

Syllabus for Assistant Professor (Microbiology)

General Microbiology and Microbial Physiology History of Microbiology. Contributions of Scientists. Types, applications, and the importance of microscopy. Structure of microbial cells. Methods of sterilization: Physical methods – chemical methods and their application. Pure culture techniques. Preservation methods and Maintenance of Microbial cultures.

Microbiological media and cultivation of microorganisms. Microbial identification methods. Principles of bacterial taxonomy and classification. Microbial growth curve. Measurement of Growth. Synchronous cultures – methods of synchronous culturing. Continuous culturing methods, factors affecting growth. The phenomenon of bacterial sporulation.

Cell and Molecular Biology, Virology DNA structure, types and replication, Structure and types of RNA. Transcription and translation. Concept of the ribozyme. Genetic code and Wobble hypothesis, Gene regulation. Cloning and expression vectors. Construction and screening of genomic and cDNA libraries.

Types of mutagens, molecular basis, and analysis of mutations, site-directed mutagenesis. DNA damage and repair mechanisms. Recombination in bacteria by Transformation, Conjugation, Transduction. Transposable elements. Cell cycle and programmed cell death. Signal transduction, Protein folding & roles of Molecular chaperones.

Structure of viruses. Cultivation of viruses. Structure, genetics, and Replication of Bacteriophages (Lytic and Lysogenic cycle), Plant Virus (TMV), Animal/human viruses (eg. Influenza virus, HIV and Adenovirus). Viral Interference and Interferons. Biochips. DNA markers: RFLP, Micro/mini-satellites, SNPS, RAPDs and AFLP. Fingerprinting. DNA sequencing. Expression of recombinant proteins Protein-protein and protein-DNA interaction. Applications of recombinant DNA technology and Gene therapy.

Biochemistry and Techniques

pH and it's biological relevance. Redox potentials, Electron transport, oxidative phosphorylation. Microbial respiration and fermentation. Classification, properties and chemical structure of carbohydrates and lipids. Classification, Properties, and structure of amino acids and proteins. Biosynthesis and degradation of amino acids and proteins. Metabolism of carbohydrates and lipids – glycolytic pathways, TCA cycle, gluconeogenesis, glycogenesis. Biosynthesis of triacyl-glycerols and oxidation of fatty acids.

Enzymes – nomenclature, classification, methods for determination of enzyme activity. Enzyme kinetics – Michelis-Menton kinetics. Optical methods – colorimetry and spectrophotometry, fluorimetry, optical rotation, Circular dichroism, NMR, ESR spectroscopy, X-ray diffraction, types of mass spectrometry. Chromatographic techniques, diffusion, dialysis, cell disruption methods, centrifugation techniques, electrophoreses, and blotting techniques. Radioisotopes – detection and measurement.

Immunology Components of the immune system, Clonal selection theory. Antigen and antibody structure. Major Histocompatibility Complex (MHC) and transplantation. Antigen and antibody reactions. Immune response to infectious diseases. Hybridoma technology. Hypersensitivity, Tumor immunology, Immunological tolerance, and immunosuppression. Immune deficiency diseases. Immunotherapy of infectious diseases. Vaccines and Immunization.

Biostatistics: Variations and frequency distributions, measures of central tendency and dispersion, standard deviation, standard error, elements of probability, correlation and linear regression. Normal curve test, 't' test, 'F' test, 'Z'-test, ANOVA, Chi-square test, and confidence intervals. Experimental designs using statistical tools.

Bioinformatics: Basics of computers, Disk operating systems (DOS), Windows, MS office, information networking. Databases, Sequence and structure analysis of DNA and Proteins. Primer design. Protein engineering and drug designing. Tools and packages of networking. Industrial Microbiology Exploitation of microbes and industrial products.

Types of fermentations, Detection, and an assay of fermentation products. Scale-up of fermentations, Product recovery methods, Strain development strategies. Immobilization methods. Fermentative production of Ethanol, beer, wine, Antibiotics, citric acid, Vitamin B12, Glutamic acid, and microbial enzymes. Steroid Biotransformations – Principles of vaccine production.

Microbial biopesticides, Microbial products from genetically modified (cloned) organisms eg. Insulin. QA, QC, GLP, GMP, Patents & IPR Medical Microbiology Principles of Medical Microbiology, Normal flora of the human body.

Properties of pathogenic microorganisms. Bacterial, viral, fungal and parasitic infectious diseases (air born, water-born, food born, insect born and zoonotic infections).

Principles of diagnostic microbiology. Systematic Medical Microbiology – β -Haemolytic streptococci, Mycobacterium tuberculosis, Neisseria gonorrhoea, E.coli, Salmonella typhi. Staphylococcus aureus, Clostridium tetani, Pseudomonas, HIV, Polio, Rabies and Amoebiasis, Malaria and Trichomoniasis and Fungal diseases. Medical diagnostics.

Mode of action of important drugs – Cell wall inhibitors (Betalactam – eg. Penicillin), membrane inhibitors (polymyxins), macromolecular synthesis inhibitors (streptomycin), Antifungal antibiotics (nystatin). Drug resistance. Antiviral agents. Microbiological assays. Food, Environment and Agriculture Microbiology.

Dairy Microbiology. microbiological examination of fresh and canned foods. Fermented foods, spoilage of foods and food preservation methods. Current and future implications concerning food safety, hazards, and risks. Microbes and animal interactions – Rumen Microbiology, termite microbial communities. Probiotics, Prebiotics, and their significance in human beings and animals. Microorganisms in air, water, and soil and their importance. Microbial diversity in the environment.

Microbial mineralization and C, N, S, P, and Fe cycles. Soil humus formation. Rhizosphere, mycorrhiza, and phyllosphere. Microbial degradation of carbonaceous materials in the soil. Biology and biochemistry of Nitrogen fixation. Biofertilizers, Biopesticides, Persistence, and the degradation of pesticides, herbicides, fungicides, and insecticides. Sewage treatment and bioremediation.