JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2018 BATCH AND THEREAFTER

Programme: B.Sc **Semester:I**

BIOCHEMISTRY PAPER I

Course Code: 18IBC1 **No. of Hours: 60**

COURSE OBJECTIVES:

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

- Basic mathematical concepts required in the study of biochemistry and the solving of numericals based on concepts studied.
- Structures of molecules based on theories of chemical bonding and understand the importance of non covalent interactions with respect to biomolecules.
- Concepts and applications of radioisotopes in elucidation of metabolic pathways and medicinal field.
- Concepts of bonding and structure of complexes with respect to VBT, CFT and LFT.
- The role of metal ions in biological systems.
- The application of polymers, solutions, colloids and photochemistry in biomolecules.
- The fundamentals of electrochemistry in relation to the electron transport chain of mitochondria and be familiar with the importance of physiological buffers in biological systems.
- The basic principles of qualitative and quantitative analysis as well as biochemical laboratory tests (the laboratory component)

LEARNING OUTCOMES:

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

- Easily do chemical calculations and understand the stoichiometry of reactions
- Apply the principles of chemical bonding as a basis for elucidating structure and function of molecules.
- Extrapolate the principles of coordination compounds as a basis for understanding the role of metals in biochemical processes.
- Apply the principles of colloids, polymers and electrochemistry in eventual biochemical research.

UNIT I

GENERAL CHEMISTRY

Chapter 1.1 MATHEMATICAL CONCEPTS 5 HRS

SI system – basic units, derived units, multiples and sub multiples of units (subsidiary units), dimensional analysis.

Mathematical concepts: scientific notation, curve sketching- line graph, errors in quantitative analysis, Significant figures.

Validity of laboratory measurements – Accuracy, precision, reliability, sensitivity, specificity and predictive value. Interpretation of laboratory tests (test and reference values of glucose, cholesterol, haemoglobin, RBC, WBC, platelets, creatinine, urea, uric acid).

Chapter 1.2 STOICHIOMETRY **5 HRS**

Avagadro number, molecular weight and mole concept, equivalent weight of acids, bases, salts and oxidizing agents (acidified, alkaline and neutral $KMnO_4$ and $K_2Cr_2O_7$) and reducing agents (Ferrous sulphate, Ferrous ammonium sulphate, sodium oxalate), Units of concentration: Normality, molarity, molality, mole fraction weight percent, standard solutions: primary and secondary standards, preparation of primary standard solutions, principle of volumetric analysis, problems.

Chapter 1.3 CHEMICAL BONDING **10 HRS**

Ionic bond- Lattice energy and Born Lande equation (no derivation), Born Haber cycle (NaCl,MgO). Problems. Covalent bond - properties, bond length, bond energy and bond angle, Sigma and pi bonds concept of resonance and its significance- examples benzene, furan, pyridine.

Non covalent interactions: Co-ordinate bond, Van der Waals' forces, electrostatic forces, hydrogen bonds (inter and intra molecular types) in alpha and beta helices of proteins, Hydrophobic forces. Applications of the above forces in micelle formation and lipid bilayers. Molecular self assembly, molecular recognition and complexation – medicine (eg: antibiotic vancomycin binding to peptides of bacterial cell wall) Template directed enzymatic synthesis/catalysis. (eg: synthesis of oligoguanylatescatalysed on oligocytidylate templates)

UNIT II

INORGANIC CHEMISTRY

Chapter2.1 RADIOACTIVITY **8 HRS**

Natural and artificial radioactivity, types of radioactive decay, disintegration constant, half life, decay constant, problems on half life ($t_{1/2}$), units of radioactivity. Detection and measurement of radioactivity – methods based upon ionization (Geiger Muller counter), excitation (Scintillation counter).Radioactive tracers and tracer technique. Production of a few radioisotopes (Na-24,P-32,C-14,S-35,I-131). Applications of radioisotopes as tracers (i) in the elucidation of metabolic pathways (C-14 in pentose phosphate pathway, P-32 in study of protein phosphorylation by kinases (ii) In medicines , P-32 in blood and skin cancer and detection of bone fracture. Co-60 in treatment of blood cancer.I-131 in diagnosis and treatment of thyroid diseases. iii) In nuclear medicine - clinical scanning - principle and difference of positron emission tomography (PET) and Single Photon Emission Computed Tomography (SPECT) scanning techniques. iv. Radiocarbon dating-to determine the age of fossils. Biological hazards of radiation, safety measures in handling radio isotopes.

Chapter 2.2 COORDINATION CHEMISTRY 5 HRS

Coordination chemistry (review)-Transition metal ions and oxidation states-Werner's Theory and types of ligands.

Bonding in complexes - Valence bond theory (Postulates with examples of Hexaamminechromium(III)ion, Hexacyanoferrate(III)ion, Hexacyanoferrate(II)ion, Hexaaquairon(III)ion complexes), Crystal field theory (postulates with examples of C.N=4: $[Ni(CN)_4]^{2-}$ and C.N=6: $[Co(H_20)_6]^{2+}$, $[Co(CN)_6]^{3-}$). Brief introduction of Ligand field theory. Stereoisomerism in complexes - geometric complex- $[Pt(NH)_2\ Cl_2]$ and optical isomerism $[Co(en)_3]^{3+}$

Chapter 2.3 BIOINORGANIC CHEMISTRY 3HRS

General role of metal ions in biological systems, structure of porphyrin ring and role of iron in Myoglobin, Haemoglobin – role of iron in anaemia. Structure of oxy and deoxy haemocyanin and role of copper, structure of chlorophyll and role of magnesium. Role of metal ion in enzymes - copper in cytochrome, zinc in carboxypeptidase, molybdenum in nitrogenase.

UNIT 3 BIOPHYSICAL CHEMISTRY

Chapter 3.1 POLYMERS 4 HRS

Classification, polymerization process with examples (polysaccharides, proteins and nucleic acids), Number average and weight average molecular weights, molecular weight determination by osmotic pressure and light scattering techniques. Mention to be made of sedimentation / ultracentrifugation method and SDS-PAGE as other methods for determination of molecular weight (done in detail in semester II).

Chapter3.2 PROPERTIES OF SOLUTIONS 3 HRS

Viscosity- Definition and its biological importance.Surface tension-definition and its biological importance.Effect of surfactants.Diffusion-definition, osmosis- osmotic pressure and its measurement by Berkeley-Hartley method. Laws of osmotic pressure, effect of osmotic pressure on living cells- hypo, hyper and isotonic solutions.

Chapter3.3 COLLOIDS 3 HRS

Colloids (sols) - lyophilic and lyophobic sols, purification of colloids by dialysis, coagulation, Donnan membrane equilibrium- application in biological system.

Chapter 3.4 PHOTOCHEMISTRY 2 HRS

Laws of photochemistry, Definition of quantum efficiency.Fluorescence and phosphorescence chemiluminescence, bioluminescence.Types of photochemical reactions-

combination, decomposition, polymerization and photosensitization reactions with an example.

UNIT 4 PHYSICAL CHEMISTRY

Chapter 4.1 ELECTROCHEMISTRY 6 HRS

Electrochemical cells: oxidation-reduction reactions, reversible electrodes, single electrode potential, measurement of single electrode potential, Nernst equation (derivation not required), standard electrode potentials (for biochemical half reactions eg: cytochromes), electrochemical series, reference electrodes: *construction and working of Hydrogen electrode* (*review*), calomel electrode and quinhydrone electrode- construction and their applications in potentiometric titrations (acid base and redox), measurement of pH.

Chapter 4.2 PH AND BUFFERS 6 HRS

Ionization of water, ionic product of water, Concepts of pH and pOH.Measurement of pH by colorimetric method (universal indicator) and electrode method (glass and combination electrode).Dissociation of acids and bases.Concept ofpK_a and pK_b, Importance of pKa in preparation of buffers, Calculation of pH and hydrogen ion concentration.

Buffers: buffer action with reference to acetate buffer, Henderson–Hasselbalch equation (derivation not required), buffer capacity, problems on preparation of buffer solutions. Biological buffer systems: bicarbonate, phosphate, protein, amino acid and hemoglobin buffers.

REFERENCES:

1. Puri B.R. and Sharma L.R. - Principles of physical chemistry, 42nd edition, 2007, Vishal Publishing Co.
2. Lee, J.D. - Concise Inorganic Chemistry. 5th edition, 2006, Blackwell Science Ltd.
3. Prakash Satya and Madan R.D. - Modern Inorganic Chemistry, 10th Edition 2001, S Chand & Co.
4. Debajyoti Das, Biochemistry, 13th edition, 2008, Academic publishers.
5. Jain J.L., Jain Sunjay, Jain Nitin, Fundamentals of Biochemistry, 6th edition 2012, S. Chand & company.
6. West, Edward Staunton, Todd, Wilbert R., Mason, Howard S, and Bruggen, John T Van- Text Book Of Biochemistry. 4th Edition 1974. Oxford and IBH Publishing Co Pvt. Ltd.
7. Allen, James P., Biophysical Chemistry, 2008 Wiley-Blackwell.
8. Journal of molecular evolution. 1981,Volume 17,Issue 5,pp295-302.Springer Link.

9. Atkins Peter and De Paula Julio – Atkins' Physical Chemistry Volume 1, 9th edition 2010, W. H. Freeman.
10. Murray Robert K., Bender David A., Botham Kathleen M., Kennelly Peter J., Victor Rodwell W., Weil P. Anthony, Harper's Illustrated Biochemistry, 29th Edition 2012, McGraw Hill.
11. Bhattacharya P.K.,Metal ions in Biochemistry, 2006
12. Greenwood N.N. and Earnshaw A., Chemistry of the elements, second edition, 2005, Elsevier Publication
13. Berg Jeremy M., Tymoczko John L., StryerLubert, Biochemistry, seventh edition 2011, W. H. Freeman.

I SEMESTER BIOCHEMISTRY: PRACTICAL – I

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

1. Calibration of volumetric glass wares.
2. Preparation of standard potassium hydrogen phthalate(PHP) and estimation of alkali.
3. Preparation of standard sodium oxalate and estimation of potassium permanganate.
4. Preparation of standard potassium dichromate solution and estimation of sodium thiosulphate using starch as the indicator.
5. Preparation of standard potassium dichromate solution and estimation of ferrous ammonium sulphate using internal indicator.
6. Preparation of standard potassium dichromate solution and estimation of ferrous ammonium sulphate using potassium ferricyanide as an external indicator.
7. Determination of the standard single electrode potential of Cu and Zn.
8. Preparation of buffers (acetate, phosphate).
9. Determination of pH of a buffer using glass electrode and quinhydrone electrode.
10. Estimation of glucose by Somogyi's method.

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 biochemistry and molecular biology, 7th Edition 2010, Cambridge University Press
5. Vogel, Arthur Isreal, Textbook of Quantitative Chemical Analysis, Sixth Edition 2000, Prentice Hall.