Syllabus

Entrance test for admission to Ph.D. Programme

The Department of Biochemistry

Biomolecules and catalysis

Structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).Physico-chemical interactions in biological systems (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.), Importance of water.Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics). Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. Conformation of proteins, Levels of protein structure, Ramachandran plot, domains, motif and folds, Fibrous and Globular proteins, Structural Features of Membrane. proteins, Protein Folding, Protein engineering. Structure Predictions for Nucleic Acids and Proteins, Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA). Stability of proteins and nucleic acids.Principtes of catalysis, enzymes and enzyme kinetics, Enzyme assays, enzyme regulation, mechanism of enzyme catalysis, isozymes, Multisubstrate enzymes; Multisite and allosteric enzymes, proteomics, application of proteomics for drug discovery, proteomic profiling for host-pathogen interaction, Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins, metabolomics, metabolite profiling in diseases, metabolomics for metabolic pathway structure, metabolic fingerprinting.

Biochemical and Biophysical Techniques

Preparation of buffers, Estimation of biomolecules, Cell Fractionation, Principles of purification, Chromatography: Gel filtration, ion-exchange, hydrophobic interaction chromatography, hydroxyapatite and affinity chromatography, FPLC HPLC, Hydrodynamic methods, Centrifugation, Sedimentation, Molecular spectroscopy, IR, ESR, FRET, Biomolecular fluorescence complementation assay; Chemiluminescance and Phosphoresence, Spectroscopic methods : Absorbance, Fluorescence, Circular dichroism; Electrophoretic methods: Limited proteolysis and SDS-PAGE, gradient gel electrophoresis, 2-D Gel Electrophoresis, immunoblotting; Structural methods : NMR; X-ray crystallography. Radioisotope and their use in biology, autoradiography, radioactive labeling of biological macromolecules, radioimmunoassay, ELISA, immunohistochemistry, immunoelectron microscopy, Flow cytometry, Microscopy, Transformation, Transfection, Animal cell/tissue culture.

Immune system

Cells and molecules involved in innate and adaptive immunity, Hematopoiesis antigens, antigenicity and immunogenicity. Band 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 Band T cells, B and T cell receptors, humoral and cell-mediated immune responses, immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, cytokines, hypersensitivity

and autoimmunity, immune response during bacterial, parasitic and viral infections, microbial pathogenicity, principles of diagnostics, immunodeficiencies, vaccines, Tumor antigens and cancer immunotherapy.

Cell Organisation and Function

Cell theory, Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility, extracellular matrix). Cell division and cell cycle (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle), protein sorting, protein targeting, glycosylation. Cellular signalling, Hormones, Membrane composition, structure and function, Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, transport across membranes, membrane pumps, mechanism of sorting and regulation of intracellular transport, membrane permeability, electrical properties of membranes, molecular assembly of biomembranes, membrane pores, membrane receptors, endocytosis and cell signalling, Hemolysins, Liposome technology and its application in biotechnology, Structure and function of enveloped animal viruses. Organization of genes and chromosomes (Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons, telorneres), chemistry of nucleic acids, DNA replication, repair and recombination, RNA synthesis and processing, RNA editing, RNA transport, Catalytic roles of RNA, Protein synthesis and processing, inhibitors, Post- translational modification of proteins, Control of gene expression (in phages, viruses, prokaryotic and eukaryotic genomes), role of chromatin in gene expression, gene sllencinq, SOS response.

Recombinant DNA Technology

Restriction and Modification enzymes, plasm ids, Cosmid, PAC, YAC and BAC, Biology of Bacteriophage lambda, filamentous phages, DNA sequencing, cloning, Polymerase chain reaction !PCR), Oligonucleotide synthesis, cDNA libraries, Genomic libraries, expression of heterologous proteins, Mutagenesis, Recombinant DNA strategies to study protein interactions.jjveast 2-hybrid system, Bacterial-2 hybrid system, Phage display, Ribosome Display, Cell Display, Protein fragment complementation), study of gene function, microarrays, Next-gen sequencing, Antibody gene cloning and engineering, Micro/si RNA technology, gene transfer, knockouts, gene deletion, expression of recombinant proteins.

Mendelian principles, Concept of gene, Allele, Codominance, incomplete dominance, linkage and crossing over, sex linkage, Gene mapping methods, Linkage maps, Extra chromosomal inheritance, Microbial genetics, transformation, conjugafion, transduction, Polygenic inheritance, Mutations, Structural and numerical alterations of chromosomes, Recombination, transposition.