

**DETAILED SYLLABUS FOR THE POST OF
MICROBIOLOGIST IN FOOD SAFETY (GOVT. ANALYTICAL
LABORATORY)
(Category No.: 055/2019)**

Module 1 -General Microbiology (10 Marks)

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

Module 2 -Biochemistry (10 Marks)

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.

Module 3 -Molecular Biology (Total – 10 Marks

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, Rihozyme, inhibitors of Transcription. Gene regulation in prokaryotes, Transcriptional regulation in prokaryotes; Inducible and repressible system, Operon concept, structure of Lac, Trp, Arc 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.

Module 4 - Immunology (10 Marks)

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

Module 5 - Food Microbiology (10 Marks)

Microorganisms associated with food, Factors influencing microbial growth in food, Intrinsic and extrinsic factors, implicit and processing factors, Probiotics, Prebiotics, Synbiotics, Cobiotics, Health benefit and mechanism of action of probiotics, SCP, Edible mushrooms, Microbial spoilage of food, Food preservation - physical and chemical methods of preservation, natural food preservation

Hurdle effect, HACCP, Lactic acid bacteria, Homo and hetero fermentative lactic acid bacteria, Microbiology of cultured dairy products, Yogurt manufacture, cultured butter milk, Sour cream, Kefir and microbiology of kefir grains, cheese, structural model of casein micelle, role of chymosin, steps in cheese making with role of microorganisms, types of cheese and cheese ripening.

Microorganisms in the preparation of traditional fermented food, vegetable fermentation, Microbial succession during production of fermented vegetables, Manufacture of sauerkraut, kimchi, cucumber fermentation, Soy sauce production, Temph fermentation. Microbial Enzymes in Food Industry

Food borne infections and intoxications, Mycotic poisoning and mycotoxins, Prevention of food borne outbreaks, Laboratory testing of food borne outbreaks. Lab methods

for the analysis of microbiological quality of milk and food. Methods for the detection of aflatoxin

Module 6 - Industrial Microbiology (Total – 10 Marks)

Fermentation, Industrial fermentations. Types of fermentation: Batch, fed batch, continuous, dual and multiple, submerged and solid substrate fermentation. Isolation and screening of industrially useful microorganisms, Primary and secondary screening, Strain improvement- methods used, Inoculum development

Fermenter parts, design and construction. Antifoam agents and devices. Bioreactors used for solid state fermentation Sterilization of media and fermenters Downstream processing-methods used, cell harvesting techniques, Solid –liquid separation, Cell disruption techniques, Purification of microbial products- methods used

Microbial processes for the production of alcoholic beverages - ethanol, beer, wine, distilled liquors, processes for the production of acetone, butanol, citric acid, acetic acid, lactic acid and baker's yeast

Microbial processes for the production of penicillin and alkaloids. Microbial production of vitamins and amino acids. Microbial transformation of steroids. Microbes in mineral leaching and metal concentration, Microbial enhanced oil recovery, Microbial enzyme technology industrially useful microbial enzymes. Immobilization of enzymes and cells- methods used

Module 7 - Medical Microbiology Total – 10 Marks

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

Module 8- Dairy Microbiology (10 Marks)

Milk – composition and classes of milk, Factors influencing microbial growth in milk, antibacterial properties and system of milk. Defects and spoilage of milk

Preservation of milk and milk products –methods used and principle involved, Asepsis, removal of microorganisms, anaerobic conditions, high and low temperature, drying, irradiation, chemical and bio preservatives and food additives

Market milk and milk products, condensed and dry milk products, frozen desserts, Fermented Dairy Products, Starter cultures used, Products -cream, Cheese, yogurt, butter and indigenous dairy products of India – probiotic dairy products

Milk-borne diseases and pathogens transmitted through milk and milk products. Quality analysis of milk- SPC, MBRT, alkaline phosphatase test, Resazurin test, clot on boiling test, titratable acidity, butter fat content test - FSSAI standards of milk

Module 9 -Fermentation technology (10 Marks)

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, K_La , methods to estimate K_La . Heat transfer in Bioreactor systems. Overall heat transfer coefficient. Heat exchangers, Instrumentation of bioreactor online and offline control. pH probe, temperature probe, DO probe, Tacchometer, 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-application of lactase in diary industry, use of proteases in food, leather and detergent industry. Diagnostic and therapeutic enzymes

Module 10 - Bioinstrumentation**(10 Marks)**

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.

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