

CHE C 9-T INORGANIC AND PHYSICAL CHEMISTRY-III

60 h

UNIT-I

15h

Chemistry of main group elements- Structure and bonding in boranes, carboranes, metallocarboranes, Wades rules, borazines, phosphazenes, S,N- compounds. Silicates- Classification, structures, isomorphous replacement, pyroxenes, layered and vitreous silicates, zeolites and molecular sieves.

HSAB concept: Basis of HSAB concept, acid-base strength, hardness and softness, symbiosis, applications of HSAB concept; Acid- base concept in non-aqueous media, reactions in BrF_3 , N_2O_4 , anhydrous H_2SO_4 , CH_3COOH . Isopoly and heteropoly acids of W, Mo and V, preparations, properties, structure and applications.

Stereoisomerism- Chirality, optical activity- CD, ORD, Cotton effect, absolute configuration of metal complexes, magnetic circular dichroism.

UNIT- II

15h

A. M-M bond and metal atom clusters, halide clusters, bonding in $[\text{ReCl}_8]^{2-}$. Metal carbonyl clusters- LNCC's and HNCC's. Electron counting in carbonyl clusters, Wades-Mingos and Lauher rules.

B. Nuclear Chemistry-The atomic nucleus-elementary particles, quarks, classification of nuclides based on Z and N values, nuclear stability, nuclear potential, binding energy. Nuclear Models: Shell model-salient features, forms of the nuclear potential, filling of orbitals, nuclear configuration, Liquid drop model, Fermi gas model, Collective model and Optical model. Radioactivity, radioactive decay kinetics, Parent-daughter decay-growth relationship-secular and transient equilibria, theories of α , β^- , β^+ and γ -decay, internal conversion, Auger effect.

UNIT-III

15h

Quantum Mechanics; Quantum numbers and their characteristics. List of wave functions for few initial states of hydrogen like atoms. Diagrams of radial and angular wave functions. Radial and angular distribution function and their significance. Electron spin (Stern-Gerlach experiment), spin-orbital, anti-symmetry and Pauli-exclusion principle, Slater determinants. Coupling of Angular momenta. Russell-Saunders and JJ-coupling, Term symbols. Spin-orbital interaction and explanation of term multiplicities (Na-D doublet). Zeeman effect.

Approximate methods: Need for approximate methods. Perturbation method. Rayleigh Schrödinger perturbation theory for time-independent non-degenerate system. Application to electron in a box under the influence of an electric field. Application to He atom. Variation theory-statement and proof. Application of variation method to particle in a one-dimensional box and He atom.

Chemical Dynamics-1: Macroscopic and microscopic kinetics, Review of theories of reaction rate-Collision theory and Transition state theory, Comparison of collision theory with transition state theory, Arrhenius equation- characteristics, Significance of energy of activation, Temperature coefficient and its evaluation. Thermodynamical formulation of reaction rates (Wynes-Jones and Eyring treatment), Reaction between ions in solutions - Influence of ionic strength on reaction rates (primary and secondary salt effects).

UNIT-IV

15h

Chemical Dynamics-2: Concept of Steady state kinetics, Chain reactions - chain length and chain inhibition, comparison of photochemical and thermal reactions, Mechanisms of thermal and photochemical reactions between hydrogen-bromine and hydrogen-chlorine. Comparative study of thermal and photochemical hydrogen-halogen reactions. Pyrolysis of acetaldehyde, Decomposition of ethane.

Kinetics of homogeneous catalysis-kinetics of auto catalytic reactions, kinetics of acid-base catalysed reactions. Comparison of enzyme catalysed and chemical catalysed reactions, Mechanism (Lock and Key

theory), Kinetics of enzyme catalyzed reactions - Henri-Michaelis- Menten mechanism, Significance of Michaelis-Menten constant, Lineweaver-Burk plot. Effects of enzyme concentration, pH, Temperature, Activators and Inhibitors on enzyme activity.

Theories of unimolecular reactions: Perrin theory, Lindemann theory, and Hinshelwood theory.

Surface chemistry- Mechanical adsorption, Estimation of surface area using BET equation, Gibbs adsorption isotherm and its significance, Surface tension and surface energy, Pressure difference across curved surface (Laplace

Kinetics of fast reactions- Introduction, Study of reactions by relaxation method (Temperature and pressure jump), flow method (Plug flow method and Stopped flow method), Flash photolysis and Shock tube method.

Recommended Books/References:

1. Basic Inorganic Chemistry- F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley and sons. Inc, 6th edition (1999).
2. Advanced Inorganic Chemistry, 6th edition; F. A. Cotton and G. Wilkinson.
3. Inorganic Chemistry IV edition; J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley (1993).
4. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford, ELBS; Oxford University Press, 1994.
5. Chemistry of elements; N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).
6. Concise Inorganic Chemistry, 5th edition; J. D. Lee (1996).
7. Essentials of nuclear chemistry, 4th edition; H. J. Arniker, NAIL publishers (1995); Chapters 1, 3 and 4.
8. Nuclear and Radioactive chemistry; Friedlander, Kennedy and Miller; Chapters 8 and 9.
9. Inorganic Chemistry, 3rd Edition; Gary. L. Miessler and Donald . A. Tarr (2007).
10. Physical Chemistry, P. W. Atkins, Julio de Paula, ELBS, 7th edition, (2002).
11. Physical Chemistry: A Molecular Approach, McQuarie and Simon, Viva, New Delhi, (2001).
12. Introduction to Quantum Chemistry, A. K. Chandra, Tata McGraw Hill, (1988).
13. Quantum Chemistry, Ira. N. Levine, Prentice Hall, New Jersey, (1991).
14. Quantum Chemistry, R. K. Prasad, New Age International, 2nd edition, (2000).
15. Quantum Chemistry through problems and solutions, R. K. Prasad, New Age International (1997).
16. Chemical Kinetics- K. J. Laidler, McGraw Hill. Inc. New York (1988).
17. Principles of Chemical Kinetics - House J. E. Wm C Brown Publisher, Boston, (1997).
18. Kinetics and Mechanism - A. A. Frost and R. G. Pearson, John-Wiley, New York, (1961).
19. Chemical Kinetic Methods - C. Kalidas, New Age International Publisher, New Delhi (1995)
20. S.H. Maran and C. F. Pruton, 4th Edn., Oxford, & IBH publishing Co. Pvt. Ltd. New Delhi (1965).
21. Physical Chemistry- P. Atkins and J. D. Paula, 9th Edn., Oxford University Press (2010).
22. Biochemistry, - Geoffrey Zubay, 2nd Edn., Macmillan Publishing Co. New York (1981).
23. Kinetics and Mechanism of Chemical Transformations- J. Rajaraman and J. Kuriakose, Mc Millan. (1986).
24. Physical Chemistry of Surfaces- A. W. Adamson, Interscience Publisher Inc., New York (1967).
25. Surface Chemistry: Theory and Applications, J. J. Bikerman, Academic Press. New York (1972).

CHE C10-P INORGANIC AND PHYSICAL CHEMISTRY PRACTICAL

INORGANIC CHEMISTRY PRACTICAL

Preparation and quantitative analysis of inorganic complexes:

1. Cis- and trans- potassium dioxalatochromium(III) complex [analysis of oxalate and chromium]
2. Hexamminecobalt(III)chloride [analysis of cobalt]
3. Mercurytetrathiocyanatocobaltate.
4. Preparation of pentamminechloro cobalt(III)chloride.

PHYSICAL CHEMISTRY PRACTICAL

1. Verification of Beer's Law for Cu^{2+} ions
2. Verification of Beer's Law for Fe^{2+} ions
3. Estimation of Fe^{2+} ions concentration in the given solution by titration of FAS versus KMnO_4 through colorimetric method.
4. Estimation of Fe^{2+} ions concentration using EDTA through colorimetric method
5. Phase diagram of two component systems and determination of E_c , E_T and the determination of the composition of given unknown.

Potentiometric Experiments

1. Determination of single electrode potential of Cu^{2+}/Cu and estimate the given unknown concentration.
2. Determination of single electrode potential of Zn^{2+}/Zn and estimate the given unknown concentration.
3. Titration of AgNO_3 versus KCl .
4. Titration of weak acid against a strong base using quinhydrone electrode and calculation of pK_a and K_a values of the weak acid.
5. Determination of pH of a buffer by using quinhydrone electrode and comparison of the pH values obtained with glass electrode.

Recommended Books/References:

1. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
2. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).
3. Findlays practical physical chemistry revised by P. B. Levitt, Longman's London (1966).
4. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill International Edn. (1966).
5. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988).
6. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987).
7. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
8. Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd (1968)
9. Experimental Physical Chemistry by Wilson, Newcombe & others, Pergamon Press, New York (1962).
10. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983).
11. Experimental Physical Chemistry by V. D. Atavale and Parul Mathur, New Age International, New York (2001).
12. Physical Chemistry Laboratory Principles and Experiments by H. W. Salberg J. I. Morrow, S. R.
13. Cohen and M. E. Green Macmillan publishing Co. New York.
14. Practical's in physical chemistry A. Modern Approach by P.S Sindhu, Mac. Millan
i. Publishers Delhi (2006).

CHE C11-T ORGANIC CHEMISTRY – III AND SPECTROSCOPY-I

60h

UNIT-I

15h

Reaction Mechanisms-I; Classification of reactions and mechanisms. Thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates.

Effect of structure on reactivity: - Resonance and field effects; steric effects. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.

Stereochemistry; Conformational analysis: Conformational analysis of cycloalkanes: cyclobutane, cyclopentane, cyclohexanes (monosubstituted e.g., methyl, iso-propyl, tert-butyl and di-substituted cyclohexanes e.g., dialkyl, dihalo, diols), and cycloheptane.

Nomenclature and conformations of fused rings and bridged ring systems. Prochirality: Enantiotopic and diastereotopic atoms, groups and faces.

Heterocyclic compounds: Nomenclature of heterocyclic compounds. Structure, reactivity, synthesis and reactions of pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, pyrimidine, purine and indole.

Preparation and reactions of coumarins, acridines, cinnolines and quinoxalines.

Vitamins: Biological importance and synthesis of Vitamins A, Vitamin B1 (thiamine), Vitamin B6 (pyridoxine), folic acid, pantothenic acid, riboflavin, Vitamin C, Vitamin E (?-tocopherol), Vitamin H (biotin), Vitamins K1 and K2.

UNIT-II

15h

Carbohydrates

Introduction. Kiliani-Fischer synthesis, Determination of configuration of the monosaccharides, conformational analysis of monosaccharides. Synthesis of amino sugars (β -D- Glucosamine, galactosamine, N-acetylmuramic acid (NAMA), N-acetyl neuraminic acid(NANA). C- and N- glycosides. Synthesis of aldonic, uronic, aldaric acids and alditols. Structure elucidation of sucrose and maltose. Structures of lactose, gentiobiose, and meliobiose. Photosynthesis of carbohydrates

Lipids

Introduction, Classification. Fatty acids—definition, classification as saturated and unsaturated with examples and structure (lauric, myristic, palmitic, stearic, oleic, linoleic, linolenic and arachidonic acids). Essential fatty acids – definition with examples Triglycerides—Structure of simple and mixed glycerides, properties of triglycerides- acid and alkali hydrolysis, saponification number and its significance, iodine number and its significance, rancidity (oxidative and hydrolytic), biological importance of triglycerides. Phosphoglycerides – general structure of 3-Sn–phosphatidic acid, lipid bilayer (as in cell membrane), micelles, liposomes and its applications, structure and biological importance of lecithin, cephalin, phosphatidylserine, phosphatidylinositol. Cholesterol – definition, types (HDL, LDL and VLDL) Sphingolipids—structure and biological significance of ceramide

Unit III

15h

Molecular spectroscopy: Interaction of electromagnetic radiation with molecules and various types of spectra; Born- Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies. Fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Organic Spectroscopy : General principles Introduction to absorption and emission spectroscopy.

UV Spectroscopy: Types of electronic transitions, λ max, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ max

for the following systems: α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance, and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.

UNIT-IV

15h

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules. Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds. Applications of IR, UV and NMR for identification of simple organic molecules. Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

Elemental analysis: Mass spectrometry (electrical discharges).

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence.

Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences). X-ray analysis and electron spectroscopy (surface analysis) Electroanalytical Methods:

Potentiometry & Voltammetry

Radiochemical Methods

Recommended Books/References:

1. Advanced Organic Chemistry - Reactions, Mechanism and Structure, Jerry March, John Wiley (2008).
2. Advanced Organic Chemistry, F A Carey and R J Sundberg Plenum, (1990).
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman, (2000).
4. Structure and mechanism of Organic Chemistry, C K Ingold, Cornell University Press (1999).
5. Organic Chemistry, R T Morrison and R N Boyd, Prentice-Hall, (1998).
6. Modern Organic Reactions, H O House, Benjamin, (1972).
7. Stereochemistry of Carbon Compounds, E L Eliel, S H Wilen and L N Mander, John Wiley, (1994).
Organic Chemistry, Volumes I and II, I L Finar, Longman, (1999).
8. Levine I. N., Physical Chemistry, Fourth Edition, McGraw-Hill (International), 1995.
9. P.W. Atkins: Physical Chemistry.
10. G.W. Castellan: Physical Chemistry.
11. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
12. Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
13. Kemp, W. Organic Spectroscopy, Palgrave
14. Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler, and Stanley Crouch (ISBN 0-495-01201-7).
15. Instrumental Methods of Analysis, 7th ed, Willard, Merritt, Dean, Settle.
16. Biochemistry A. L. Lehninger et. al., CBS, 2000
17. Biochemistry P. C. Champe and R. A. Harvey, J. B. Lipincott & Co, 1982

CHE C12-P ORGANIC CHEMISTRY PRACTICAL

Preparation (one stage)

1. Cannizarro reaction: Benzaldehyde.
2. Fries rearrangement: Phenyl acetate.
3. Friedel-Crafts reaction: Benzene and Acetyl chloride.
4. Sandmeyer reaction: 4-Chlorotoluene from 4-toluidine.
5. Pechmann reaction: Resorcinol and ethylacetoacetate.
6. Oxidation of Cyclohexanol.
7. Preparation of S- Benzylisothiuronium chloride.
8. Synthesis of p-iodonitrobenzene
9. Synthesis of N-Phenyl-2,4-dinitroaniline.
10. Synthesis of 2,4-dichlorophenoxyacetic acid.

Preparation (Two and three stages)

1. 2,4-Dinitrophenylhydrazine from chloronitrobenzene.
2. Anthranilic acid from phthalic acid.
3. Benzanilide from benzophenone.
4. Benzilic acid from benzoin.
5. Synthesis of Acridone.

Quantitative analysis

6. Saponification value of oil.
7. Estimation of glucose by Feighling's method.
8. Estimation of keto group.
9. Estimation of phenols.
10. Iodine value of oil (chloramine-T method).

Recommended Books/References:

1. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, New Delhi, (1996).
2. Practical Organic Chemistry - Mann and Saunders, (1980).
3. Textbook of Practical Organic Chemistry- A. I. Vogel, (1996).
4. Textbook of Quantitative Organic Analysis- A. I. Vogel, (1996).
5. A Handbook of Organic Analysis - Clarke and Hayes, (1964).
6. Comprehensive practical organic chemistry: Preparation and quantitative Analysis,
7. V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.
8. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, Universities Press (India), 2000.
9. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.
10. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
11. Practical organic chemistry (Quantitative analysis), B. B. Dey, M. V. Sitaraman and T. R. Govindachari, Allied Publishers, New Delhi, 1992.

6TH SEMESTER B.Sc

CHE C13-T INORGANIC AND PHYSICAL CHEMISTRY - IV

60h

UNIT-I

Coordination chemistry; introduction, postulates (Werners, EAN and VBT) ligand and its types. Metal-Ligand equilibria in solution; Stepwise and overall formation constant and their relationship, trends in step-wise constant, kinetic and thermodynamic stability of metal complexes, factors affecting the stability of metal complexes with reference to the nature of the metal ion and ligand, chelate effect, macrocyclic effect and their thermodynamic origin. Determination of binary formation constant by pH metry, spectrophotometry, polarography and ion exchange methods. Structure and bonding- Structure and bonding in hydride, dihydrogen, dioxygen, isocyanide, CO, NO, N₂ and tertiary phosphine complexes of transition metals.

15h

UNIT-II

Metal- ligand bonding

15h

Stereoisomerism- coordination numbers 3 to 8. Crystal field theory, salient features, spectrochemical series, splitting of d-orbitals in tetragonal, square planar, trigonal bipyramidal and square-pyramidal geometry, applications of CFT- colours of transition metal complexes, magnetic properties of octahedral complex, distortion of octahedral complex, CFSE and their uses, factors affecting CFSE, limitations of CFT, experimental evidence for metal-ligand covalent bonding in complexes, nephelauxetic effect, Ligand Field Theory, MO theory: tetrahedral and octahedral complexes (including p- bonding), angular overlap model. Stereochemical non-rigidity, self-assembly in supramolecular chemistry. Magnetic properties of coordination compounds

UNIT-III

Thermodynamics: Concepts of partial molar properties - partial molar free energy, chemical potential, partial molar volume and its significance. Gibbs-Duhem equation, Gibbs-Duhem- Margulus equation. Determination of partial molar volume: Graphical method, intercept method and Apparent molar volume method. Concept of fugacity; Determination of fugacity by graphical method and compressibility factor method. Activity and activity coefficient: Determination of activity coefficient by EMF and solubility method. Thermodynamics of non- ideal system-Excess thermodynamic function, GE, SE, HE etc.

15h

Phase Rule: Derivation of phase rule from the concept of chemical potential. Application of Phase Rule to three components system: Principle of triangular diagram: Plots for a mixture of three liquids consisting of one, two and three pairs of partially miscible liquids. Statistical Thermodynamics: Objectives of statistical thermodynamics, Concept of distributions, Types of ensembles. Thermodynamic probability, Most probable distribution Law

- Partition Function, (Definition and significance): Molar and molecular partitions-translational, rotational, vibrational and electronic partition functions- Relation between thermodynamic functions (E, H, S, G and Cv) and the partition functions.

UNIT-IV

Statistical Thermodynamics: Sackur-Tetrode equation for entropy of translation function. Relation between equilibrium constant and partition function.

15h

Different Distribution Laws: Types of Statistics: Maxwell - Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Derivation of the equations for the above three distribution Laws. Comparison of Bose-Einstein and Fermi-Dirac statistics with Maxwell - Boltzmann statistics. Problems and their Solutions.

Non-equilibrium Thermodynamics: Thermodynamic criteria for non-equilibrium states-Phenomenological Laws and Onsager's reciprocity relations, Coupled and Non-coupled reactions, Entropy production and entropy flow. Electro kinetic Phenomenon.

Postulates and methodologies: Uncompensated heat and thermodynamics function production. de-Donder's inequality. Rate of entropy production. Transformations of the generalized fluxes and forces: eg., Chemical reaction, heat flow, Diffusion or material flow, flow of electric current.

Recommended Books/References:

1. Basic Inorganic Chemistry- F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley and sons. Inc, 6th edition (1999).
2. Chemistry of elements- N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).
3. Inorganic Chemistry IV edition; J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley (1993).
4. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford, ELBS; Oxford University Press, 1994.
5. Inorganic Chemistry A Unified Approach by W. W. Porterfield, Elsevier 2005 2nd edition.
6. Textbook of inorganic chemistry by G. S. Sodhi, Viva books Pvt. Ltd (2011).
7. Molecular thermodynamics, Donald A. Mc Quarrie, John D. Simon University Science Books California, (1999).
8. Thermodynamics for Chemists, by S. Glasstone, East-West Press, New Delhi, (1960).
9. Thermodynamics, by Rajaraman and Kuriacose, East-West Press, (1986).
10. Statistical Thermodynamics, M. C. Gupta (Wiley Eastern Ltd.) 1993.
11. Elementary Statistical Thermodynamics, N. D. Smith, Plenum Press, NY, (1982).
12. Elements of Classical and Statistical Thermodynamics, L. K. Nash, Addison-Wiley (1979).
13. Thermodynamics, Statistical Thermodynamics and Kinetics by Thomas Engel & Philip Reid, Pearson Education inc. (2007)

CHE C 14-P INORGANIC AND PHYSICAL CHEMISTRY PRACTICAL

INORGANIC CHEMISTRY PRACTICAL

Gravimetric analysis

1. Gravimetric determination of Ni in Cu and Ni solution.
2. Gravimetric determination of Fe in Fe and Cr solution.
3. Total gravimetric estimation of Fe and Al.
4. Gravimetric estimation of Cu in Cu and Fe solution.
5. Gravimetric estimation of Cu in Cu and Zn solution.

Volumetric analysis

6. Volumetric estimation of Ca and Mg in Dolomite solution.
7. Volumetric estimation of Cu in Cu and Ni (German Silver).
8. Volumetric estimation of Fe in Cu and Fe solution.
9. Volumetric estimation of Zn in Cu and Zn solution.
10. Volumetric estimation of Ni in Ni and Zn solution.

PHYSICAL CHEMISTRY PRACTICAL

1. Study the hydrolysis of methyl acetate in presence of two different concentrations of HCl and report the relative strength.
2. Study the hydrolysis of methyl acetate in the presence of HCl at different temperatures and report the energy of activation.
3. Study of variation of viscosity of a liquid with temperature, determine the constant A and B.
4. Determination of pH of acetic acid with sodium acetate buffer by pH metry method.

5. Determination of pKa value of phosphoric acid by pH meter.
6. Evaluation of Arrhenius parameter for the reaction between $K_2S_2O_8$ versus KI (first order)

Conductometry

7. Acid mixture versus NaOH
8. Weak acid with salt versus NaOH
9. Strong acid with salt versus NaOH

Potentiometry

10. Acid mixture versus NaOH
11. $KMnO_4$ versus FAS

Recommended Books/References:

1. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
2. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).
3. Findlays practical physical chemistry revised by P. B. Levitt, Longman's London (1966).
4. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill International Edn. (1966).
5. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988).
6. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987).
7. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
8. Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd (1968)
9. Experimental Physical Chemistry by Wilson, Newcombe & others, Pergamon Press, New York (1962).
10. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983).
11. Experimental Physical Chemistry by V. D. Atavale and Parul Mathur, New Age International, New York (2001).
12. Physical Chemistry Laboratory Principles and Experiments by H. W. Salberg J. I. Morrow, S. R. Cohen and M. E. Green Macmillan publishing Co .new York.
13. Practical's in physical chemistry A. Modern Approach by P.S Sindhu, Mac. Millan Publishers Delhi (2006).

CHE C15-T ORGANIC CHEMISTRY – IV AND SPECTROSCOPY-II

60h

UNIT-I

Aromatic Substitution Reactions

15h

The arenium ion mechanism. Orientation and reactivity. Energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Effect of leaving group. Amination, sulfonylation reactions; Diazonium coupling, Vilsmeier-Haack reaction, Gatterman reaction, Gatterman-Koch reaction and Hoesch reaction.

Addition Reactions

Addition to carbon-carbon multiple bonds: mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles, and free radicals. Regio, stereo- and chemoselectivities. Orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Addition of alkenes and/or alkynes to alkenes and/or alkynes. Ene synthesis. Michael reaction. Addition to carbon-heteroatom multiple bonds: Mechanism of metal hydride reduction (NaH, LiH, LiAlH_4 , NaBH_4) of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents and organolithium reagents to carbonyl compounds and unsaturated carbonyl compounds. Conversion of aldehydes to nitriles. Hydrolysis of nitriles and addition of amines to isocyanates. Formation of xanthates. Wittig, Mannich and Stobbe reactions.

UNIT-II

Rearrangements

15h

Wagner-Meerwein, Pinacol-Pinacolone, Fries, Wolff, Beckmann, Hofmann, Curtius, Lossen and Schmidt rearrangements. Benzil-benzilic acid rearrangement, Arndt-Eistert reaction, Tiffeneau-Demjanov reaction, Fritsch-Buttenberg-Wiechell rearrangement. Stevens, Wittig and Favorskii rearrangements, Dienone-phenol, Baker-Venkatraman rearrangement. Baeyer-Villiger oxidation. Neber rearrangement. Benzidine rearrangement, Sommelet-Hauser and Smiles rearrangements.

Amino acids and Peptides

Synthesis and reactions of amino acids. Classification and nomenclature of peptides. Sanger and Edman methods of sequencing. Cleavage of peptide bond by chemical and enzymatic methods. Peptide synthesis- Protection of amino group (Boc-, Z- and Fmoc-) and carboxyl group as alkyl and aryl esters. Use of DCC, EEDQ, HOBT and active esters, acid halides, anhydrides in peptide bond formation reactions. Deprotection and racemization in peptide synthesis. Solution and solid phase techniques. Synthesis of oxytocin, gramicidin, enkephalins, LH-RH. Introduction to peptidomimetics.

UNIT-III

15

Symmetry and Group Theory in Chemistry

Definition of groups, subgroups, cyclic groups, conjugate relationships, classes, simple theorems in group theory. Symmetry elements and symmetry operations, point groups, Schönflies notations, representations of groups by matrices, reducible and irreducible representations, characters of representations, Great Orthogonality Theorem (without proof) and its applications, character tables and their uses (representations for the C_n , C_{nv} , C_{nh} , D_{nh} etc., groups to be worked out explicitly) Mulliken symbols for irreducible representations Direct products, Applications of group theory to quantum mechanics- identifying non-zero matrix elements, derivation of the orthonormalization conditions.

Unifying principles

Interaction of electromagnetic radiation with matter- time-dependent perturbation theory, transition moment integral, selection rules- symmetry and spin forbidden transitions

Unit -IV

15h

Infrared Spectroscopy

Infrared spectra of simple molecules and coordination compounds, changes in infrared spectra of donor molecules upon coordination (N,N-dimethylacetamide, urea, DMSO, pyridine N-oxide, ammine, cyano, cyanato and

thiocyanato complexes), mono and multinuclear carbonyl complexes, nitrosyls, phosphine and arsine complexes. Change in spectra accompanying change in symmetry upon coordination (NO_3 , SO_4 , NO_2 , and ClO_4), hydrogen bonding. Vibration-rotation spectra of polyatomic molecules- parallel and perpendicular vibrations of linear and symmetric top molecules. Instrumentation including FTIR.

Raman spectroscopy: Theory, relation with IR spectroscopy, resonance Raman stimulated hyper and inverse Raman effects. Experimental techniques, structure determination from IR and Raman spectra.

Nuclear Magnetic Resonance spectroscopy

Magnetic properties of nuclei, population of energy levels, the Larmor precession, relaxation processes, chemical shift, shielding mechanism, spin-spin interactions, rules governing the interpretation of first order spectra, effect of chemical exchange on spectra. Analysis of complex NMR spectra, and complex metal ligands. Spin-systems: First order and second order patterns. Long range coupling : Spin decoupling, CIDNP and NOE. NMR shift reagents.

Recommended Books/References:

1. Advanced Organic Chemistry - Reactions, Mechanism and Structure, Jerry March, John Wiley (2008).
2. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum (1990).
3. A Guide Book to Mechanism of Organic Chemistry, Peter Sykes, Longman (2000).
4. Structure and Mechanism of Organic Chemistry, C. K. Ingold, Cornell University Press.
5. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall (1998).
6. Modern Organic Reactions, H. O. House, Benjamin (1972).
7. Principles of Organic Synthesis, R.C. Norman and J. M. Coxon, Blackie Academic and Professional (1996).
8. Organic Chemistry, Volumes I and II, I L Finar, Longman. (1999).
9. Peptides Chemistry: A practical text book, M. Bodansky, Springer-Verlag NY, 1988.
10. Solid-phase peptide synthesis: A practical approach-E. Artherton & R.C. Sheppard, IRL, Oxford Univ. Press, 1989.
11. Peptides: Chemistry and Biology, N Selwad and H.-D. Jakubke, Wiley-VCH, 2002.
12. Chemical Applications of Group Theory, F. A. Cotton, Wiley Eastern (1976).
13. Molecular Symmetry, D. S. Schonland, Van Nostrand (1965).
14. Introduction to Molecular Spectroscopy, C. N. Banwell, TMH Edition (1994).
15. Introduction to Molecular Spectroscopy, G. M. Barrow, McGraw Hill (Int. Students Edition) (1988).
16. Molecular Spectroscopy, J. D. Graybeal, McGraw Hill (Int. Students Edition) (1990).
17. Spectroscopy, Vols. 1-3, B. P. Straughan and W. Walker, Chapman Hall (1976).
18. Infrared Spectroscopy - C.N.R. Rao.
19. Introduction to Spectroscopy - D.L.Pavia, G.M.Lampman and G.S.Kriz, Thomson
20. Learning, Singapore (2001)
21. Spectroscopic Identification of organic compounds - R. M. Silverstein and F. X. Webster, 6th Edition, Wiley and Sons, India Ltd. (2006).

CHE C16-P ORGANIC CHEMISTRY PRACTICAL

Preparation (Two and three stages)

1. 2,4-Dinitrophenylhydrazine from chloronitrobenzene.
2. Anthranilic acid from phthalic acid.
3. Benzanilide from benzophenone.
4. Benzilic acid from benzoin.
5. Synthesis of Acridone.
6. Synthesis of Hydantoin.

Quantitative analysis

7. Titrimetric estimation of amino acids.
8. Saponification value of oil.
9. Estimation of glucose by Feighling's method.
10. Estimation of keto group.
11. Estimation of phenols.
12. Iodine value of oil (chloramine-T method).
13. Recording/predicting/downloading from websites the UV, IR, NMR spectra of the compounds prepared in organic chemistry practical (**CHE C16-P**)

Recommended Books/References:

1. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, New Delhi, (1996).
2. Practical Organic Chemistry - Mann and Saunders, (1980).
3. Text Book of Practical Organic Chemistry- A. I. Vogel, (1996).
4. Test Book of Quantitative Organic Analysis- A. I. Vogel, (1996).
5. Comprehensive practical organic chemistry : Preparation and quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.
6. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.
7. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
8. Practical organic chemistry (Quantitative analysis), B. B. Dey, M. V. Sitaraman and T. R. Govindachari, Allied Publishers, New Delhi, 1992.
9. Spectrometric identification of organic compounds, sixth edition, R. M. Silverstien, and F. X. Webster, 2004.
10. Introduction to spectroscopy, 3 rd Edition, D. L. Pavia, G. M. Laupman and G. S. Kriz, Harcourt college publishers, 2001.
12. The IR spectra of complex molecules, Vols.1 and 2, L J Bellamy, Chapman and halli, London, 1975.
13. 12. Spectroscopic techniques for organic chemists, J W Cooper, John Wiley, NY, 1980.