

## JAIN (DEEMED-TO-BE UNIVERSITY)

### DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

#### Syllabus for PhD Entrance Exam (Biochemistry)

**Bioenergetics and Bioorganic chemistry-** Laws of thermodynamics, concept enthalpy and free energy, high energy compounds, energy harnessing mechanisms in chloroplast and mitochondria. Buffers and mechanism. Stereochemistry in biology. Structure of atom.

**Biomolecules and Metabolism-** Structural aspects of carbohydrates, lipids, amino acid, nucleotides, proteins and nucleic acid. Important pathways for catabolism and anabolism of carbohydrates, lipids, amino acids and nucleotides and regulation.

**Enzymology-** Classification of enzymes, mechanism of enzyme action, rates of reaction, concept of  $K_m$  and  $V_{max}$ , inhibition (types and effect on  $K_m$  and  $V_{max}$ ), enzyme purification and characterization techniques.

**Signal transduction and hormones-** Primary and secondary messengers, signalling pathways (GPCR, RTK and nuclear receptors), mechanisms of downregulation of signalling pathways. Synthesis, secretion and functions of key endocrine hormones. Disorders associated with endocrine system.

**Immunology-** Innate and acquired immunity, Cells involved in immune responses: Lymphoid cells, mononuclear cells, granulocytic cells, mast cells and dendritic cells. Immunogenicity Vs antigenicity, factors influencing immunogenicity, epitopes, haptens, adjuvants and mitogens. Classification, fine structure and functions of immunoglobulins. Monoclonal antibody production and purification. MHCs. antigenicity: humoral and cell mediated immunity. Cytokines, monokines and lymphokines and their function. Complement system: alternate and classical pathway, regulation. Immunization practice: Active and passive, use of toxoids, killed and attenuated organisms. Newer vaccines, production of vaccine

**Analytical Biochemistry-** Preparation of buffers, 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. Spectroscopic methods - Absorbance, Emission principle. Electrophoretic methods - SDS-PAGE, gradient gel electrophoresis, immunoblotting; Structural methods - NMR; X-ray crystallography. Radioisotope and their use in biology, autoradiography, radioactive labeling of biological macromolecules, radioimmunoassay, ELISA..

**Molecular Biology** -DNA replication and repair: Identification of DNA as the genetic material - experimental proofs. DNA repair: Existence of repair systems, direct repair systems, excision repair- base excision and nucleotide excision repair. Transcription: Prokaryotic and eukaryotic transcription steps- initiation, elongation and termination. Posttranscriptional processing; 5' capping, polyadenylation, splicing. Translation: Ribosomes: Prokaryotic ribosomes; molecular components, *in vivo* assembly, dissociation of subunits and polysomes. The operon model: Genes involved in regulation-regulator, promoter, operator and structural gene. *Lac* operon, arabinose operon, tryptophan operon.

**Physiology**- Nervous system, muscular system, digestive system, cardiovascular system, respiratory system, cardiovascular system and excretory system.

**Cell Biology**-cytoskeletal elements, vesicular transport mechanism, cellular junctions, signalling mechanisms- MAP Kinase pathway, NF-kB pathway, Wnt signalling, Functions of cellular organelles. Cell cycle and regulation. Mitosis and meiosis.

**Microbiology**-Basic Techniques in Microbiology,Safety rules in laboratory. Methods of sterilization and disinfection. Handling of autoclave, Hot air oven, BOD incubator, Laminar flow, Colony counter, pH meter, Biological filters; Isolation and preservation of different types of microorganisms; Microscopy: Light, Compound, Dark field, Phase Contrast, Fluorescent, EM, TEM, SEM ; Wet mount, Hanging drop technique, Stains and staining techniques.Types of culture and culture media, Inoculation techniques, Isolation of pure culture, Maintenance and preservation of pure cultures, Culture collections.Identification of bacteria using biochemical tests, Introduction and importance of Bergey's Manual, Bioassay techniques, Antibiotic sensitivity assays.