

Syllabus for Biochemistry PGQP74 (xi)

Introduction to Biochemistry

Understanding of Biochemistry as a discipline.

Fundamental properties of elements, their role in formation of biomolecules and in chemical reactions.

Concepts of mole, mole fraction, molarity, etc.

Unique property of water as a universal solvent.

Fundamentals of Adsorption, Viscosity, Distribution law, Osmotic pressure, etc.

Fundamental laws relating to photochemistry.

Bioorganic Chemistry and Metabolites

Significance of organic reactions

Electrochemistry to conductance, voltaic, and electrolytic systems.

Chemical bonding

Aliphatic and aromatic compounds and IUPAC nomenclature.

Formation of polymers and their importance.

Stereochemistry in determining conformations of biomolecules.

Cell Biology

Structure of cell and various cellular events.

Function of various subcellular organelles.

Cell theory and techniques for fractionation of sub-cellular organelles.

Composition of cytoskeleton and extracellular matrix.

Cell cycle, cell division and cell death mechanisms.

Biochemical Techniques

Chromatographic techniques and their application

Centrifugation and chromatography in biological investigations.

Principles of Electrophoresis, Spectrophotometry and ELISA and their applications.

Biomolecules

Biomolecules present in living cells.

Key contributions of scientists such as Hans Krebs, G. N. Ramachandran, Melvin Calvin, Louis Pasteur, Har Gobind Khorana, Watson etc.

Properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, glycoproteins and glycolipids.

Process of fermentation and manufacture of Biodiesel.

Amino acid and nucleotide sequences of proteins and DNA respectively.

Nutrition

Glycemic index, balanced diet, micronutrient deficiencies and the remedies, nutraceuticals and their importance, junk foods and their hazards.

Need for specialized food for people with special needs - diabetes, pregnancy, inherited genetic disorders.

Use of alternate crops – cereals and pulses and their importance.

Cattle industry and its contribution to greenhouse gases.

Merits and demerits of vegetarian and non-vegetarian foods.

Metabolism

Importance of lipids as storage molecules and as structural component of biomembranes.

Importance of high energy compounds, electron transport chain, synthesis of ATP under aerobic and anaerobic conditions.

Role of TCA cycle in central carbon metabolism, importance of anaplerotic reactions and redox balance.

Properties of metabolic enzymes of the host and pathogens

Metabolic engineering for the production of useful biomolecules.

Bioenergetics and Membrane Biology

Basic concepts of Bioenergetics, mechanisms of oxidative phosphorylation and photophosphorylation.

Composition and structure of biomembranes, transport mechanisms across biological membranes.

Concept and mechanism of ATP synthesis.

Human Physiology

Mechanism of signal transduction by steroid and polypeptide hormones .

Process of gaseous exchange in tissues and lungs, respiratory adaption to high altitude.

Difference between hemoglobin and myoglobin.

Muscular dystrophies, the role of steroids in muscle building.

Nitrogen metabolism.

Clinical Biochemistry

Constituents of urine, blood and their significance.

Causation of diseases of liver, kidney, mechanism of Cancer.

Triglycerides and lipoproteins and their relationship with various diseases.

Role of enzymes in diagnosis of various diseases.

Microbiology

Contributions of Louis Pasteur, Edward Jenner and Robert Koch in microbiology and immunology.

Discovery of antibiotics and their targets, drug/antibiotic resistance, preventive and therapeutic approaches of infectious diseases.

Microorganisms as model systems in genetics and biochemistry.

Contribution of gut microbiome in human health.

Basic concepts of metabolic engineering and synthetic biology.

Immunology

Immune system including cells, organs and receptors.

Structure and functions of different classes of immunoglobulins, the genetic basis of antibody diversity and the importance of humoral, cell-mediated and innate immune responses in combating pathogens.

Different types of hypersensitivity, and the importance of conventional vs. recombinant vaccines.

Importance of antigen-antibody interaction in disease diagnosis.

Principles of tolerance, autoimmunity and the role of immunity in protection against pathogens.

Enzymology

Enzymes and their importance in biological reactions.

Difference between a chemical catalyst and biocatalyst.

Activation energy and its importance in biological reactions.

Molecular Biology and Genetic Engineering

DNA as genetic material, DNA replication, transcription, DNA repair and translation.

Coding and non-coding regions of eukaryotic genome.

Exposure of E. coli lac operon, PCR, expression vectors and their importance in Biotechnology.

Merits and Demerits of transgenic crops.

Genomics, proteomics, metabolomics and their importance in human health