Minor -III

General Chemistry -III

Credit 06 (Theory 04, Practical 02)

Course Overview: This course aim to provide knowledge about different aspects of biological chemistry including bioinorganic and biochemistry. It also helps to understand preliminary knowledge about spectroscopic methods and separation techniques used in various industry.

Course Outcomes. Students from various backgrounds can learn the chemistry of biological systems and know several techniques for separation methods. These learning would be helpful in their respective fields.

Part A: Inorganic Chemistry **20 Lectures**

Coordination Chemistry: Werner's theory, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt).

Bioinorganic Chemistry: Elements of life: essential, major, trace and ultra-trace elements. Basic chemical reactions in the biological systems and the role of metal ions (specially Na^{+}, K^{+}, Mg^{2+}, Ca^{2+}, $Fe^{3+/2+}$, $Cu^{2+/+}$, and Zn^{2+}). Ionophores, Sodium potassium pump. Biological functions of hemoglobin and myoglobin, cytochromes and ferredoxins, carboxypeptidase, carbonic anhydrase. Biological nitrogen fixation, Photosynthesis: Photo system-I and Photosystem-II. Toxic metal ions and their effects, chelation therapy, Pt and Au complexes as drugs (examples only), metal dependent diseases.

Part B: Organic Chemistry **20 Lectures**

Nucleic acid: Components of nucleic acids, Nucleosides and nucleotides; Structure and nomenclature of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides.

Amino acids, Peptides, Proteins: Amino acids, Classifications of amino acids and their structure, Zwitterion, Isoelectric point and Electrophoresis. Reactions of amino acids: esterification, of $–CO_2H$, acetylation of $–NH_2$, complexation, ninhydrin test. Overview of primary, secondary, tertiary and quaternary structures of proteins, Determination of primary structure of peptides by degradation – Edman degradation (N-terminal), with thiohydantoin and carboxypeptidase enzyme (C-terminal).

Carbohydrates: Monosaccharides – Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, Interconversions of aldoses and ketoses, Kiliani-Fischer synthesis, Oxidation and Reduction.

Part C: Physical & Analytical Chemistry 20 Lectures

Spectroscopy: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

Solvent Extraction and Separation techniques: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Affinity Chromatography, Paper Chromatography, Thin-layer Chromatography, Column Chromatography.

Practical 30 Lectures

1. Preparation of Mohr's salt.
2. Preparation of urea formaldehyde.
3. Verification of Beer-Lambert's law using $KMnO_4$ solution**.**
4. Separation of two amino acids using Paper Chromatography and calculation of R_f value.

Suggested Textbooks

1. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
2. Barrow, G. M. *Physical Chemistry,* Tata McGraw-Hill (2007).
3. R. L. Dutta & G.S. De, Inorganic Chemistry (Vol. 1), The New Book Stall, 1973.
4. Quantitative Chemical Analysis, Daniel C Harris: 10^{th} Edition, W H Freeman and Company.

Reference Books for Practical

1. Vogel, A.I. A text book of Quantitative Analysis, ELBS 1986.
2. Practical Analytical Chemistry, Dr. G Devala Rao, 2010, Birla Publications P Limited.
3. An Advanced Course in Practical Chemistry, Nad, Mahapatra & Ghosal, New Central Book Agency (P) Limited, 2014.
4. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.