CHE-312-MJ-T: BIOCHEMISTRY

Course Type: Major Elective Theory **Credits: 2**

A. Course Objectives:

1. To provide fundamental knowledge of biomolecules and cellular organization.
2. To familiarize students with structure and functions of carbohydrates, lipids, proteins, and nucleic acids.
3. To develop understanding of enzyme structure, function, and mechanisms.
4. To introduce concepts of vitamins and their biological significance.
5. To promote insight into biochemical processes and molecular functions in living systems.

B. Course Outcomes (COs):

CO No.	Course Outcome Statement (COs) *After learning the course, the students are able to -*
CO-1	Recall concepts of biomolecules, enzymes, and nucleic acids.
CO-2	Explain structure and functions of carbohydrates, lipids, proteins, and vitamins.
CO-3	Apply biochemical principles to understand reactions and metabolic functions.
CO-4	Analyze properties and behavior of biomolecules and enzyme activity.
CO-5	Evaluate biological roles and significance of biomolecules and enzymes.
CO-6	Illustrate structures, mechanisms, and functions of biomolecules.

C. Contents:

Prerequisites	
Students should have basic knowledge of organic chemistry, functional groups, and biomolecules. Familiarity with basic biological concepts and chemical bonding is required.	
Chapter 1: Carbohydrates	**08 Hours**
Chemical molecules of life, the structure of prokaryotic and eukaryotic cells, and the functions of eukaryotic cell organelles. Definition: Classification of Carbohydrates: Classification: Monosaccharides, Disaccharides, Polysaccharides, Biological significance of carbohydrates, Monosaccharides: Structure of aldoses and ketoses, D- and L-isomers, Ring structures of sugars: hemiacetals and hemiketals, Conformations of sugars, Anomers and epimers, Mutarotation, Reaction with phenyl hydrazine (Osazone formation), Disaccharides: Sucrose, lactose, and maltose, Glycosidic bond, Reducing and non-reducing disaccharides, Polysaccharides:	

Homopolysaccharides and heteropolysaccharides.	
Chapter 2: Lipids and Vitamins	**07 Hours**
Classification and biological significance of lipids. Fatty acids, Triacylglycerols, Properties of Triacylglycerols (Saponification, Rancidity), Tests to check purity of fats and oils (Iodine number, Saponification number, , Acid number), Lipoproteins, steroids (Cholesterol, Ergosterol). Definition, Classification of Vitamins- Fat-soluble and Water-soluble. Individual Vitamin: Vitamin A, D, E, K, C, B1, B2, B6, B12, Biotin, Niacin, Folic acid, Pantothenic acid, (Chemistry, Functions, Sources, Deficiency symptoms).	
Chapter 3: Amino Acids and Proteins	**06 Hours**
Amino Acids: Classification based on R-group, Structures of amino acids, Physicochemical Properties; Amphoteric nature, and zwitterions, pKa values, Isoelectric point (pI), Concept of ampholytes, Reactions of Amino Acids: Ninhydrin reaction, Transamination, Oxidative deamination. Significance of these reactions, Amino acids as useful drugs (D-Penicillamine, N-Acetylcysteine, Gabapentin) Proteins: Classification based on: Function, Structural Hierarchy of proteins: Primary structure**,** Secondary structure**,** Tertiary structure**,** Quaternary structure**.**	
Chapter 4: Introduction to Enzymes	**06 Hours**
Classification of Enzymes: Enzyme classes with examples, Chemical Nature and Properties of Enzymes: Isoenzymes, Active site: concept and features, Enzyme–substrate (ES) complex formation, Enzyme Specificity, Factors Affecting Enzyme Activity: Substrate concentration, enzyme concentration, pH, temperature, and mechanism of enzyme action: substrate strain theory. Enzyme Inhibition: Concept of enzyme inhibition, Allosteric enzymes, Conjugated Enzymes: Holoenzyme and Apoenzyme, Prosthetic groups, Industrial Applications of Enzymes	
Chapter 5: Nucleotides and Nucleic Acids	**03 Hours**
Introduction to Nucleic Acids, Functions of nucleic acids, Chemistry of Nitrogenous Bases: Purines and pyrimidines, General Composition of Nucleic Acids: Nucleosides and nucleotides, Structure of DNA: Watson–Crick model, Chargaff's rule of DNA composition, RNA: Structure and function of major RNA species.	
References: 1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox, Macmillan Publishers, 4th Edition, 2005.	

2. Biochemistry, U. Satyanarayana, U. Chakrapani, Books and Allied (P) Ltd., 5th Edition, 2020.
3. Principles of Biochemistry, Donald Voet, Judith G. Voet, Charlotte W. Pratt, John Wiley & Sons, 3rd Edition, 2008.
4. Harper's Illustrated Biochemistry, Robert K. Murray et al., McGraw-Hill, 27th Edition, 2006.
5. Biochemistry, Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, W. H. Freeman & Company, 7th Edition, 2012.
6. Fundamentals of Biochemistry, J. L. Jain, S. Jain, Nitin Jain, S. Chand Publishing, 7th Edition, 2016.
7. Organic Chemistry, R. T. Morrison, R. N. Boyd, Pearson Education, 7th Edition, 2010.