MC-07
BIOINORGANIC CHEMISTRY, BIOORGANIC CHEMISTRY AND BIOPHYSICAL CHEMISTRY

Max. Marks - 100

Units		Topics
I	(a)	**Biological Cell and its Constituents:** Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coil transition.
	(b)	**Cell Membrane and Transport of Ions:** Structure and Functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport. Never conduction.
	(c)	**Metal Ions in Biological Systems:** Essential and trace metals.
	(d)	**Na+/ K+ Pump:** Role of metals ions in biological processes.
	(e)	**Transport and Storage of Dioxygen:** Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythrin, model synthetic complexes of iron, cobalt and copper.
II	(a)	**Bioenergetics:** Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.
	(b)	**Diffraction Methods:** Light scattering, low angle X-ray scattering, X-ray diffraction and photo correlation spectroscopy. ORD.
	(c)	**Bioenergetics and ATP Cycle:** DNA polymerization, glucose storage, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water. Model systems.
	(d)	**Electron Transfer in Biology:** Structure and function of metalloproteins in electron transport processes cytochromes and ion-sulphur proteins, synthetic models.
	(e)	**Nitrogenase:** Biological nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenases model systems.
III	(a)	**Statistical Mechanics in Biopolymers:** Chain configuration of macromolecules, statistical distribution end to end dimensions, calculation of average dimensions for various chain structures. Polypetide and protein structures, introduction to protein folding problem.
	(b)	**Biopolymer Interactions:** Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes inbiological systems. Hydrogen ion titration curves.
	(c)	**Thermodynamics of Biopolymer Solutions:** Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical system.
	(d)	**Biopolymers and their Molecular Weights:** Evaluation of size, shape, molecular weight and extent of hydration of biopolymers by various experimental techniques. Sedimentation equilibrium, hydrodynamic methods, diffusion, sedimentation velocity, viscosity, electrophoresis and rotational motions.
IV	(a)	**Introduction:** Basic considerations. Proximity effects and molecular adaptation.
	(b)	**Enzymes:** Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots, reversible and irreversible inhibition.

	(c)	**Mechanism of Enzyme Action:** Transition - state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chymotrypsin, ribounclease, lysozyme and carboxypeptidase A.
	(d)	**Kinds of Reactions Catalysed by Enzymes:** Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in isomerization reactions, β - cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.
V	(a)	**Co-Enzyme Chemistry:** Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophoshphate, pyridoxal phosphate, NAD+, NADP+, FEN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofactors.
	(b)	**Enzyme Models:** Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetic chemistry, crown ethers, cryptates. Cyclodextrins, cyclodextrin-based enzyme models, calixarenes, ionophores, micelles, synthetic enzymes or synzymes.
	(c)	**Biotechnological Applications of Enzymes:** Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheese-making, syrups from corn starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA technology.