - glutamic acid and lysine. Antibiotics- penicillins and streptomycins. Immobilization of microbes and enzymes- methods used.

Module 8: Food Microbiology (10 marks)

Role of microbes in food industry - Molds, yeasts and bacteria. Principles of food preservation, physical methods- high temperature - low temperature – drying, chemical additives-organic acids and their salts, nitrites and nitrates, sulfur dioxide and sulfites, wood smoke. Spoilage of vegetables and fruits, meat and meat products, milk and milk products, fish and seafood and poultry products, Spoilage of canned foods. Foodborne infections, food poisoning and intoxications. Microbiological examination of food and Milk – MBRT test. HACCP- definition and principles. Role of microbes in the production of bread and vinegar. Alcoholic beverages- wine, beer, cedar. Fermented vegetables. Fermented - milk and milk products- butter, cheese, Probiotics, Prebiotics, Microbial cells as food, single cell proteins.

Module 9: Medical microbiology (10 marks)

Beneficial and harmful microbes. Properties, Pathogenicity and laboratory identification of - *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 *Actinomycete*. Prevention and Control of Bacterial Infections. Vaccines against pathogenic bacteria.

Module 10: Microbiology of air, water and soil (10 marks)

Microbial contamination of air, Enumeration of bacteria in air, Air sampling devices. Microbiology of water, Water pollution and water borne pathogens, Bacteriological

examination of water, Indicator organisms. Purification and disinfection of water, Microbiology of sewage, Waste water treatment, BOD, COD. Microbial flora of soil and role of microorganisms in nitrogen, carbon, phosphorus, sulphur and iron cycles. Microbial interaction with plants, Endophytes, PGPR and their mechanisms of plant growth promotion, Plant Microbiome, Biofertilizers, Microbial control of pests and diseases, Integrated pest management. Composting, biogas, biodegradation, bioremediation, Bioleaching

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.