

Bachelors with Chemistry as Major/Minor 6th Semester

Title of the course: Biological Chemistry

Course Code: CHM622J/N1 **Credits:** Theory-3, Tutorial-1

Theory (3 credits: 45 Hours)

Max. Marks: 75, Min Marks: 27

Course Objectives:

- To provide exposure of various biomolecules containing metal ions that comprise many important.
- To understand structure of various biomolecules.
- To understand the working of ATP and providing us the energy on demand.
- To understand the membrane transport and nerve conduction process.

Learning outcomes:

On completion of the course, the student should be able to:

- Importance of metal ions in biology
- Knowledge of various enzymes and their activities
- Advanced applications of bioinorganic chemistry in the field of medicine
- Knowledge of various bioorganic molecules
- Knowledge of biological process in the realm of thermodynamics and ion transport.

Unit –I: Bio-Inorganic Chemistry

(15 hours)

Classification of elements in human system. Concept of essentiality. Biodistribution and biochemical role of essential trace elements: Fe, Zn, Cu, P, F and I. Effects of deficiency of essential trace elements in biological systems and its treatment. Antagonism and Synergism among essential trace elements.

Role of alkali and alkaline earth metal ions in biological systems. Lithium and the mental health. Chlorophyll: Structure and role of magnesium in photosynthesis.

Enzyme, Apoenzyme, Coenzyme, Prosthetic group and Metalloenzymes, General mechanism of enzyme action. Toxicity of heavy metals: Hg, Cd, Pb and As and its treatment.

Unit-II: Bio-Organic Chemistry

(15 hours)

Carbohydrates: Introduction, Classification, Mechanistic studies of reactions of monosaccharide's: Epimerization, Oxidation (using Fehling's solution and Tollen's reagent), Reduction reactions (using NaBH₄), Chain lengthening and shortening reactions (Killiani Fischer synthesis, Ruff's degradation). Formation of hemiacetal/acetals. (Glycoside) Glycoside's in nature. Structural features and utility of maltose, cellobiose, galactose, lactose and sucrose. Invert sugar, Galactosemia and lactose intolerance.

Polysaccharides: Structural features of cellulose, rayon, and dextrin.

Amino-Acids: Introduction, classification, acid –base properties, isoelectric point and synthesis of amino acids.

Amino sugars: Glucosamines and their applications.

Proteins: Primary, secondary, tertiary and quaternary structure. Denaturation of proteins.
Glycoproteins: Blood types A, B and O.

Unit-III: Biophysical Chemistry

(15 hours)

Thermodynamics of living systems, Biochemists standard state, standard free energy changes in biochemical reactions, ATP as energy currency of cell.

Biological membranes: Structure, molecular motion across membranes, ion transport through cell membrane, Mechanism of Membrane Transport (active and passive transport).

Semipermeable membrane and Donnan membrane equilibrium, Donnan effect in Osmosis.

Membrane potential, Classical theory of membrane potentials; Nernst Equation, Nernst-Planck equation, Nerve conduction: Action potential, factors affecting speed of action potential propagation.

Tutorial (1 credits: 30 Hours)

Max. Marks: 25, Min Marks:9

1. Understanding stereochemistry and identification of active sites of proteins using various biological 3D Modeling softwares like Jmol, BIOVIA Draw, ChemDraw etc.
2. Animations showing how amino acids form proteins and protein folding.
3. Animations showing Osazone formation and identification of sugars based on Osazone formation.
4. Animations (in video form) showing how glucose interacts in our body.

Books Recommended:

1. Organic Chemistry 8th Ed. - F. A. Carey and Robert M. Giuliano (McGraw Hill-2012).
2. Organic Chemistry 5th Ed, R.J. Fessenden, J.S. Fessenden. (Brooks/Cole-1993).
3. Organic Chemistry, A mechanistic Approach, Penny Chaloner (CRC Press-2015).
4. Organic Chemistry, Paula Y, Bruice (Pearson, New Age International Edition)
5. Advanced Organic Chemistry, 5th Ed., F.A Carey & R.J Sundberg (Springer-2007).
6. Organic Chemistry, 2nd Ed., Jonathan Clayden (OUP-2016).
7. Organic Chemistry, 11th Ed., Solomons, T.W.G., (Wiley-2015).
8. Organic Chemistry, 7th Ed. Morrison, Boyd and Bhattacharya. (Pearson-2013.)
9. Bioinorganic Chemistry- An introduction; Ochiai; Allyn and Bacon;1977.
10. Principles of Bioinorganic Chemistry; S. J. Lippard and J. M. Berg; University Science Books; 1994.
11. The Inorganic Chemistry of Biological Processes; Inndedn.; M. N. Hughes; John Wiley;1973.