

SEMESTER V

Paper 17-CHHT 511: Inorganic Chemistry -IV

THEORY

Marks: 100

Unit I : Coordination Chemistry

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of $10 Dq$ (Δ_o), CFSE in weak and strong fields, pairing energies, factors effecting the magnitude of $10 Dq$ (Δ_o , Δ_t). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

Unit II: Transition elements: General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series.

Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

Unit III: Lanthanoids and actinoids: electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

Recommended Texts:

1. Purecell, K.F. and Kotz, J.C., *Inorganic Chemistry* W.B. Saunders Co. 1977.
2. Basolo, F, and Pearson, R.C., *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967.
3. Greenwood, N.N. & Earnshaw A., *Chemistry of the Elements*, Butterworth-Heinemann, 1997.

Paper 18-CHHT 512: Organic Chemistry -IV

THEORY

Marks: 100

Unit I: Carbohydrates

Occurrence, classification and their biological importance

Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation;

Disaccharides – Structure elucidation of maltose, lactose and sucrose

Polysaccharides – Elementary treatment of starch, cellulose and glycogen.

Unit II: Nucleic Acids

Components of nucleic acids, Nucleosides and nucleotides;

Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides.

Unit III: Amino acids, Peptides and Proteins

Amino acids, Peptides and their classification.

α -Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pK_a values, isoelectric point and electrophoresis;

Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups - Solid-phase synthesis

Unit IV: Lipids

Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

Unit V: Pharmaceutical Compounds: Structure and Importance

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis).

An elementary treatment of Antibiotics and detailed study of chloramphenicol,

Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine)

Unit VI: Terpenes

Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral, Neral and α -terpineol.

Recommended Texts:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry*, Fourth Edition, W. H. Freeman.
5. Berg, J. M., Tymoczko, J. L. & Stryer, L. *Biochemistry*, Sixth Edition, W. H. Freeman.

Paper 19-CHHT 513: Physical Chemistry -IV

THEORY

Marks: 100

Unit I : Conductance

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules.

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

Unit II: Chemical Kinetics

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

Surface chemistry: Physical adsorption, chemisorption, adsorption isotherms. nature of adsorbed state.

Catalysis: Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Unit III: Photochemistry

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

Recommended Texts:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 8th Ed., Oxford University Press (2006).
2. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
3. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
4. Laidler, K. J. *Chemical Kinetics* Pearson Education: New Delhi (2004).

Paper 20-CHHT 514: Biochemistry and Environmental Chemistry

THEORY

Marks: 100

Unit I:

- Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle
- Proteins: classification, biological importance; Primary, secondary and tertiary structures of proteins: α -helix and β -pleated sheets, Denaturation of proteins
- Enzymes: Nomenclature, Characteristics (mention of Ribozymes), Classification; Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in "Green Chemistry" and Chemical Industry

Unit II:

- Lipids: Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications.
- Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy.

Unit III:

- Environment and its segments, Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulfur
- Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical Smog: its constituents and photochemistry, Environmental effects of Ozone, Major sources of Air pollution
- Effects of air pollution on living organisms and vegetation, Controls of air pollution, Climate change, Green house effect, global warming. Techniques of measuring air pollutants.
- Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods

Unit IV:

- Energy and Environment: Sources of energy: Coal, petrol and Natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel etc.
- Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its Management

Recommended Texts:

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VI the Edition. W.H. Freeman and Co.
2. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) principles of Biochemistry. IV Edition. W.H. Freeman and Co.
3. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange medical Books/ McGraw-Hill
4. Manahan S.E. (2005) Environmental Chemistry, CRC Press
5. Miller, G.T. (2006) Environmental Science 11th edition. Brooks/Cole
6. Mishra, A. (2005) Environmental Studies. Selective and Scientific Books, New

Paper 17-CHHP 511: Inorganic Chemistry -IV

PRACTICAL

Marks: 50

- (a) Quantitative Analysis: The following quantitative estimations are to be carried out.
- (i) Estimation of nickel (II) using Dimethylglyoxime as the precipitant.

- (ii) Estimation of copper as CuSCN
 - (iii) Estimation of iron as Fe_2O_3 by precipitating iron as $\text{Fe}(\text{OH})_3$ through (i) Heterogeneous and (ii) Homogeneous media.
 - (iv) Estimation of Al (III) by precipitating with oxine and weighing as $\text{Al}(\text{oxine})_3$ (aluminium oxinate).
- (b) Inorganic Preparations
- (i) Tetraammine copper (II) sulphate, $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$
 - (ii) Potassium trisoxalatochromate (III), $\text{K}_3[\text{Cr}(\text{C}_2\text{O}_4)_3]$
 - (iii) Cis and trans $\text{K}[\text{Cr}(\text{C}_2\text{O}_4)_2(\text{H}_2\text{O}_2)]$ Potassium dioxalatodiaquachromate (III)
 - (iv) Pentaammine carbonato Cobalt (III) ion
- (c) Spectrophotometric estimation of Ferrous ions by using 1,10 phenanthroline

Recommended Texts:

1. Vogel, A.I. A text book of Quantitative Analysis, ELBS 1986.

Paper 18-CHHP 512: Organic Chemistry -IV

PRACTICAL

Marks: 50

1. Systematic analysis of extra elements in the given unknown compounds
2. Tests for following functional groups and unsaturation
3. Qualitative analysis of the following types of unknown organic compounds
 - Carboxylic acids
 - Phenols
 - Alcohols
 - Aldehydes
 - Ketones
 - Esters

Paper 19-CHHP 513: Physical Chemistry -IV

PRACTICAL

Marks: 50

- (I) To study changes in conductance in the following systems
- (i) strong acid-strong base
 - (ii) weak acid-strong base and
 - (iii) mixture of strong acid and weak acid-strong base
- (II) Study the kinetics of the following reactions.
- 1. Initial rate method: Iodide-persulphate reaction
 - 2. Integrated rate method:
 - (a) Acid hydrolysis of methyl acetate with hydrochloric acid, volumetrically or conductometrically.
 - (b) Iodide-persulphate reaction
 - (c) Saponification of ethyl acetate.

Any other experiment carried out in the class.

Paper 20-CHHP 514: Biochemistry and Environmental Chemistry

PRACTICAL

Marks: 50

1. To perform quantitative estimation of protein using Lowry's method. Determine the concentration of the unknown sample using the standard curve plotted.
2. Study of the action of salivary amylase at optimum conditions
3. Effect of pH on the action of salivary amylase
4. Effect of temperature on the action of salivary amylase
5. Effect of inhibitor on the action of salivary amylase
6. Study of the activity of Trypsin using fresh tissue extracts.
7. To study the effect of temperature, organic solvents, on semi-permeable membrane.
8. Isolation of Genomic DNA from E Coli
9. Qualitative analysis of the soil from different locations for pH and different water soluble cations and anions

10. Quantitative estimation of oxidisable organic matter in soil, carbonate and bicarbonates by volumetry and calcium and magnesium by EDTA titration.
11. Hardness of water by EDTA titration
12. Study of pH and conductivity of tap water and polluted water.