

---

## **Syllabus for PhD entrance Examination: MICROBIOLOGY**

### **General**

1. Classification of Microorganisms: Haekel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese, classification and salient features of bacteria according to Berger's Manual of Determinative Bacteriology.
2. Morphology and ultra structure of bacteria: size, shape, and arrangement of bacteria, ultra structure of bacterial cell wall of eubacteria and archeobacteria. Protoplast and spheroplast formation and L-form.
3. Components external to cell wall: Structure and function of flagella, fimbriae and pilli, capsule- types, composition and function, slime layers, S-layers.
4. Prokaryotic cell membrane and cytoplasmic matrix – cell membrane structure and function of bacteria and archeobacteria, mesosomes, ribosomes, cytoplasmic inclusion bodies (polyhydroxy butyrate, polyphosphate granules, oil droplets, cyanophycin granules) and nucleoid.

### **Nutrition**

1. Bacterial nutrition: Basic nutritional requirements, growth factors, nutritional categories, physical requirements of bacterial growth.
2. Bacteriological media: types (complex, synthetic, differential, enrichment and selective media) and their uses, culture characteristics of bacteria on different media.
3. Cultivation of bacteria: aerobic and anaerobic culture, pure culture techniques, shaker and still culture, maintenance and preservation of microbial culture.
4. Bacterial growth: growth kinetics, growth curve. Batch, continuous and synchronous culture. Measurement of growth and influence of environmental factors affecting growth.

### **Viruses**

1. General properties of viruses, morphology and ultra-structure of viruses, capsid and their arrangements, types of envelopes and their composition, measurement of viruses.
2. Viral genome; their types and structure, viral related agents-viroids and prions.
3. Cultivation of viruses- in embryonated eggs, experimental animals and cell lines; primary and secondary cell lines, diploid cell culture.
4. Plant viruses: recent advance in classification of plant viruses. Structure and pathogenicity of TMV.
5. Transmission of plant viruses with vector (insect, nematodes and fungi) and without vector (contact, seed and pollens). Biochemical changes induced by virus in plant cell.

### **Fungi**

1. Structure, reproduction and classification of fungi, general characteristics of Zygomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes.
2. Cultivation of fungi, culture media for fungal growth, effects of environment on growth, isolation, identification and preservation of fungi.
3. Dimorphic fungi, yeast morphology, general characteristics and reproduction. Lichens, Mycorrhiza, and Actinomycetes.

### **Instrumentation**

1. Microscopy: history and principles of microscopy, properties of light, magnification power, resolution limit, resolving power, numerical aperture.
2. Principles and applications of light microscopy, bright field, dark field, phase contrast and fluorescent microscopy. Determination of size of microorganisms by micrometry.
3. Principles and application of electron microscopy- transmission and scanning electron microscopy. Fixation and staining techniques in electron Microscopy.
4. Chromatography: Principles, types and applications of partition, paper and thin layer chromatography.
5. Adsorption and Gel filtration chromatography: Principle, matrix, column packing and applications.
6. Affinity, ion exchange, and Gas chromatography: Principle and applications.

7. Electrophoresis: principle, types and applications of Paper, Starch gel and Agarose gel electrophoresis.
8. Polyacrylamide Gel Electrophoresis: Native PAGE and SDS-PAGE.

### **Genetics**

1. Structure of DNA, super helicity of DNA, linking number, topological properties and role of topoisomerase. DNA denaturation and renaturation.
2. DNA damage and repair: types of DNA damage (deamination, oxidative damage, alkylation and pyrimidine dimers), repair mechanism; mismatch repair, nucleotide excision repair, recombination repair, SOS repair.
3. DNA replication: general principle, various mode of replication, unwinding of DNA helix, continuous and discontinuous synthesis of leading and lagging strands.
4. Structural features of RNA (rRNA, tRNA, mRNA) and polycistronic and monocistronic RNA.
5. Transcription: general principle and processes of transcription; initiation, elongation and termination, types of RNA polymerases, inhibitors of RNA synthesis.

### **Immunology**

1. Anatomical organization of immune system: primary and secondary lymphoid organs: structure and function.
2. Antigens- structure and properties, factors affecting the immunogenicity, properties of B and T- cell epitopes, haptens, mitogens, super antigen, adjuvants.
3. Antibody: structure, properties, types and function of antibodies, antigenic determinants on immunoglobulin; isotypes, allotypes, and idiotypes, molecular mechanism of antibody diversity and class switching.
4. Cell mediated immunity and its mechanism.
5. Major histocompatibility complex: organization of MHC genes, types and function of MHC molecules, antigen presentation, MHC polymorphism, MHC related diseases.
6. Complement system: components, activation pathways, regulation of activation pathways and role of complement system in immune response.

### **Recombinant Technology**

1. Enzymes used in DNA technology: Restriction and modification enzymes, nucleases, polymerases, ligase, kinases and phosphatases. Linkers and adapters.
2. Cloning techniques: DNA isolation (Bacteria, Fungi, Plant and animal), Insert preparation, Ligation, Transformation methods (chemical methods, Electroporation and microinjection), Transfection.
3. DNA Sequencing: Sangers method, Maxam Gilbert method, Thermocycle sequencing and Pyrosequencing
4. Principles of hybridization and hybridization based techniques: Colony, plaque, in-situ Hybridization, Southern, Northern, Western blotting.
5. Oligonucleotide synthesis, Restriction mapping, S1 nuclease and RNase mapping.
6. Polymerase Chain Reaction (PCR): Principle, Types and variants of PCR (Touch-Down PCR, Hot start PCR, Inverse PCR, RT-PCR, multiplex PCR, nested PCR), Real time PCR.