JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2018 BATCH AND THEREAFTER

Programme: B.Sc. **Semester: III**

BIOCHEMISTRY PAPER III

Course Code:18IIIBC3 **No. of Hours: 60**

COURSE OBJECTIVES:

Through this course, the student is imparted knowledge of:

- The principles of stereochemistry, optical activity and importance of stereoisomerism
- The chemistry of heterocyclic compounds as these compounds are present in several important biomolecules.
- Introduction to biochemistry outlining its importance
- The basic structures and properties of proteins, lipids, carbohydrates and nucleic acids.

LEARNING OUTCOMES:

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

- Apply the concepts of stereochemistry towards structure-function relationships of biomolecules
- Understand the influence of the heteroatoms such as nitrogen, oxygen and sulphur in the properties of compounds
- Understand the nuances and methodology in the study of biochemistry.
- Learn the structural elements and properties of important biomolecules.

UNIT I

ORGANIC CHEMISTRY

Chapter 1.1 STEREOCHEMISTRY 8 HRS

Definition of stereoisomerism, elements of symmetry with respect to organic molecules; Stereo isomers: types: geometric and optical isomerism; stereo chemical terminology: configuration, conformation, plane of polarized light, optical activity; Optical isomerism: molecular dissymmetry, chirality: enantiomers with respect to glyceraldehydes, lactic acid and tartaric acid; nomenclature of enantiomers – CIP rules, the RS and DL rotation; racemisation and resolution. Diastereomers: definition, characteristics and types with respect to tartaric acid and erythrose, Fischer projection formulae; Geometrical isomerism: cis-trans isomerism in alkenes and ring compounds (5- and 6-membered), structure of maleic and fumaric acid. EZ system of specifying geometrical isomers, Significance of chirality in the biological world: Examples – D-phenylalanine and D-alanine.

Chapter 1.2 HETEROCYCLIC COMPOUNDS 2 HRS

Structural formulae and biological role of heterocycle in thiazole, pyrrole, imidazole, pyridine, pyrimidines, purine, quinone and isoalloxazine.

UNIT II

BIOMOLECULES

Chapter 2.1 INTRODUCTION TO BIOCHEMISTRY 2 HRS

Development and scope of Biochemistry, Biochemical composition of living organisms, Water as the solvent of life.Relationship between biochemistry and medicine, Impact of Biochemical research on nutrition and preventive medicine.

Chapter 2.2CARBOHYDRATES 12 HRS

Biological importance and classification. Monosaccharides: D and L designation. Optical rotation of sugars.Glucose- structural elucidation, configuration and conformation (explanation of chair and boat conformations), tautomerization of monosaccharides.Action of acids on carbohydrates (furfural formation) ring structure of fructose, galactose, mannose and ribose.Importance of glycosides.Structure and formation of methyl glycoside.Importance of invert sugars.Differences between reducing and non reducing sugars.Straight structure of sedoheptulose.Epimers and anomers. Derived monosaccharides – Structure and biological importance of amino sugars: glucosamine, galactoseamine and their N acetyl derivatives. Sugar phosphates: Glucose-6-phosphate, fructose1,6-bisphosphate, ribose and deoxy-5-ribose-5-phosphates. Sugar acids: i) Aldonic acids- gluconic acid ii) Alduronic acids-glucuronic and galacturonic acids iii) Aldaric acids- glucaric acid. Disaccharides – glycosidic linkage, structure and biological importance of sucrose, maltose, lactose, isomaltose, cellobiose and trehalose. Trisaccharide – Raffinose. Oligosaccharides: Definition, types (N-linked and O-linked), its association with proteins and lipids. Polysachharides- storage (starch and glycogen) structural – cellulose and chitin.Pectins. Glycosaminoglycans – Structure and biochemical function of hyaluronic acid, keratin sulphate, chondroitin sulphates, heparin. Cell wall components – Peptidoglycans and teichoic acid. Lectins: Characteristics, types and functions in biological system

UNIT III

Chapter 3.1 AMINO ACIDS & PROTEINS 11 HRS

Structure and classification of α-amino acids, 3 and 1 letter designations for amino acids, Definition structure and functions of Protein, non-standard amino acids (hydroxylysine and hydroxyproline) and non protein amino acids:(Ornithine, citrullene, azaserine, homocysteine and β-alanine), optical isomerism of D, L –amino acids, Properties: (1) Due to –COOH group: esterification, reaction with PCl_5, reduction, decarboxylation, (2) Acid - base properties of C-α carboxyl and C-α amino group: amphoteric nature, zwitterion formation, characteristic titration curve, isoelectric point, reaction with formaldehyde, (3) Due to $–NH_2$ group: reaction with ninhydrin, Sanger's and Edman reagents, reaction with CO_2 and HNO_2, amide formation (peptide bond), (4) Reactions due to R group UV absorption property (R group ring structures)

Peptides: the peptide bond, characteristics of peptide bond, Ramachandran plot, peptide chain, N and C terminals, representation of peptide chain, naming of peptide chain, biologically important peptides – glutathione(structure), oxytocin, vasopressin and gramicidin

Proteins: Classification based on composition, shape, function; Structural organization: primary (insulin), secondary- α helix, β-pleated sheet, β turns (triple helix-collagen), tertiary (myoglobin) and quaternary structure (haemoglobin), Denaturation and renaturation of

proteins - Anfinsen experiment on RNAse, Irreversible reaction (Albumin of egg white) and reversible reaction (trypsin), Protein folding - Assisting proteins: chaperonins, Improper protein folding, diseases due to this, Alzheimer's disease and Prion disease (mad cow).

Chapter 3.2 ENZYMES 8 HRS

Introduction, Classification of enzymes, IUB classification (EC number not required); Characteristic features: Properties – specificity, activation energy active site, binding site, catalytic site, enzyme activators and inhibitors, cofactors, coenzyme, metalloenzyme, metal activated enzymes, Fischer and Koshland models (lock and key model & Induced fit hypothesis).

Enzyme units, turnover number, Enzyme Kinetics: factors affecting rate of enzymatic reactions (pH, temperature, substrate and enzyme concentration), Michaelis - Menten equation (with derivation), Significance of MM equation, Km and Vmax, transformation of MM equation to Lineweaver Burk plots. Enzyme inhibition: definition, types: reversible (competitive, non-competitive and uncompetitive) and irreversible enzyme inhibition, Allosteric regulation of enzymes and feedback regulation. Industrial enzymes - Laccase, lipase and pectinase.

UNIT IV

Chapter 4.1 LIPIDS AND MEMBRANES 14 HRS

Classification and biological function - Fatty acids: classification of lipids (simple, compound and derived lipids).Saturated and unsaturated fatty acids (C12 to C20), Nomenclature of fatty acids. Acyl glycerols; Hydrolysis, Rancidity, acid number: saponification number and iodine values. Phosphoglycerides; structures and biological roles, plasmologens.Sphingolipids, phosphosphingolipids-sphingomyelins; Glycosphingolipids - cerebrosides.and gangliosides. Prostaglandins; An overview of biological roles, structure of primary prostaglandins: PGE_1, PGE_2, ,PGE_3, $PGF_{1\alpha}$, , $PGF_{2\alpha}$, $PGF_{3\alpha}$,Waxes of biological importance (bee wax and spermaceti), Lipoproteins: types and functions, Membranes: Behaviour of amphipathic lipids in water, formation of micelles, bilayers and vesicles, Biological membranes : Function and chemical composition , Fluid mosaic model. Membrane proteins – Intrinsic and extrinsic protein, Lipid linked protein (prenylated protein : isoprenoid groups such as farnesyl and geranylgeranylresidues), Fatty acylated proteins –Myristic and palmitic acids, Glycosylphosphotidyl inositol linked proteins, The erythrocyte membrane – the human erythrocyte cytoskeleton. Steroids –basic structure of steroids, structure and functions of cholesterol and cholic acid , differences between steroids and sterols

UNIT V

Chapter 5.1 NUCLEIC ACIDS 3 HRS

Types: Components of nucleic acids, bases, nucleosides and nucleotides. Polynucleotides.Structure of DNA (Watson – Crick model) and RNA.Biological roles of DNA and RNA, Thermal properties of nucleic acids – denaturation and renaturation of nucleic acids, hypochromicity and hyperchromicity.

REFERENCES:

1. Biochemistry by Debajyoti Das, 13th edition 2008, Academic publishers
2. Fundamentals of Biochemistry by J.L Jain, Sunjayjain , Nitin Jain, 7th edition, 2016, S. Chand & Company
3. U .Satyanarayana - Text book of Biochemistry, 5th edition, 2017, Books and Allied Private Limited.
4. Lehninger, David Nelson and M. Chael. M Cox - Principles of Biochemistry, 7th edition, 2017, W. H. Freeman and Company Ltd.
5. Harper's illustrated biochemistry, Robert K. Murray *et al*., 30th Edition, 2015, McGraw Hill publication
6. Trevor Palmer – Enzymes, 2nd Edition 2008, Woodhead publishing
7. I. L. Finar, Organic Chemistry, Volume 2: Stereochemistry and the Chemistry of Natural Products, 5th Edition, 2011, Pearson India.

III SEMESTER BIOCHEMISTRY: PRACTICAL 3

DURATION: 3 HRS / WEEK **NO.OF UNITS: 15**

1. Estimation of reducing sugar by dinitrosalicylic acid (DNS) method.
2. Estimation of glucose by Hagedorn and Jensen (HJ) method
3. Estimation of glycine by formal titration method
4. Estimation of amino acid (glycine)by ninhydrin method
5. Estimation of amino acid(tyrosine) by Millon's method
6. Qualitative analysis of carbohydrates
7. Qualitative analysis of proteins and amino acids
8. Qualitative analysis of lipid.
9. Determination of saponification no of a lipid.
10. Determination of acid number of lipid
11. Determination of iodine number of a lipid

Repetition and Tests.

REFERENCES:

1. P.K.Mani&A.O.Thomas, Text book of Practical Chemistry,4th Edition 1976, Scientific Publications.

2.J.Jayaraman Laboratory Manual in Biochemistry, 2007, New Age International Publishers, New Delhi.

3. David Plummer-Practical Biochemistry,3rd Edition 2004, McGraw Hill Publishers.

4. S.K.Sawhney, Randhir Singh – Introductory Practical Biochemistry, 2nd Edition 2014, Narosa Publishers.