Course Title: **Fundamentals of Biochemistry**

Course code: **Credits: 4**

Maximum marks: 100 **Total teaching hours: 60**

Course objectives

This course aims to provide students with an understanding of biomolecules, with an emphasis on their structural foundations, unique properties, biological roles and functions, and inter-relationships. The focus is on the structural and functional relationships of various biomolecules at the chemical level from a biological point of view.

Learning outcomes

After the completion of this course students will be able to:

1) Describe the chemistry of carbohydrates, lipids, proteins and amino acids.

2) Describe the classification and structural organization of carbohydrates, lipids, proteins, nucleotides and nucleic acids and utilize the knowledge for getting employed in pharmaceutical industries.

THEORY

Unit I: Foundation of Biochemistry

The fundamentals of biochemistry, Cellular and chemical foundations of life; Water: unique properties, weak interactions in aqueous systems, ionization of water, buffering action in biological system, water as a universal solvent, reactant and fitness of the aqueous environment

Unit II: Carbohydrate

Monosaccharides - structure of aldoses and ketoses; Ring structure and conformation of sugars mutarotation, anomers, epimers and enantiomers; Structure of biologically important sugar derivatives, oxidation and reduction of sugars; Formation of disaccharides, reducing and non-reducing disaccharides; Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides; Structure and role of glycoconjugates - proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides); Carbohydrates as informational molecules

Unit III: Amino acids, proteins and Lipids

Amino Acids; Structural features and classification; physical properties, chemical

properties (acid base properties, titration curve); Uncommon amino acids and their functions; Proteins: primary, secondary and tertiary structures and function of proteins Lipids: building blocks of lipids - fatty acids, glycerol, ceramide; Storage lipids - triacyl glycerol and waxes; Structural lipids in membranes – glycerophospholipids; Galactolipids and sulpholipids, etherlipids, sphingolipids and sterols; their distribution and role of. Plant steroids; Lipids as signals, cofactors and pigments

Unit IV: Nucleotides and Nucleic acid

Nucleic Acids: Nucleotides - structure and properties of bases, pentoses; nucleosides; Watson-Crick model of DNA; forms and structure of DNA; Watson-Crick model of DNA; Structure of major species of RNA - mRNA, tRNA and rRNA; Other functions of nucleotides - source of energy, component of coenzymes and second messengers; Enzymes; classification and mode of action

PRACTICALS

1) Safety measures in laboratories.
2) Preparation of normal and molar solutions.
3) Preparation of buffers, phosphate and acetate buffers.
4) Determination of pKa of acetic acid and glycine.
5) Qualitative tests for carbohydrates.
6) Qualitative test for lipids.
7) Qualitative test for amino acids, proteins.
8) Qualitative test for nucleic acids.
9) Separation of amino acids/ sugars/ bases by thin layer chromatography/paper chromatography.

Suggested Readings

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning

2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone

3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman 4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.

6. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.

7. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.

8. Cooper, G.M. and Hausman, RE. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland. Washington, D.C.; Sinauer Associates, MA.

9. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco