JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2018 BATCH AND THEREAFTER

Programme: B.Sc. **Semester: II**

BIOCHEMISTRY PAPER II

Course Code: 18IIBC2 **No. of Hours: 60**

COURSE OBJECTIVES:

This course aims to impart to the student, knowledge of:

- Basic mechanistic aspects of organic chemistry
- The chemistry of different functional groups which are commonly encountered in biological systems
- Principles of solid state and reaction kinetics and their applications to biological systems
- Bioanalytical separation methods such as centrifugation, electrophoresis and chromatography, which are important tools in analysis
- Spectrometric techniques to analyse biomolecules

LEARNING OUTCOMES:

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

- Apply the concepts of stability and chemistry of different functional groups to better understand biochemical reactions
- Use the principles of solid state to better understand the structures of enzymes and DNA
- Understand the importance of kinetics in biological systems and identify the various factors affecting rates to biochemical processes
- Use the concepts learned to outline separation and analysis techniques for biomolecules.

UNIT I

BIO-ORGANIC CHEMISTRY

Chapter 1.1 INTRODUCTION TO ELECTRONIC CONCEPTS IN ORGANIC CHEMISTRY 3 HRS

Inductive effect, resonance and hyper conjugation concepts, reactive intermediates - carbocations ,carbanions and their relative stabilities, carbenes and free radicals with examples

Chapter 1.2 CARBOXYLIC ACIDS 5 HRS

Meaning and usefulness of pK_a values, acidity of monocarboxylic acids, effect of substituents on acid strength-electron donating and withdrawing. Saturated dicarboxylic acids - effect of heat on the first five members, Hydroxy acids: occurrence and structures of lactic, tartaric, malic, citric and isocitric acids. Preparation of lactic acid from acetaldehydes and by reduction of pyruvic acid properties of lactic acid. Keto acids: Preparation of pyruvic acid

from (i) lactic acid (ii) tartaric acid, Properties of pyruvic acid. Structures and biological importance of iso-citric acid, alpha- ketoglutaric acid and oxaloacetic acid.

Chapter 1.3 AMINES **4 HRS**

Classification, isomerism, distinguishing reactions of primary, secondary, tertiary amines.p$K_b$values of amines, effect of substituents on the basic strength of amines, some biologically important amines - structure and biological roles of Dopamine, Gamma amino butyric acid(GABA), histamine, acetylcholine, N-acetyl glutamine (NAG), N- acetyl muramic acid(NAM), N-acetyl neuraminic acid(NANA), nitrogenous bases in DNA and RNA.

Chapter 1.4 ALCOHOLS **3 HRS**

Classification, monohydric alcohols-general properties, distinguishing reactions for primary, secondary and tertiary alcohols, dihydric alcohols: ethane1,2diol- preparation (from epoxide, ethylene dibromide) and properties, trihydric alcohols- glycerol and its synthesis from propene, properties and uses, structure and biological importance of sorbitol, retinol, cholesterol and xylitol.

Chapter 1.5 PHENOLS **2 HRS**

Classification, electronic interpretation of the acidity of phenol, structure and functions of phenolic compounds and their derivatives: tyrosine, Dihydroxyphenylamine (DOPA), and catecholamines (epinephrine and norepinephrine).

UNIT II

Chapter 2.1: ARENES **4 HRS**

Aromaticity, Huckel's rule. Electronic interpretation of the orienting influence of substituents in the electrophilic substitution of higher arenes- disubstitutedarenes: 4-hydroxybenzoic acid,1,3-dichlorobenzene, 2-nitrotoluene, resonance structures of naphthalene, anthracene, phenanthrene, oxidation reactions of naphthalene.

Chapter 2.2 CARBONYL COMPOUNDS **3 HRS**

General properties of carbonyl compounds, addition of alcohols to aldehydes and ketones, keto enol tautomerism- purine, pyrimidine, mechanisms and importance of a few reactions: addition of HCN to acetaldehyde (usefulness in Kiliani synthesis), addition of phenyl

hydrazine and hydroxylamine to glucose (Osazone test), structure and function of glucose, fructose, retinal, pyridoxal, hormones: civetone, testosterone, β-estradiol, progesterone and cortisone.

UNIT III

PHYSICAL CHEMISTRY

Chapter 3.1 SOLIDS 4 HRS

Types, and shape, elements of symmetry, law of rational indices, Miller indices, space lattice and unit cells, crystal systems, Bragg's equation (derivation not required), elementary treatment of X-ray diffraction, applications of crystallography in elucidating the structure of deoxyribonucleic acid.

Chapter 3.2 CHEMICAL EQUILIBRIUM 3 HRS

Reversible reactions - characteristics of chemical equilibrium, homogeneous and heterogeneous equilibria, red-ox equilibria in biomolecules- cytochromes.

UNIT IV

PHYSICAL CHEMISTRY

Chapter 4.1 REACTION KINETICS 8 HRS

Factors influencing rate of a reaction, rate equation, order of a reaction, molecularity of a reaction, derivation of expression for rate constant of second order reaction(a=b), problems.

Determination of order of a reaction- Half-life method, Ostwald's isolation method.energy of activation, Arrhenius equation and problems, theories of reaction rate- Collision theory, elementary treatment of transition state theory.

Catalysis: general characteristics of catalysts, types of catalysis: homogeneous and heterogeneous, theories of homogeneous catalysis, pH dependence of catalyzed reactions, enzymes and their importance.

UNIT V

BIOCHEMICAL TECHNIQUES

Chapter 5.1 CENTRIFUGATION TECHNIQUES 5 HRS

Classification of centrifugation techniques- preparative and analytical centrifugation, basic principles of centrifugation, sedimentation coefficient, types of centrifuges- bench top, high speed and ultra centrifuge, applications-i) isolation of DNA and viruses. ii) Determination of relative molar mass of macro molecules like proteins, DNA.

Chapter 5.2 CHROMATOGRAPHIC TECHNIQUES 7 HRS

General principles of chromatography. Principles, operational procedure and applications of

(i)paper chromatography (ii) thin layer chromatography (TLC) (iii) Ion exchange chromatography (iv) Gas liquid chromatography, applications – separation of amino acids (paper chromatography), separation of chlorophyll pigments (TLC), separation of glycated haemoglobin(ion-exchange), separation and identification of pesticides using GLC(any one pesticide).

Chapter 5.3 ELECTROPHORETIC TECHNIQUES 5 HRS

General principles. Factors affecting the migration rate – sample, electric field , buffer and supporting medium. Types of electrophoresis (a) Tiselius moving boundary electrophoresis, (b) Zone electrophoresis.Principles, operational procedure and applications of paper electrophoresis, polyacrylamide gel electorphoresis (PAGE), agarose gel electrophoresis, Sodium Dodecyl Sulphate-polyacrylamide gel electorphoresis (SDS–PAGE), applications-separation and analysis of proteins and nucleic acids.

Chapter 5.4 SPECTROPHOTOMETRY 4 HRS

Fundamental principles of spectroscopy- Basic laws of absorption-Beer-Lambert's law, principle and application of Ultraviolet-Visible (UV-VIS), Infrared (IR) spectrophotometry, applications i) Quantitative estimation of nucleic acids and proteins by UV-VIS, ii) identification of functional groups by IR.

REFERENCES:

1.B.R. Puri and L.R. Sharma - Principles of physical chemistry, 42nd edition, 2007, Vishal Publishing Co.
2. R.D. Madan, Modern Inorganic Chemistry, 10th Edition 2001. S Chand & Co.

3. Debajyoti Das - Biochemistry. 13th edition, 2008, Academic publishers.

4. J.L Jain, Sunjay Jain, Nitin Jain- Fundamentals of Biochemistry, 6th edition S. Chand & Company.
5. Upadhyay, Upadhyay and Nath-Biophysical Chemistry-Principles and techniques.

6. Campbell I.D and Dewk-Biological Spectroscopy, Cummings Publishing Co.1981.
7. Robyt, John F and White, Bernard J – Biochemical Techniques: Theory and Practice. Waveland Press Inc. 1990.
8. Keith Wilson and John Walker, Principles and techniques of biochemistry and molecular biology, 7th Edition 2010,Cambridge University Press.
9. Wilson K, Goulding K.H., Principles and Techniques of Practical Biochemistry, Fourth Edition, 1993.Hodder General Publishing Division
10.Jackman, Lance E. Separation of glycohemoglobins by ion exchange chromatography: An undergraduate biochemistry laboratory experiment J. Chem. Educ. 1981, 58, 77.
11. Chang Raymond, Chemistry, 10th edition 2009.

II SEMESTER BIOCHEMISTRY: PRACTICAL – II

TIME: 3 HOURS PER WEEKS **NO. OF UNITS: 15**

1. Determination of density and viscosity of a liquid.
2. Determination of density and surface tension of a liquid.
3. Estimation of FAS by potentiometric titration against acidified $K_2Cr_2O_7$
4. Determination of the % composition of binary liquid mixture by viscosity method (water and sucrose)
5. Determination of rate constant for the saponification of ethyl acetate.
6. Determination of rate constant for the acid hydrolysis of methyl acetate.
7. Separation of amino acids by paper chromatography
8. Separation of plant pigments by TLC
9. Colorimetric estimation of copper by cuprammonium sulphate method.
10. Determination of pI, pK_a and pK_b of an amino acid (glycine) using pH meter.

Repetition and Tests.

REFERENCES:

1. P.K.Mani&A.O.Thomas, Text book of Practical Chemistry,4th ed1976,Scientific Publications.
2. M.J.Sienko,R.A.Plane,S.T.Marcus,Experimental Chemistry,6thed, McGraw Hill Book Company.
3. Wilson K. Goulding K.H., Principles and Techniques of Practical Biochemistry. Fourth Edition, 1993. Holder General Publishing Division
4. Wilson Keith and Walker John, Principles and techniques of Practical Biochemistry, 5th Edition 2010, Cambridge University Press 2000.
5. N. SharathChandra Bose Biochemistry: A practical manual. Pharma med Press /BSP 2010.