



# **Syllabus for Ph.D., Entrance Examination**

## **Microbiology**

### **Faculty of Applied Science & Technology**

#### **General Microbiology:**

Bacteria: Origin of life, Structure of bacteria: Cytoplasmic and outer membrane, capsule, flagella, pili, endospore and special organelle. Gram-negative, Gram-positive and acid-fast bacteria, Culture of Bacteria: aerobic, anaerobic and facultative. Isolation of pure culture and its characteristics, Nutritional types, culture media, Strategies of cell division, growth kinetics, generation time, asynchronous, synchronous, batch, continuous culture, measurement of growth and factors affecting growth. Control of bacterial growth - physical and chemical agents, preservation methods, stress responses. Study of bacterial growth, kinetics, effect of inhibitors and stimulators on growth, Characterization of bacteria: shape, Gram stain, endospore stain, capsule stain, acid fast stain, flagella stain, Assay of antibiotic, MIC & MBC. microbiological media.

Virus: Nomenclature and classification, Morphology and ultrastructure: capsids and their arrangements, types of envelopes and composition, Genome: types and structures. Subviral particles: viroids, virusoids, prions, Lytic and Lysogenic Cycle.

Fungi: General characteristics, somatic structure, classification, and method of identification (classical and molecular approach), thallus organization, Symbiotic association and parasexual life cycle, Asexual and sexual reproduction of fungi, Growth and its measurement, Mycorrhiza - ecto, endo, and VA mycorrhiza.

Algae: Classification, algal pigments, thallus structure, nutrition, ecology, sexual and asexual reproduction and their importance, SCP, biofuels, food, chemical and pharmaceutically important products.

#### **Biochemistry & Cell Biology:**

Structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). Enzyme kinetics, enzyme inhibition, Allosteric enzyme, Rate limiting enzymes in multistep reaction, ribosome, electron transport chain and oxidative phosphorylation, Pathway and regulation of major metabolism - glycolysis (EMP pathway), TCA cycle, glyoxylate cycle, pentose phosphate cycle. Biological buffers, Biological transport-active and passive, Bio Signaling-Mechanism and role in diseases.

Cell Biology Prokaryotic Cells: cell walls, cell membranes, mechanisms of solute transport across membrane, Flagella and Pili, Capsules, Cell inclusions like endospores and gas vesicles; Eukaryotic cell organelles: Endoplasmic reticulum, Golgi apparatus, mitochondria and chloroplasts

### **Genetics & Molecular biology:**

DNA replication- mechanisms, proteins and enzymes, involved, regulation DNA damage and repair and recombination, DNA damage and repair mechanisms, Recombination- mechanism types and biological roles and practical applications, Transcription- mechanisms, proteins and enzymes, involved, regulation, transcription activator and repressor, cis acting and trans acting elements, RNA polymerases, capping, Rho protein, inhibitors of transcription, Protein synthesis and processing : ribosome, Translation- mechanisms, proteins and enzymes, involved, t-RNA structure, amino acid activation, initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, Post- translational modification of proteins, inhibitors of translation, regulation of gene expression, operon concept, role of chromatin in gene expression and gene silencing, genomic imprinting, Types of mutation; Physical and chemical mutagens; Selection of mutants; Ames test for mutagenesis; Bacterial genetic system: transformation, conjugation, transduction, recombination, plasmids, transposons RNA interference, Principles and procedures of protein and nucleic acid sequencing, southern, northern and western blotting, polymerase chain reaction, RT -PCR, real time PCR, mutagenesis, gel electrophoresis, Nucleic acid sequencing sequencing, pyrosequencing, RFLP and RAPD, SNP, VNTR analysis, Restriction enzymes. vectors. gene cloning. gene therapy.

### **Immunology:**

Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. Epitope and paratope, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antigen-antibody interactions, MHC molecules, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell mediated immune responses, primary and secondary immune response, the complement system, inflammation, hypersensitivity and autoimmunity, immunity to infections.

### **Medical and Diagnostic Microbiology:**

Epidemiology, symptomatology. General description of microbial pathogens, endotoxins and exotoxins, diagnosis, prevention and therapy of - meningitis, tuberculosis, leprosy, urinary tract infection, cholera, ring-worm, syphilis, diphtheria, mycotoxicosis, opportunistic fungal pathogens, dermatophytes, malarial parasite, Giardia and Leishmania, Types of vaccine: live microorganism, attenuated organism, genetically modified organism, protein, edible, synthetic, recombinant and anti-idiotypic vaccine.

### **Fermentation Technology Industrial microbiology:**

Types of Fermentation, bioreactor configurations, storage tank, bubble column, airlift reactor, stirred and air driven reactors, packed bed, fluidized bed, trickle bed, monitoring and control of bioreactors, Ideal reactor operation: batch, fed-batch, and continuous operation. Downstream processing: filtration, centrifugation, cell disruption, ideal stage concept, aqueous two-phase liquid extraction, adsorption, chromatography, Solid state fermentation'

### **Environmental Microbiology:**

Environmental complex, interaction of ecological factors: light, temperature, precipitation (rainfall), humidity of air, atmospheric gasses and wind; topographical factors, edaphic factors, Extremophile: anaerobes, halophiles, acidophile, alkaliphile, thermophile, barophile, Community structure and organization, Aeromicrobiology: Microbes of indoor and outdoor environment, pathways, enumeration, Extramural and intramural, control, bioterrorism' Eutrophication, Biosafety, Water microbiology: Significance of microbes in water quality, Test for potability of water, Microbial treatment of sewage: application of wastewater in land. composting of biosolids and domestic solid waste.

### **Pharmaceutical Microbiology:**

Antibiotics (antibacterial and antifungal): classification, mode of action, mechanism of resistance to antibiotics. Probiotics: Characteristics of Probiotic organism, application for curing enteric disease and induction of host immunity.