SEMESTER -III

BIOORGANIC CHEMISTRY

THEORY

Programme: M.Sc. **Max. Marks: 60**
Course code: P20/CHE/DSE/301 **Hours per week: 4**
Course type: DSE – 1 **Max. Marks: 100**
No. of credits: 4

COURSE OBJECTIVES:

1. Carbohydrate Chemistry primarily concerned to distinguish between different typeof sugars, their synthesis, structures, and functions.

2. Tounderstand the structure, function of important biological molecules such as DNA, RNA, enzymes etc, andbiological processes such as protein biosynthesis,DNA replication and RNA biosynthesis.

3. This module describes the different synthetic methods of peptides and classification of proteins.

4. To study of Enzyme selectivity and its catalytic property in various organic synthetic reactions.

5. Co-factors and co-enzymes assist enzymes in their function and how they might affect the catalysis of a reaction. Biological Significance and Classification of Vitamins

COURSE OUTCOMES:

CO1 Determine configuration and ring size of sugars and conformational analysis of monosaccharide.

CO2 Explain structure, synthesis, ring size determination and conformational structure of different types of carbohydrates.

CO3 Discuss the structure and synthesis of nucleosides and nucleotides. Explain primary, secondary and tertiary structure of DNA and RNA and their different types. Discuss Replication, transcription, translation, genetic code and DNA fingerprinting

CO4 Discuss the classification and properties of lipids, Chemical synthesis and of biosynthesis phospholipids and glycolipids

CO5 Explain the Classification, nomenclature and bonding of peptides and biological

importance and classification of different structure of proteins.

CO6 Discuss classification, mechanism of action and factors affecting enzyme catalysis, Enzyme inhibition and immobilized enzymes.

CO7 Explain Classification, structure, and biological functions of different type of Coenzymes.

CO8 Discribe the Classification, structure, synthesis and biological importance of different Vitamins

MODULE 1: CARBOHYDRATES (15 Hrs)

Introduction to the importance of Carbohydrates. Types of naturally occuring sugars. Deoxy sugars, aminosugars, branched chain sugars mrthyl ethers and acid derivatives of sugars. Determination of configuration and determination of ring size of D-glucose and D- Fructose. Conformational analysis of monosaccharides. $^4C_1$ and $^1C_4$ conformations of D- glucose. Reactions of six carbon sugars: Ferrier, Hanesian reaction and Ferrier rearrangement. Synthesis of amino, halo and thiosugars. Structure, ring size determination of sucrose and maltose.Conformational structures of sucrose, lactose, maltose, cellobiose and gentobiose.Structure and biological functions of starch, cellulose, glycogen and chitin. Role of sugars in cell to cell recognition, blood groups.

MODULE 2: NUCLEIC ACIDS & LIPIDS (15 Hrs)

Nucleic acids: Retro synthetic analysis of nucleic acids - Nucleotides, Nucleosides, Nucleotide bases and Sugars. Structure and synthesis of nucleosides and nucleotides. Primary, secondary and tertiary structure of DNA. Types of mRNA, tRNA and rRNA. Replication, transcription and translation. Geneticcode. Protein biosynthesis. DNA finger printing.

Lipids: Introduction and classification of lipids. Stereochemical notation inlipids. Chemical synthesis and biosynthesis of phospholipids and glycolipids. Properties of lipid aggregates, micelles, bilayers, liposomes and biological membranes.

MODULE 3: PROTEINS AND ENZYMES (15 Hrs)

Proteins: Introduction. Peptide bond, classification and nomenclatue of peptides. Aminoacid sequence of polypeptides and proteins: terminal residue analysis and partial hydrolysis. Peptide synthesis by solution phase and solid phase synthesis methods. Proteins - Biological importance and classification - Primary, secondary and tertiary structure of proteins.

Enzymes: Definition. Classification based on mode of action.Mechanism of enzyme catalysis Lock and Key, Induced- Fit and three point contact models. Enzyme selectivity – chemo, regio, diastereo and enantio selectivity – illustration with suitable examples. Factors affecting enzyme catalysis. Enzyme inhibition- reversible and irreversible inhibition. Enzymes in organic synthesis. Immobilised enzymes

MODULE 4: COENZYMES AND VITAMINS **(15 Hrs)**

Coenzymes: Introduction Co factors – co substrates-Prosthetic

Classification — Vitamin derived coenzymes and metabolite coenzymes.Structure and biological functions of coenzyme A, thiamine pyrophosphate (TPP), pyridoxal phosphate (PLP), oxidized and reduced forms of I) nicotinamide adenosine dinucleotide / their phosphates (NAD), NADH, $NADP^+$ NADPH) ii) Flavin adenine nucleotide FAD, $FADH_2$ and iii) Flavin mononucleotide (FMN, $FMNH_2$) lipoic acid, biotin, tetrahydrofolate and ubiquinone. Adenosine triphosphate (ATP)and adenosine diphosphate (ADP), S-adenosylmethionine (SAM) and uridinediphosphosugars (UDP-sugars) Mechanism of reactions catalyzed by the above coenzymes.

Vitamins: Introduction, classification and biological importance of vitamins.
Structuredetermination and synthesis of vitamins A, B_1, and B_2.Synthesis of vitamins - B_6, C, E and K. Structure of vitamin B_{12}

Reference Books:

1. Organic Chemistry Vol.I and Vol.II by I.L.Finar
2. Carbohydrate Chemistry by Barton Volumes
3. Carbohydrate chemistry by G.J.Boons
4. The chemistry of natural products:vol.V - carbohydrates by S.F.Dyke
5. Organic Chemistry by McMurry
6. Nucleic acids in Chemistry and Biology by G M Blackbum MI Gait
7. Lehninger Principles of Biochemistry by D L Nelson and M MCoxon
8. Outlines of Biochemistry by Conn and Stumpf
9. Enzyme structure and mechanism by Fersht and Freeman
10. Enzymes for green organic synthesis by V.K.Ahluwalia
11. Biotransformations in Organic Chemistry by K Faber.
12. Principles of biochemistry by Horton &others.
13. Bioorganic chemistry - A chemical approach to enzyme action by Herman Dugas and Christopher Penney.
14. Concepts in Biotechnology by D.Balasubramanian & others
15. Chemistry and physiology of the vitamins by H.R.Rosenberg.

SEMESTER-III

MODEL THEORY QUESTION PAPER

Course Code: P20/CHE/DSE/301 **Max. Time: 2½hrs**
Credits: 4 **Max. Marks: 60**

SECTION-A

I Answer the following Questions:- **4 x 10 = 40 M**

1. a) Write the conformational structures of disaccharides:
   i) Lactose ii) Maltose iii) Cellobiose **(CO2)**
   b) Write the structure and biological function of the following:
   i) Cellulose ii) Chitin **(CO2)**

OR

2.a) Determine the ring size of sucrose **(CO2)**
   b) Give any two synthetic methods for the synthesis of halo sugar and thiosugar. **(CO1)**

3. a) Write about any two chemical synthesis of Glycolipids. **(CO4)**
   b) Discuss about Retro synthetic analysis of Nucleosides. Give the synthesis of anyone nucleoside. **(CO3)**

OR

4. a) Explain briefly about the replication and translation. **(CO3)**
   b) Explain briefly about DNA finger printing. **(CO3)**

5. a) Explain the determination of amino acid sequence of polypeptides (**CO5)**
   b) Describe the solution phase synthesis of peptides. **(CO5)**

OR

6. a) Explain the mechanism of enzyme catalysis Lock and Key, induced –fit and three point contact model. **(CO6)**
   b) Write a note on Enzyme selectivity**. (CO6)**

7 a) Write the synthesis of Vitamin B_6 **(CO8)**

b) Write the oxidation and reduction forms of NAD and NADH, NADP+ and NADPH **(CO7)**

OR

8. a) Discuss the structure and biological functions of pyridoxal phosphate **(CO8)**

b) Write the synthesis of Riboflavin (Vitamin B_2) **(CO8)**

SECTION-B

II Answer any <u>FIVE</u> **5 x 4 = 20 M**

9. Discuss about Ferrier rearrangement reaction with example **(CO1).**
10. Write the conformational structure of Gentobiose. **(CO2)**
11. Write the classification of lipids. **(CO4)**
12. What is genetic code? Explain Briefly. **(CO3)**
13. Discuss the primary structure of proteins. **(CO5)**
14. Write a note on enzyme inhibition. **(CO6)**
15. Write the synthesis of Vitamin C **(CO8)**
16. Give the structures of following co enzymes **(CO7)**

    i) ATP ii) UDP – sugars