M Sc II YEAR-2015
SEMESTER III

CH-501 APPLICATIONS OF SPECTROSCOPY

INORGANIC CHEMISTRY

UNIT I Vibrational Spectroscopy

Symmetry and shapes of AB_2, AB_3, AB_4, AB_5 and AB_6, mode of bonding of ambidentate ligands, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy particularly for the study of active sites of metalloproteins.

Electron Spin Resonance Spectroscopy

Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron) including biological systems and to inorganic free radicals such as PH_4, F_2 and $[BH_3]$.

UNIT II Nuclear Magnetic Resonance of Paramagnetic Substances in Solution

The contact and pseudo contact shifts, factors affecting nuclear relaxation, some applications including biochemical systems, an overview of NMR of metal nuclides with emphasis on ^{195} Pt and ^{199}Sn NMR.

Mossbauer Spectroscopy

Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (2) Sn^{+2} and Sn^{+4} compounds nature of M-L bond, coordination number, structure and (3) detection of oxidation state and inequivalent MB atoms.

ORGANIC CHEMISTRY

UNIT III Ultraviolet and Visible Spectroscopy

Various electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

Mass Spectrometry

Introduction, ion production – El, Cl, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral framentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometery. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

UNIT IV Infrared Spectroscopy

Instrumentation and sample handling.

Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids,

anhydrides, lactones, lalctams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. FT IR. IR of gaseous, solids and polymeric materials.

Optical Rotatory Dispersion (ORD) and Circular Dichroism (CD)

Definition, deduction of absolute configuration, octant rule for ketones.

UNIT V Nuclear Magnetic Resonance Spectroscopy

General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra-nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier transform technique, Nuclear Overhauser effect (NOE). Resonance of other nuclei- F, P.

Carbon-13 NMR Spectroscopy

General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants.

Two dimension NMR spectroscopy – COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques.

Books Suggested:

1. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS.
2. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley.
3. Progress in Inorganic Chemistry vol., 8 ed., F.A. Cotton, vol., 15, ed. S.J. Lippard, Wiley.
4. Inorganic Electronic Spectroscopy., A.P.B. Lever, Elsevier.
5. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Horwood.
6. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.
7. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill, John Wiley.
8. Introduction to NMR Spectyroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
9. Application of Spectroscopy of Organic Compounds, J.R. dyer, Prentice Hall.
10. Spectroscopic Methods in Organic Chemistry, D.H. Williams, I. Fleming, Tata McGraw-Hill.

CH-502 PHOTOCHEMISTRY AND SOLID STATE CHEMISTRY

UNIT I Photochemical Reactions

Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

Determination of Reaction Mechanism

Classification, rate constants and life times of reactive energy states - determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions- photo-dissociation, gas-phase photolysis.

UNIT II Photochemistry of Alkenes

Intramolecular reactions of the olefinic bond – geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5- dienes,

Photochemistry of Carbonyl Compounds

Intramolecular reactions of carbonyl compounds – saturated, cyclic and acyclic, β,γ - unsaturated and α,β-unsaturated compounds. Cyclohexadienones.

Intermolecular cyloaddition reactions – dimerisations and oxetane formation.

UNIT III Photochemistry of Aromatic Compounds

Isomerisations, additions and substitutions.

Miscellaneous Photochemical Reactions

Photo-Fries reactions of anilides. Photo-Fries rearrangement.

Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog.

Photodegradation of polymers. Photochemistry of vision.

UNIT IV Solid State Reactions

General principles, experimental procedures,

Crystal Defects – Perfect and imperfect crystals, intrinsic and extrinsic defects – point defects, line and plane defects. Thermodynamics of Schottky and Frenkel defect formation, colour centers.

UNIT V Solid State Chemistry

Electronic Properties and Band Theory

Metals, insulators and semiconductors, band theory of solids(qualitative treatments), band structure of metals, insulators and semiconductors. Inrinsic and extrinsic semiconductors, p-n junctions.

Superconductors- factors affecting the super conductivity, magnetic properties, persistent current and BCS theory of superconductors.

Optical properties – photoconduction.

Magnetic Properties – Classification of materials, Magnetic domains, hysteresius.

Organic Solids

Electrically conducting solids, organic charge transfer complex - new superconductors.

Books Suggested:

1.Fundamentals of Photochemistry, K.K Rohtagi-Mukherji, Wiley- Easter.
2. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
3. Introductory Photochemistry, A. Cox and T. Camp, McGraw-Hill.
4. Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.
5.Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.
6.Solid State Chemistry and its Applications, A.R. West, Plenum.
7. Principles of the Solid State, H.V. Keer, Wiley Eastern.
8.Solid State Chemistry, N.B. Hannay.
9. Solid State Chemistry, D.K. Chakrabarty, New Age International.

CH-503 ENVIRONMENTAL CHEMISTRY

UNIT I Environment

Introduction, Composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, vertical stability atmosphere. Biogeochemical cycles of C, N, P, S and O. Biodistribution of elements.

UNIT II Hydrosphere

Chemical composition of water bodies: lakes, streams, rivers and wet lands, etc. Hydrological cycle.

Aquatic pollution – inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters – dissolved oxygen (DO), biochemical oxygen demand(BOD), solids, metals, content of chloride, sulphate, phosphate, nitrate and micro-organisms.Water quality standard.

Analytical methods for measuring BOD, DO, COD, F. Oils, metals (As, Cd, Cr, Hg, Pb, Se etc.), residual chloride and chlorine demand.

Purification and treatment of water.

UNIT III Lithosphere : All types of soils

Composition, micro nutrients, Pollution: fertilizers, pesticides, plastics and metals. Waste treatment.

UNIT IV Atmosphere

Chemical composition of atmosphere – particles, ions and radicals and their formation.

Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect, pollution by chemicals, petroleum, minerals, chlorofluorohydrocarbons.

Green house effect, acid rain, air pollution controls and their chemistry.

Analytical methods for measuring air pollutants.Continuous monitoring instruments.

UNIT V Industrial Pollution and Environmental Toxicology

Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy. Polymers, drugs etc. Radionuclide analysis. Disposal of wastes and their management.

Chemical solutions to environmental problems, biodegradability, principles of decomposition, better industrial processes.

Bhopal gas tragedy, Chernobyl, Three Mile Island, Sewozo and Minamata disaster.

Books Suggested:

1. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
2. Environmental Chemistry, Sharma & Kaur, Krishna Publishers.
3 Environmental Chemistry, A.K. De, Wiley Eastern.
4. Environmental Pollution analysis, S.M. Khopkar, Wiley Eastern.
5. Standard Method of Chemical Analysis, F.J. Welcher Vol, Van Nostrand Reinhold Co.
6. Environmental Analysis of Airborne Particles, Ed. S. Landsberger and M. Creatchman, Gordon and Breach Science Publication.
7. Environmental Chemistry, S. Baird, W.H. freeman.

CH-504 BIO-CHEMISTRY

UNIT I

Metal ions in Biological Systems Role of metal ions in biological processes.

Bioenergetics and ATP Cycle:

Photosynthesis, Chlorophylls, Photosystem I and Photosystem II.

Diosygen Uptake: Structure and function of haemoglobin, myoglobin, hemocyanins and hemerythrin, model system and synthetic complexes of iron Cobalt and copper.

Electron Transfer in Biology: Structure and function of metalloproteins, Cytochromes and iron-sulphur proteins, synthetic models, peroxidases and catalases.

Nitrogenases: Biological nitrogen fixation, molybdenum nitrogenases, model systems.

UNIT II **Enzymes**

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and enzyme modification by site directed muta genesis. Transition state theory, orientation and stearic effect, acid-base catalysis, covalent catalysis, strain or distortion. Coupling of ATP cleavage to endergonic processes, β-cleavage and condensation.

UNIT III Co-Enzyme Chemistry

Cofactors as derived from vitamins, coenzyme, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD^+, $NADP^+$, FMN, FAD, lipoic acid, vitamin B_{12}, Mechanism of reaction catalysed by the above cofactors. Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry, brewing and cheese making, syrups from corn starch.

UNIT IV Bioenergetic and Biopolymer Interactions:

Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.
Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves.

UNIT V Diffraction Methods and Statistical Mechanics in Biopolymers.

Evaluation of size, shape, molecular weight and textent of hydration of biopolymers by various experimental techniques. Light scattering, low angle X-ray scattering, X-ray diffraction and photo correlation spectroscopy ORD Chain configuration of macromolecules, statistical distribution end to end dimensions, calculation of average dimensions for various chain structure. Polypeptide and protein structures, introduction to protein folding problem.

Books Suggested :

1. The Inorganic Chemistry of Biological Processes, M.N.Hughes Wiles (1972).
2. Bioinorganic Chemistry-An Introduction, Enchiroochiai.
3. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M.Berg, University Science Books.
4. Bioinorganic Chemistry, I Bertini, H.B. Gray, S.J.Lipard and J.S. Valentine, University Science Books.
5. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C.Penny, Springer-Verlag.
6. Understanding Enzymes, Trevor Palmer, Prentice Hall.
7. Enzyme Chemistry:Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall.
8. Enzyme Mechanisms Ed. M.I.Page and A.Williams, Royal Society of Chemistry.
9. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press.
10. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael D. Tevan, John Wiley.
11. Enzymatic Reaction Mechanisms, C.Walsh, W.H. freeman.
12. Enzynie Structure and Mechanism, A Fersht, W.H. Freeman.

13. Biochemistry: The Chemical Reactions of Living Cells, D.E.Metzler, Academic Press.
14. Principles of Biochemistry, A.L.Lehninger, Worth Publishers.
15. Biochemistry, L. Strver, W.H.Freeman
16. Biochemistry, J.David Rawn, Neil Patterson.
17. Biochemistry, Voet and Voet, John Wiley.
18. Outlines of Biochemistry, E.E.Conn and P.K.Stumpf, Johh Wiley.
19. Bioorganic Chemistry: A Chemical Approach to Enzyme Achon. H. Dugas and C.Penny, Springer-Verlag.
20. Macromolecules: Structure and Function, F.World, Prentice Hall.

Laboratory Course -I
Course No.511 : Inorganic Chemistry

Experiment No. 1 :
Preparation of some Inorganic coordination compounds.

Experiment No. 2:
Analyse the given mixture for four rare elements.

Experiment No. 3:
Estimation of three constituent in the given mixture (Two gravimetrically and one volumetrically**).**

Experiment No. 4: Iron phenanthroline complex : Job's Method of continuous variations.

Experiment No. 5: Find out the stability constant of metal complex by Bjerrum's Method.

Laboratory Course -II
CH 512: Instrumental Lab.

I . pH metry:

1. To determine the dissociation constants of dibasic and tribasic acids.
2. Titration of mixture of acids (HCl + CH_3COOH) again strong base.

II. Spectrophotometry:

1. Determination of PK_a of an indicator (e.g. methyl red) in (a) aqueous and (b) micellor meda.
2. Defermination of stoichiometry and stability constant of inorganic (e.g. ferri – salcylic acid) and organic (e.g. amine – iodine).
3. To determine the concentration of chromium and manganese in a binary mixture.

III. Polarography:

1. To study oxygen wave by polorography.

2. To characterize and determine Pb^{2+}. Cd^{2+} and Zn^{2+}, ions by polarography/cyclic voltammetry

IV Fluorometry
1. Determination of strength of Vitamin B (Riboflavin) and Aluminium.

V. Nephelometry
1. Determination of sulphate content in water sample.
2. Determination of phosphate content in water sample.

VI. Flame photometry
1.Estimation of Ma, K and Ca.
2.Estimation in a mixture (Na and K; K and Ca).

VII Water and Waste Water examination:
1. DO and BOD determination.
2. COD estimation.
3.Fluoride and nitrate determination.

VIII Cement Analysis
IX Chromatography: Coloumn

M Sc II YEAR (Affiliated college)-2015

SEMESTER IV

LIST of ELECTIVE PAPERS IN THE M.Sc. CHEMISTRY.

GROUP A

CH 601 :Organotransition Metal Chemistry.

CH 602 : Advanced Analytical Techniques

CH 603 : Liquid State

CH 604 : Polymers

ELECTIVE PAPER 1

CH-601 Organotransition Metal Chemistry

UNIT I
Organotransition metal compounds : Definition, Classification and nomenclature of organotransition metal compounds. Difference in nature of bonding between metal carbonyls and organotransition metal compounds.

UNIT II
Alkyls and Aryls of Transition Metals: Types, methods of synthesis, thermal stability and decomposition pathways.

UNIT III

Transition Metal π-Complexes: Transition metal π-complexes with unsaturated organic molecules, alkenes, cyclopentadienyls and arenas, methods of synthesis, properties, nature of bonding and structural features.

UNIT IV

Homogeneous Catalysis: Homogeneous catalytic hydrogenation of Alkenes, Zeigler Natta polymerization of olefins, Isomerisation of Alkenes, Hydroformylation, Dimerisation and polymerization of Alkenes and Alkynes.

UNIT V

Organocopper in Organic Synthesis: Conjugated additions, halogen substitution, alkylation of epoxides, alkylation of allylacetates, ketones from acid chlorides.

Books Suggested:

1. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organomettalic Chemistry of the Transition Metals, R.H. Crabtree, John, Wiley.
3. Metallo-organic Chemistry, A.J. pearson, Wiley.
4. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.

ELECTIVE PAPER 2

Ch-602 Advanced Analytical Techniques

Unit I Basics of Instrumentation and Gas Chromatography

Basic Electronics for Analytical Instruments;
Automation in Analysis: Introduction to On-line/ Process control analyzer, Discrete, Continuous analysis and Flow injection analysis
Gas Chromatography (GC): Theory, General layout of equipment, detectors for GC, Applications; Gas Chromatography with Mass Spectrometry (GC-MS).

Unit II Column and Thin Layer Chromatography

High performance Liquid Chromatography (HPLC): Types of Liquid Chromatography, General layout of equipment & detectors for HPLC, Applications of HPLC in pharmaceutical Analysis.
Thin Layer Chromatography (TLC), Application of TLC special reference to forensic analysis; High Performance Thin Layer Chromatography (HPTLC).

Unit III X-ray and Emission Techniques:

Production of X-rays, Instrumentation, direct X-ray method, X-ray Absorption Spectroscopy, X-ray Fluorescence Spectroscopy.
Inductively Coupled Plasma Emission Spectroscopy (ICPES): theory,

instrumentation and applications.

Unit IV Surface Techniques:

Basic Principle, Theory; Chemical & Surface applications of:
Electron Spectroscopy for Chemical Analysis (ESCA), Auger Emission Spectroscopy (AES), Photoacoustic Spectroscopy (PAS)

Unit V Tools for Nanotechnology:

Basic Principle, Instrumentation and Significance of Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Atomic Force Microscopy (AFM).

Books:

1. Instrumental Methods of Analysis, H.H. Willard, L.L. Merritt, J.A. Dean and F.A. Settle, CBS Publ. Delhi.
1. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, Publ. W B Saunders
2. Instrumental Methods of Analysis, Strobel
3. Instrumental Methods of Analysis, H.H. Willard, L.L. Merritt, J.A. Dean and F.A. Settle , CBS Publ. Delhi.
4. Nanoscale materials, L.M. L. Marzan, Prashant V.Kamat, Publ. Springer 2003
5. Nanoscale Science and Technology, R.w. Kelsall, M. Geoghegan I.w. Hamley Publ John Wiely & Sons 2005

ELECTIVE PAPER 3

CH-603 Liquid State

UNIT I General Properties of Liquids

Properties of liquids, Structure of liquids, Comparison of liquid Argon and liquid sodium. Some thermodynamic relations, equations of state, critical constants. Different types of intermolecular forces in liquids, Order on liquids.

UNIT II Theories of Liquids

A classical partition function for liquids, correspondence principle, configuration properties: configuration integral. Theory of liquids: cell theory, model approach; single cell models, communal energy and entropy.

UNIT III Distribution Function and Related Equations

Molecular distribution functions, pair distribution function. Internal energy of liquids. Relationship between pair distribution function and pair potential function. The YBG equation, the HNC equation, the PY equation, cluster expansion.

UNIT IV Methods for Structure Determination and Computational Techniques

Spectroscopic techniques for liquid dynamic structure studies, Neutron and X-ray scattering spectroscopy.

Computation Techniques-Monte Carlo and molecular dynamics methods.

UNIT V Super cooled and Ionic Liquids

Super cooled and ionic liquids, theories of transport properties; non Arrhenius behaviour of transport properties,

Quantum liquids: Comparison of classical and quantum liquids. Critical velocity for superfluids.

Books Suggested:

1. An Introduction to Liquid State, P.A. Egelstaff, Academic Press.
2. The Dynamic Liquid State, A.F.M. Barton, Longman.
3. Introduction to Statistical Thermodynamics, T.L. Hill, Addison Wiley.
4. The Liquid State, J.A. Pryde.
5. Significant Liquid Structures, H. Eyring and M.S. John.
6. Properties of liquids and solutions, Murrel & Boucher, John Wiley & Sons

ELECTIVE PAPER 4

CH-604 Polymers

UNIT I Basic

Importance of polymers. Basic concepts : Monomers, repeat units, degree of polymerization. Linear, branched and network polymers.

Classification of polymers.

Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

UNIT II Polymer Characterization

Polydispersion-average molecular weight concept. Number, weight and viscocity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscocity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength, impace. Tear resistance. Hardness and abrasion resistance.

UNIT III Structure and Properties

Morophology and order in crystalline polymers-configurations of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point Tm-melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Tg-Relationship between

Tm and Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

UNIT IV Polymer Processing

Plastics, elastomers and fibres. Compounding. Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spining.

UNIT V Properties of Commercial Polymers

Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers – Fire retarding polymers and electrically conducting polymers. Biomedical polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

Books Suggested:

1. Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.
2. Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Screedhar, Wiley-Eastern.
3. Functional Monomers and Polymers, K. Takemoto, Y. Inaki and RM. Ottanbrite.
4. Contemporary Polymer Chemistry, H.R. Alcock and F.W. Lambe, Prentice Hall.
5. Physics and Chemistry of Polymers, J.M.G. Gowie, Blackie Academic and Professional.

Laboratory Courses-III

CH 513 : Organic Chemistry

I. Qualitative Analysis

Separation, purification and identification of three components of a mixture of organic compounds (three solids or two liquids and one solid, two solids and one liquid).

II. Multi-step Synthesis of Organic Compounds

Benzophenone → Benzpinacol → Benzpinacolone

→ Benzophenone → Benzophenone oxime → Benzanilide

Benzoin → Benzil → Benzilic acid

Skraup synthesis: Preparation of quinoline from aniline.

Synthesis using microwaves

To carry out oxidation of alcohols and oxime by PCC.

Synthesis using phase transfer catalyst

Alkylation of diethyl malonate or ethyl acetoacetate with an alkyl halide.

III. Extraction of Organic Compounds from Natural Sources

1. Isolation of caffeine from tea leaves.
2. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins).
3. Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and $R_f$value reported).
4. Isolation of piperine from black pepper.
5. Isolation of lycopene from tomatoes.
6. Isolation of cartoene from carrots.
7. Isolation of eugenol from cloves.

IV. Paper Chromatography / TLC

Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

V. Spectroscopy

Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, Ms).

Spectrophotometric (UV/VIS) Estimations

1. Amino acids
2. Proteins
3. Carbohydrates
4. Ascorbic acid
5. Aspirin
6. Caffeine

Books Suggested

1. Systematic Qualitative Organic analysis by H. Middleton.
2. Qualitative and Quantitative hand book of Organic analysis by H. Clark
3. Vogel's Text book of practical Organic Chemistry by Vogel
4. Practical Organic Chemistry by N.K. Vishnoi.

Laboratory Courses-IV

CH 514- Physical Chemistry

I. Chemical Kinetics

(i) To investigate the kinetics of the reaction between I^- and persulphate ion
(a) Order of the reaction
(b) Energy of activation of the reaction.
(c) Effect of ionic strength on rate.

(ii) To find out the order of the reaction of saponification of ester using unequal concentrations of reactants.

II. Chemical kinetics

(i) To investigate the kinetics of the reaction between ceric ammonium sulfate and glycollic acid.

(a) Order with respect to ceric ion.
(b) Order with respect to glycollic acid.
(c) Energy of activation of the reaction.
(d) Effect of ionic strength on rate.

(ii)To study the reaction between cericammonium nitrate and primary alcohol.

III. Thermodynamics

(i) Determination of partial molar volume of solute (e.g.,KCl) and solvent in a binary mixture.

(ii) Determination of the temperature dependence of the solubility of a compound in two solvents having similar intermolecular interactions (benzoic acid in water and in DMSO-water mixture) and calculate the partial molar heat of solution.

IV. Phase Equilibrium

(i) To find out the equilibrium constant for the triiodide formation.

(ii) To find the formula of complex cuprammonium ion by distribution method.

V. Conductometry

(i) To find out the equivalent conductance of strong electrolytes at different dilutions and to verify Debye Huckel Onsagar equation.

(ii) To determine the equivalent conductance of a weak electrolyte at infinite dilution.

(iii) To determine the dissociation constant of acetic acid/Oxalic acid and verify the Ostwald's dilution law.

(iv) To determine the degree of hydrolysis and hydrolysis constant of ammonium chloride at room temperature.

(v) To determine the activity coefficient of zinc ions in the solution of 0.002 M $ZnSO_4$ using Debye-Huckel's Limiting Law.

(vi) Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by NaOH conductometrically.

(vii) To determine the solubility and solubility product of sparingly soluble salt ($PbSO_4$, $BaSO_4$)

VI. Potentiometry/pHmetry

(i) To determine the dissociation constants of weak acids (oxalic, tartaric, phosphoric) using pH meter.

(ii) To determine the temperature dependence of emf of a cell.

(iii) To determine the degree of hydrolysis of aniline hydrochloride for three different solutions at room temperature and hence calculate the hydrolysis constant of the salt and dissociation constant of the base.

(iv) To study the acid-base titration in a non-aqueous media using a pH meter.

(v) To find out thermodynamic constants ΔG, ΔS and ΔH for the reaction by emf measurements.

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$$

Books suggested:

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
4. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.
5. Advanced Experimental Chemistry, vol.1 – Physical J.N. Gurtu and R. Kapoor, S. Chand & Co.