

Syllabus for Ph.D Biotechnology Admission

1. **Molecules and their Interaction Relevant to Biology** - Structure of atoms, chemical bonds, and molecules - Principles of biophysical chemistry (pH, buffer, thermodynamics, reaction kinetics, colligative properties). Composition, structure, and function of biomolecules (carbohydrates, proteins, lipids, nucleic acids, and vitamins). Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis. Metabolism of carbohydrates, amino acids, lipids, nucleotides, and vitamins. Conformation of nucleic acids (helix (A, B, Z), micro-RNA, t-RNA). Stability of proteins and nucleic acids
2. **Cellular Organisation** - Prokaryotic and eukaryotic cell structure; Membrane structure and function, Structural organization and function, of the intracellular organelles, Organization of genes and chromosomes, Cell division and cell cycle-Mitosis and meiosis, their regulation, control of cell cycle, and steps in the cell cycle, Microbial Physiology-Growth, yield, characteristics, stress response, strategies of cell division.
3. **Cellular Communication and Signalling** - Host-parasite interaction-Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, pathogen-induced diseases in animals and plants, alteration of host cell behavior by pathogens, virus-induced cell transformation, cell-cell fusion in both normal and abnormal cells. Cell signaling-Hormones and their receptors, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, cell surface receptors, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, bacterial chemotaxis, and quorum sensing.
4. **Molecular structure of genes and chromosomes**- Fundamental Process - Nucleic acid replication, transcription, translation and their regulatory mechanisms in prokaryotes and eukaryotes; Mendelian inheritance; Complementation; Linkage, genetics (plasmids, transformation, transduction, conjugation); Horizontal gene transfer and Transposable elements; Organelle DNA, Satellite-and repetitive DNAs, RNA interference for gene silencing; DNA damage and repair; Chromosomal variation; Control of gene expression at transcription and translation level. Mutations and mutagenesis.
5. **Principles of microscopy**-light, electron, fluorescent and confocal; Centrifugation- high speed and ultra; Principles of spectroscopy-UV, visible, FTIR, Raman, MS, NMR; Principles of chromatography- ion exchange, gel filtration, affinity, GC, HPLC, Electrophoresis; Microarray.
6. **Microbes** - Viruses- structure and classification; Microbial classification and diversity (bacterial, algal and fungal); Methods in microbiology; Kinetics of Microbial growth and nutrition; Aerobic and anaerobic respiration; Nitrogen fixation; Microbial diseases and host-pathogen interaction
7. **Development Biology** -Basic concepts of development. Gametogenesis, fertilization, and early development. Morphogenesis and organogenesis in animals. Morphogenesis and organogenesis in plants. Programmed cell death, senescence, and aging. Micropropagation. Meristem culture and production of virus-free plants. Anther and microspore culture. Embryo and ovary culture. Protoplast isolation. Protoplast fusion-somatic hybrids, cybrid. Synthetic seeds. In vitro germplasm conservation. Methods of gene transfer in plants. Achievements and recent developments of genetic engineering in agriculture.

8. **Plant Physiology** - Photosynthesis Light-harvesting complexes; Respiration and photorespiration –plant mitochondrial electron transport and ATP synthesis; photorespiratory pathway. Stomata and stomatal movement Nitrogen metabolism. Plant hormones. Biosynthesis, Nutrient Uptake, transport, and translocation of water through xylem and phloem; transpiration; Secondary metabolites. Stress physiology. Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature, and salt) stresses.
9. **Animal Physiology** - Blood and circulation, Cardiovascular System, Respiratory system, Nervous system Neurons, Sense organs Vision, hearing, and tactile response. Excretory system – Thermoregulation, Digestive system - Digestion, energy balance, absorption, BMR. Endocrinology and reproduction-Endocrine glands, Stress and adaptation.
10. **Methods in Biotechnology** - Restriction and modification enzymes; Vectors; plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome; mammalian and plant expression vectors; cDNA and genomic DNA library; cloning and expression; Transposons and gene targeting; DNA labeling; DNA sequencing; Polymerase chain reactions; DNA fingerprinting; Southern and northern blotting; RAPD, RFLP; Site-directed mutagenesis; Gene transfer technologies; Gene therapy, DNA fingerprinting
11. **Immunology** - History of Immunology; Innate, humoral and cell mediated immunity; Antigen; Antibody structure and function; Synthesis of antibody and secretion; Antigen-antibody reaction; Complement; Primary and secondary lymphoid organ; B and T cells and macrophages; Major histocompatibility complex (MHC); Antigen processing and presentation; Polyclonal and monoclonal antibody; Regulation of immune response, Hybridoma technology;
12. **Diversity of Life Form** - Principles & methods of taxonomy - Biological nomenclature, Levels of a structural organization-Unicellular, colonial, and multicellular forms. Levels of organization of tissues, organs & systems. Outline classification of plants, animals & microorganisms - Major habitat types of the Indian subcontinent, geographic origins and migrations of species. Organisms of conservation concern-Conservation strategies, Rare, endangered species.
13. **Ecological Principles** - The Environment, Habitat and Niche - Population Ecology - Species Interactions, Community Ecology, Conservation Biology, Applied Ecology & Environmental pollution; Ecological Succession Biogeography Major terrestrial biomes; biogeographical zones of India; Ecosystem Ecology Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (freshwater marine, estuarine); primary production and decomposition.
14. **Evolution and Behavior** - Paleontology and Evolutionary History - emergence of the evolutionary thoughts, Darwin concepts of variation, adaptation, Mechanisms-Origin of cells and unicellular evolution - Origin of basic biological molecules; Brain, Behavior, and Evolution: Molecular Evolution - Concepts of neutral evolution, Molecular tools in phylogeny, classification and identification; gene duplication and divergence.
15. Major Bioinformatics resources and search tools; Sequence and structure databases; Data mining and analytical tools for genomic and proteomic studies