

SYLLABUS FOR ADMISSION TEST TO Ph.D PROGRAMME:
Departments of Biotechnology, Microbiology, Biochemistry and Bioinformatics

1. BIOMOLECULES AND THEIR BIOCHEMICAL INTERACTIONS:

Structure of atoms, molecules and chemical bonds, pH, buffer, reaction kinetics, thermodynamics, colligative properties, Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins) Stabilizing interactions Bioenergetics, coupled reaction, group transfer, biological energy transducers, Enzymology, isozymes, Conformation of proteins & nucleic acids (DNA & RNA) Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins.

2. CELL BIOLOGY AND SIGNALLING:

Membrane structure and function, Structural organization and function of intracellular organelles, Cell division and cell cycle, Cell signaling, Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, Cellular communication, general principles of cell communication. Cancer Biology

3. MOLECULAR BIOLOGY:

DNA replication, repair and recombination, RNA synthesis and processing, Protein synthesis and processing, Organization of genes and chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons. Regulation of prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

4. IMMUNOLOGY:

Innate and adaptive immune system. Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses; primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies.

5. DEVELOPMENTAL BIOLOGY

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients, cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development. Morphogenesis and organogenesis in animals and plants.

6. SYSTEM PHYSIOLOGY - PLANT

Photosynthesis, Respiration and photorespiration, Nitrogen metabolism, Plant hormones, Sensory photobiology, Solute transport and photoassimilate translocation, Secondary metabolites, Stress physiology. Plant Cell and Tissue culture.

7. SYSTEM PHYSIOLOGY-ANIMAL

Blood and circulation, Cardiovascular System, Respiratory system, Nervous system, Sense organs, Excretory system, Thermoregulation, Stress and adaptation, Digestive system, Endocrinology and reproduction

8. GENETICS:

Mendelian principles, Deviation from Mendelian inheritance, Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests, linkage and crossing over, sex linkage, Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Extra chromosomal inheritance, Microbial genetics, Methods of genetic transfers Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders, Structural and numerical alterations of chromosomes

9. MICROBIOLOGY

History and Scope of Microbiology, Microbial Biodiversity: Prokaryotes and Eukaryotes bacteria, Fungi, Algae, Classification systems, External and internal Structural and chemical composition of cell wall, Microbial Nutrition and growth kinetics, Bacterial Metabolism, Fermentation and anaerobic respiration, Conditions influencing antimicrobial action, Evaluation of antimicrobial agents, Chemotherapeutic agents and antibiotics, mode of action of antibiotics and antifungal agents, Drug Resistance Mechanism of drug resistance. Normal microflora of human body, Host parasite interaction, Nonspecific Defense Mechanisms of Host, Microbial spoilage of food, Food preservation, Food borne diseases, Microbiology of fermented food, Virology, Distinctive properties of Viruses, Viroids and Prions, Virus Purification, Viral nucleic acid and its replication, Capsid and envelope, Bacteriophages Morphology and structure, Replication: Adsorption, Penetration, Synthesis of nucleic acid and protein, Assembly and release. Temperate phages and Lysogeny. Control of viruses: Interferon, Chemical antimicrobial agents and Antiviral antibiotics.

10. EVOLUTION AND ECOLOGY

Principles and methods of taxonomy, Levels of structural organization, classification of plants, animals and microorganisms: Important criteria used for classification in each taxon, Organisms of health and agricultural importance: Common parasites and pathogens of humans, domestic animals and crops, Molecular Evolution, Population genetics, The Environment: biotic and abiotic interactions, Habitat and niche, Population ecology: life history strategies (r and K selection) Species interactions: Types of interactions Community ecology, Ecological succession, Ecosystem, Biogeography: Major terrestrial biomes, Applied ecology, Conservation biology

11. METHODS IN BIOLOGY: Isolation and purification of RNA, DNA and proteins, different separation methods, one and two dimensional gel electrophoresis, isoelectric focusing gels, molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; expression of recombinant proteins using bacterial, animal and plant vectors; generation of genomic and cDNA libraries, in vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms; protein and DNA sequencing methods, methods for analysis of gene expression at RNA and protein level, large scale expression analysis, micro array, PCR, RFLP, RAPD and AFLP techniques. Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction

and NMR, light scattering, different types of mass spectrometry and surface plasma resonance methods Histochemical and immunotechniques: Antibody generation, ELISA, RIA, western blot, immunoprecipitation, flowcytometry and immunofluorescence microscopy, *in situ* localization by techniques such as FISH and GISH. Radiolabeling techniques and safety guidelines. Microscopic techniques: Visualization of cellular components by light microscopy, resolving powers of microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy. Computational methods: Nucleic acid and protein sequence databases, data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation.

12. Applied Biology: Microbial fermentation and production of small and macro molecules. Plant and animal tissue and cell culture methods, Transgenic animals and plants, molecular approaches to diagnosis and strain identification, Genomics and its application to health and agriculture, including gene therapy. Breeding in plants and animals, including marker-assisted selection, Bioremediation and phytoremediation, Biosensors.

13. Statistical Methods: Students t test, Chi Square Test, Probability, ANOVA