

SEMESTER- V

CHEMISTRY-C XI: ORGANIC CHEMISTRY-IV

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

End Sem-60 marks

Mid Sem- 15 marks

UNIT-I

Aminoacids, peptides, Proteins and Nucleic Acids

Classification, structure of amino acids, acid-base behaviour, isoelectric point and electro-phoresis, Preparation and reactions of α -aminoacids, structure and nomenclature of peptides & proteins, Classification of proteins, peptide structure determination, end group analysis, selective hydrolysis of peptides, classical peptide synthesis, solid phase peptide synthesis. Structure of peptides and proteins, Levels of protein structure, Protein denaturation/ renaturation.

Nucleic Acid

Introduction, constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA. (18 Lectures)

Unit – II

(a) Molecular Rearrangement

Pinacole – Pinacolone, Demzanov, Dienone – Phenol, Benzidine, Benzillic acid, (Mechanism and applications).

(b) Name Reactions

Diels-Alder, Fries, Michael, Reformatsky, Dieckmann, Mannich (Principle, mechanism and applications)

(c) Synthetic Reagents

Mechanism of action and uses of OsO_4 , HIO_4 , LiAlH_4 , $\text{Pb}(\text{OAc})_4$, PCC, DCC, & Wilkinson's catalyst. (16 Lectures)

UNIT-III

(a) Fats, Oils and Detergents

Fats & Oils, chemical properties, hydrogenation of oils, saponification; Reichert–Meissl, Iodine and Acid value ; Soaps and Detergents, alkyl & aryl sulphonates, cleansing action, Micelle formation, Critical Micellar Concentration (CMC).

(b) Synthetic Drugs

Synthesis and uses of Aspirin, Phenacetin, Paracetamol, Sulphaguanidine, sulphanilamide. (10 Lectures)

UNIT-IV Carbohydrates

Classification, nomenclature of monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides, conversion of glucose into mannose; formation of glycosides, ethers and esters. Determination of ring size of monosaccharides, cyclic structure of D (+) glucose, mechanism of mutarotation. Elementary idea about disaccharides (*maltose, sucrose and lactose*) and polysaccharides (*starch and cellulose*).

(10 Lectures)

UNIT V Synthetic Dyes

Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing. Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red, mechanism of Diazo Coupling; Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.

(8 Lectures)

Reference Books:

1. Organic Chemistry – Morrison & Boyd (Prentice Hall)
2. Advanced Organic Chemistry – B.S. Bahl (S. Chand)
3. Organic Chemistry (Vol- I & II) I.L. Finar (ELBS)
4. Organic Chemistry, (Vol-I, II & III) Mukherjee, Singh & Kapoor (NewAge International).
5. Organic Chemistry – F.A. Carey (MC. Graw Hill Inc.)
6. Organic Chemistry – Mc. Murry
7. Organic Chemistry – Solomon
8. Reactions & Reagents - O.P. Agarwal
9. Reaction Mechanism & Reagents in Organic Chemistry- Chatwal
10. Reactions, Rearrangement and Reagents – S.N. Sanyal
11. Chemistry of Natural Products – O.P. Agarwal.

CHEMISTRY PRACTICAL- C XI LAB (Expt. -15, Viva Voce- 6 & Lab. Record- 4)

Time ~~3 hrs~~ 6 hrs

(Full Marks -25)

1. Preparations of the following compounds:
 - a. Aspirine,
 - b. Phenacetin,
 - c. Milk of magnesia,
 - d. Aluminium hydroxide gel,
 - e. Divol
2. Saponification value of oil or fat.
3. Determination of Iodine number of an oil/ fat.

Reference Books

1. Vogel, A.I. Quantitative Organic Analysis, Part 3, Pearson (2012).

CHEMISTRY-C XIII INORGANIC CHEMISTRY-IV

(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

End Sem-60 marks
Mid Sem- 15 marks

UNIT-I

Metal – Ligand Bonding in Transition Metal Complexes

Limitations of valence bond theory, Crystal Field Theory; crystal field splitting in octahedral, tetrahedral and square planar complexes; Calculation of crystal field stabilization energy, factors affecting the crystal field parameters.

John Teller theorem, qualitative aspect of ligand field theory and MO theory.

(12 Lectures)

Unit - II

(a) Magnetic Properties of Transition Metal Complexes

Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, co-relation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

(b) Electronic spectra of transition metal complexes

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.

(12 Lectures)

Unit III

Reaction Kinetics and Mechanism

Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.

(12 Lectures)

Unit – IV

Organometallic Chemistry

Definition, nomenclature and classification of organometallic compounds; preparation & properties, bonding and applications of alkyls and aryls of Li & Hg. A brief account of metal-ethylenic complexes, mono-nuclear and bi-nuclear carbonyls, Effective Atomic Number rule, preparation and bonding in metal carbonyls - $Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$, $Fe_2(CO)_9$ and $Mn_2(CO)_{10}$.

(12 Lectures)

Unit - V

Nuclear Chemistry

Fundamental particles, size & stability of the nucleus, Natural & artificial radioactivity, Binding energy, mass defect, packing fraction, nuclear reactions induced by ${}^0_0n^1$, ${}^1_1H^1$, ${}^2_1H^2$, ${}^4_2He^4$, nuclear fission and fusion, liquid drop model, Hydrogen bomb, Carbon dating.

(12 Lectures)

Reference Books:

- Cotton, F.A. G.; Wilkinson & Gaus, P.L. *Basic Inorganic Chemistry 3rd Ed.*; Wiley India,
- Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson, 2006.
- Sharpe, A.G. *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005
- Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry 3rd Ed.*, John Wiley and Sons, NY, 1994.
- Greenwood, N.N. & Earnshaw, A. *Chemistry of the Elements*, Elsevier 2nd Ed, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
- Lee, J.D. *Concise Inorganic Chemistry 5th Ed.*, John Wiley and sons 2008.
- Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988.
- Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
- Basolo, F. & Person, R. *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed.*, John Wiley & Sons Inc; NY.
- Purcell, K.F. & Kotz, J.C., *Inorganic Chemistry*, W.B. Saunders Co. 1977
- Miessler, G. L. & Donald, A. Tarr, *Inorganic Chemistry 4th Ed.*, Pearson, 2010.
- Collman, James P. et al. *Principles and Applications of Organotransition Metal Chemistry*. Mill Valley, CA: University Science Books, 1987.
- Crabtree, Robert H. *The Organometallic Chemistry of the Transition Metals*. New York, NY: John Wiley, 2000.
- Spessard, Gary O., & Gary L. Miessler. *Organometallic Chemistry*. Upper Saddle River, NJ: Prentice-Hall, 1996.

CHEMISTRY PRACTICAL-C XII LAB (Expt. -15, Viva Voce- 6 & Lab. Record- 4)

Time – 6hrs

(Full Marks -25)

Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested: CO_3^{2-} , NO_2^- , S_2^{2-} , SO_3^{2-} , $S_2O_3^{2-}$, CH_3COO^- , F^- , Cl^- , Br^- , I^- , NO_3^- , BO_3^{3-} , $C_2O_4^{2-}$, PO_4^{3-} , NH_4^+ , K^+ , Pb^{2+} , Cu^{2+} , Cd^{2+} , Bi^{3+} , Sn^{2+} , Sb^{3+} , Fe^{3+} , Al^{3+} , Cr^{3+} , Zn^{2+} , Mn^{2+} , Co^{2+} , Ni^{2+} , Ba^{2+} , Sr^{2+} , Ca^{2+} , Mg^{2+} . Mixtures should preferably contain one interfering anion, or insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3) or combination of anions e.g. CO_3^{2-} and SO_3^{2-} , Cl^- and Br^- , Cl^- and I^- , Br^- and I^- , NO_3^- and Br^- , NO_3^- and I^- , NO_3^- and NO_2^- .

Reference Books

- Vogel's *Qualitative Inorganic Analysis*, Revised by G. Svehla.
- Marr & Rockett *Inorganic Preparations*.

DSE- 1

POLYMER CHEMISTRY

(Credits: Theory-06, Practicals-02)

End Sem- 60 Marks

Mid Sem- 15 Marks

Unit I

Introduction and history of polymeric materials

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

(4 Lectures)

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

(8 Lectures)

Unit II

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

(8 Lectures)

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

(8 Lectures)

Unit III

Determination of molecular weight of polymers

(M_n , M_w , etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

(8 Lectures)

Unit IV

Glass transition temperature (T_g) and determination of T_g .

Free volume theory, WLF equation, Factors affecting glass transition temperature (T_g).

(8 Lectures)

Polymer Solution

Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

(8 Lectures)

Unit V

Properties of Polymers

(Physical, thermal, Flow & Mechanical Properties)

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

(8 Lectures)

Reference Books:

- R.B. Seymour & C.E. Carraher: *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc. New York, 1981.
- G. Odian: *Principles of Polymerization*, 4th Ed. Wiley, 2004.
- F.W. Billmeyer: *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
- P. Ghosh: *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991.
- R.W. Lenz: *Organic Chemistry of Synthetic High Polymers*, Interscience Publishers, New York, 1967.

CHEMISTRY PRACTICAL - DSE LAB-1
(Expt. -15, Viva Voce- 6 & Lab. Record- 4)

Time – 6 hrs

(Full Marks -25)

1. Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
 - a. Purification of monomer
 - b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutyronitrile (AIBN)
2. Preparation of nylon 66/6
 1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein
 - a. Preparation of IPC
 - b. Purification of IPC
 - c. Interfacial polymerization
 3. Redox polymerization of acrylamide
 4. Precipitation polymerization of acrylonitrile
 5. Preparation of urea-formaldehyde resin
 6. Preparations of novalac resin/ resold resin.
 7. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:
 - (a) Polyacrylamide-aq. NaNO_2 solution
 - (b) (Poly vinyl propylidene (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers
4. DSC analysis of polymers

5. Preparation of polyacrylamide and its electrophoresis

Reference Books:

- M.P. Stevens, *Polymer Chemistry: An Introduction*, 3rd Ed., Oxford University Press, 1999.
- H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry*, 3rd ed. Prentice-Hall (2003)
- F.W. Billmeyer, *Textbook of Polymer Science*, 3rd ed. Wiley-Interscience (1984)
- J.R. Fried, *Polymer Science and Technology*, 2nd ed. Prentice-Hall (2003)
- P. Munk & T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2nd ed. John Wiley & Sons (2002)
- L. H. Sperling, *Introduction to Physical Polymer Science*, 4th ed. John Wiley & Sons (2005)
- M.P. Stevens, *Polymer Chemistry: An Introduction* 3rd ed. Oxford University Press (2005).
- Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

DSE-2

INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

(Credits: Theory-06, Practicals-02)

End Sem- 60 Marks

60 Lectures

Mid Sem- 15 Marks

Unit I

Silicate Industries

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

(12 Lectures)

Unit II

Fertilizers:

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

(8 Lectures)

Cements

Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

(4 Lectures)

Unit III

Surface Coatings

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives.

(10 Lectures)

Unit IV

Batteries

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

(6 Lectures)

Chemical explosives:

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

(4 Lectures)

Unit V

Alloys

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

(10 Lectures)

Catalysis:

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts.

(6 Lectures)

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.

- J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

PRACTICALS-DSE LAB: INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

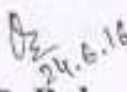
~~60 Lectures~~ Full Marks - 25

Time - 6 hrs

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.
5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
- J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).


P. C. Pal


(Member)

D. D. (Auto.) College,


S. Sahu

(Member)

Karanjia (Auto.)


Dr. S. K. Kisku

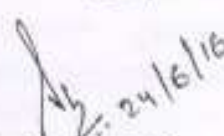
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M. P. C. (Auto.) College
Baripada


Dr. B. Ash

(Member)

M. P. C. (Auto.) College
Baripada


Prof. S. N. Sarangi

(Chairman)

M. P. C. (Auto.) College
Baripada

**SEMESTER- VI
CHEMISTRY-C XIII
PHYSICAL CHEMISTRY V**

(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

End Sem-60 marks
Mid Sem- 15 marks

UNIT-I

Quantum Mechanics

- (a) Operators, algebra of operators, commutative properties, linear operator, commutative operator, momentum operator and angular momentum operator. Eigenvalues & eigenfunctions, Hamiltonian operator, Hermitian properties of operator.
- (b) Basic postulates of quantum mechanics. Wave mechanics of simple systems - particle in one and three dimensional box.
- (c) **Molecular orbital Theory:** - Basic ideas, Criteria for forming MO from AO. Construction of MO by LCAO method, hydrogen molecule ion (H_2^+) and calculation of energy from wave function, Hybridization- Calculation of MO coefficients of sp, sp² & sp³ hybrid orbitals.

(18 Lectures)

Unit - II

Spectroscopy

Introduction, statement of the Born - Oppenheimer approximation, degrees of freedom.

- (a) **Rotational Spectrum.** Diatomic Molecules, energy levels of a rigid rotator (semi-classical principles), selection rules, spectral intensity, determination of bond length. Qualitative description of non-rigid rotator, isotope effect.
- (b) **Vibrational Spectrum - Infrared Spectrum-** energy levels of simple harmonic oscillators, selection rules, pure vibrational spectrum, intensity, effect of anharmonic motion on the spectrum. **Raman Spectrum-** concept of polarisability, quantum theory of Raman effect, pure rotational & vibrational Raman spectra of diatomic molecules, selection rules.

(18 Lectures)

Unit -III

Kinetics of Polymerization:

1. **Introduction and classification** including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index.
2. **Polymerisation reactions** -Addition and condensation - Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

(8 Lectures)

Unit -IV

Photochemistry

Interaction of radiation with matter, difference between thermal & photochemical processes.

Laws of photochemistry :- Grothus-Draper law, Stark-Einstein law. Jablonsky diagram depicting various processes occurring in the excited state, qualitative description of Fluorescence, Phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions - energy transfer with simple examples.

(8 Lectures)

Unit - V

Corrosion

Introduction, Economic aspects of corrosion, type of corrosion, (i) Dry or chemical corrosion, Factor affecting chemical corrosion, (ii) Wet or electrochemical corrosion; Theories of wet corrosion, (iii) Galvanic corrosion, (iv) Concentration corrosion, (v) Atmospheric corrosion, (vi) Underground corrosion.

Corrosive agents, prevention of corrosion, Methods based on treatment of metals, methods based on treatment of medium, methods based on external influence.

(8 Lectures)

Reference Books

- Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
- Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).
- House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA (2004).
- Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press (2005).
- Kakkar, R. Atomic & Molecular Spectroscopy, Cambridge University Press (2015).

CHEMISTRY PRACTICAL-C XIII LAB (Expt. -15, Viva Voce- 6 & Lab. Record- 4)

Time - ~~3hrs~~ 6 hrs.

(Full Marks- 25)

Colourimetry

1. Determine the concentration of HCl against 0.1 N NaOH spectrophotometrically.
2. To find the strength of given ferric ammonium sulfate solution of (0.05 M) by using EDTA spectrophotometrically.
3. To find out the strength of CuSO_4 solution by titrating with EDTA spectrophotometrically.
4. To determine the concentration of Cu(II) and Fe(III) solution photometrically by titrating with EDTA.
5. Specific rotation of optically active compound (cane sugar) by Polarimetry.

Reference Books

- Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).
- Experimental Physical Chemistry by J. N. Gurtu, R. Kapoor.

CHEMISTRY-C XIV ANALYTICAL CHEMISTRY

(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

End Sem-60 marks
Mid Sem- 15 marks

Unit – I

UV – Visible Spectroscopy

Electromagnetic radiations, Features of spectrum and characteristic of different radiations. Spectral range, absorption Law (Beer – Lambert Law), molar absorptivity, instrumentation, type of electronic transitions, concept of chromophore and auxochromes ; Bathochromic, hypsochromic, hyperchromic, hypochromic shifts ; effect of conjugation, solvent effects, UV spectra of conjugated enes and enones and determination of λ_{max} by application of Woodward – Fischer rule. Involved problems.

(12 Lectures)

Unit – II

IR Spectroscopy

Spectral range, molecular vibrations, Hooke's law, instrumentation (double beam spectrophotometer), sampling techniques, factors influencing vibrational frequency, characteristic absorption of hydrocarbons, alcohols, amines, aldehydes, ketones, acids and aromatic ring. Involved problems.

(12 Lectures)

Unit – III

NMR Spectroscopy

Basic principles, instrumentation, shielding and deshielding, chemical shift, splitting of signals, spin-spin coupling, coupling constant, PMR spectral analysis of simple organic molecules like ethyl alcohol, propanol, ethyl bromide, 1,3-dichloropropane, acetaldehyde, toluene, acetophenone.

(12 Lectures)

Unit – IV

Mass Spectroscopy

Basic principles, instrumentation, types of ions produced in a mass spectrometer, parent and metastable peaks, determination of molecular peak, McLafferty's rearrangement, fragmentation and mass spectra of hydrocarbons, alkenes, cycloalkanes, alkynes, alcohols, amines, aldehyde, acids, esters, phenols. (simple compounds only).

(12 Lectures)

Unit – V

Chromatography

Column Chromatography:- adsorbents, classification of adsorbents, solvents and their role, separation of components in a mixture, applications.

Paper Chromatography:- Paper as a chromatography medium, solvents, mechanism and types of paper chromatography, factors influencing R_f value. Separation of amino acids in a mixture, applications.

Thin Layer Chromatography (TLC):- Choice of adsorbent and solvent, preparation of chromatogram, simple application, ion-exchange chromatography.

(12 Lectures)

Reference Books:

1. Basic Concepts of Spectroscopy – S.M. Khopkar
2. Elementary Organic Chemistry – Y.R. Sharma
3. Fundamentals of Molecular Spectroscopy – Banwel.
4. Application of Absorption Spectroscopy of Organic Compounds- J.R.Dyer.
5. Organic Spectroscopy - Jag Mohan
6. Spectroscopy of Organic Compounds - P.S.Kalsi.
7. Organic Spectroscopy – Kemp.
8. Organic Spectroscopy - Dani

CHEMISTRY PRACTICAL-C XIV LAB
(Expt. -15, Viva Voce- 6 & Lab. Record- 4)

Time - 3 hrs by 6 hrs.
UV/Visible spectroscopy

(Full Marks -25)

- I. Study the 200-500 nm absorbance spectra of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule⁻¹, kJ mol⁻¹, cm⁻¹, eV).
- II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $\text{K}_2\text{Cr}_2\text{O}_7$.
- III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colorimetry

- I. Verify Lambert-Beer's law and determine the concentration of $\text{CuSO}_4/\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ in a solution of unknown concentration
- II. Determine the concentrations of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ in a mixture.
- III. Study the kinetics of iodination of propanone in acidic medium.
- IV. Determine the amount of iron present in a sample using 1,10-phenanthroline.
- V. Determine the dissociation constant of an indicator (phenolphthalein).
- VI. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
- VII. Analysis of the given vibration-rotation spectrum of HCl(g)

Chromatography.

(i) Thin Layer Chromatography

Determination of R_f values and identification of organic compound – separation of green leaf pigments (spinach leaves may be used).

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. Pollution by SO_2 , CO_2 , CO , NO_x , H_2S and other foul smelling gases. Methods of estimation of CO , NO_x , SO_x and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming. Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates. **(16 Lectures)**

Unit- IV

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. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water. **(10 Lectures)**

Unit-V

Energy & 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. **(6 Lectures)**

Biocatalysis

Introduction to biocatalysis: Importance in "Green Chemistry" and Chemical Industry. **(4 Lectures)**

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
 - R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
 - J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
 - S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
 - K. De, *Environmental Chemistry*, New Age International Pvt., Ltd, New Delhi.
 - S. M. Khopkar, *Environmental Pollution Analysis*, Wiley Eastern Ltd, New Delhi.
 - S.E. Manahan, *Environmental Chemistry*, CRC Press (2005).
 - G.T. Miller, *Environmental Science* 11th edition. Brooks/ Cole (2006).
 - A. Mishra, *Environmental Studies*. Selective and Scientific Books, New Delhi (2005).
-

(ii) **Paper Chromatography**

Determination of R_f values & identification of organic compounds – separation of mixture of phenylalanine and glycine, spray reagent – ninhydrin.

(iii) **Column Chromatography**

Separation of a mixture of o- and p- Nitroanilines.

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

DSE -III

INDUSTRIAL CHEMICALS AND ENVIRONMENT

(Credits: Theory-04, Practicals-02)

End Sem- 60 Marks

Theory: 60 Lectures

Mid Sem- 15 marks

Unit- I

Industrial Gases

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

(10 Lectures)

Unit- II

Inorganic Chemicals

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

(10 Lectures)

Industrial Metallurgy

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

(4 Lectures)

Unit- III

Environment and its segments

Ecosystem. Biological cycle of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in

CHEMISTRY PRACTICAL – DSE-3 LAB:
(Expt. -15, Viva Voce- 6 & Lab. Record- 4)

Time – ~~3hrs~~ 6hr

(Full Marks -25)

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO_3 and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-} , HCO_3^-) using double titration method.
7. Measurement of dissolved CO_2 .
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
- K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
- S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.

DSE -4

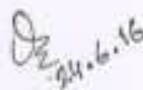
Dissertation/Project Report

Marks 100


(Report- 60, Presentation-20, Viva-voce-20 marks)


Dissertation/Project Report

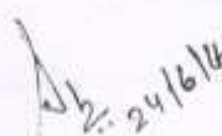
1. Students are required to choose the topic and prepare the dissertation/project work in consultation with the teachers of the Department.
2. The topic chosen must be up to date.
3. The project should be neatly hand written/typed (double space) and should be around 3000 words.
4. The consult teacher of the Department will undertake to supervise/guide the students in the preparation of the project.
5. Students are required to submit the project to the HOD by 15th March positively.
6. The Viva-voce will be conducted in the third week of March.


P. C. Pal
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