



MADHYANCHAL
PROFESSIONAL UNIVERSITY

Draft Rules & Syllabus
for the
Master of Science in Chemistry

Scheme for M.Sc., CBCS Course

Semester I

S.No.	Subject Code	Subject Name & Title	Maximum Marks Allotted								Hours per week.			Total Credits	Remarks
			Theory				Practical				L	T	P		
			End Sem	Mid Sem. MST	Quiz, Assignment	Total Marks	Lab Work	Assignment /Quiz/Term paper	End Sem	Total Marks					
1	MSc101	Inorganic Chemistry	60	20	20	100	20	10	20	50	3	1	4	6	One credit refers to one hour teaching in theory, Tutorial
2	MSc 102	Organic Chemistry	60	20	20	100	20	10	20	50	3	1	4	6	
3	MSc 103	Physical Chemistry	60	20	20	100	20	10	20	50	3	1	4	6	
4	MSc 104	Inorganic Spectroscopy and Analytical Techniques Or Environmental Chemistry	60	20	20	100	-	-	-	-	3	1		4	
5	MSc 105	Molecular Spectroscopy and Diffraction Techniques	60	20	20	100	-	-	-	-	3	1		4	
	Total		300	100	100	500	60	30	60	150	15	5	12	26	650

Semester II

S.No.	Subject Code	Subject Name & Title	Maximum Marks Allotted								Hours per week.			Total Credits	Remarks
			Theory				Practical				L	T	P		
			End Sem	Mid Sem. MST	Quiz, Assignment	Total Marks	Lab Work	Assignment/Quiz/Term paper	End Sem	Total Marks					
1	MSc 201	Advanced Inorganic Chemistry	60	20	20	100	20	10	20	50	3	1	4	6	One credit refers to one hour teaching in theory, Tutorial
2	MSc 202	Advanced Organic Chemistry	60	20	20	100	20	10	20	50	3	1	4	6	
3	MSc 203	Advanced Physical Chemistry	60	20	20	100	20	10	20	50	3	1	4	6	
4	MSc 204	Organic Spectroscopic Techniques Or Chemistry of Bio-molecules	60	20	20	100	-	-	-	-	3	1	-	4	
5	MSc 205	ronmental, Electro- and Polymer Chemistry	60	20	20	100	-	-	-	-	3	1	-	4	
	Total		300	100	100	500	60	30	60	150	15	5	12	26	650

Syllabus

CH 101: INORGANIC CHEMISTRY

UNIT- I:

- Ionic bond: Properties of ionic substances, coordination number of an ion, structures of crystal lattices- NaCl, CsCl, ZnS and rutile. Lattice energy- Born Lande equation, Born-Haber cycle, Uses of Born-Haber type of calculations. Ionic radii, methods of determining ionic radii, factors affecting ionic radii, radius ratio rule, covalent character in ionic bonds, hydration energy and solubility of ionic solids.
- Covalent bond: valence bond theory, resonance, hybridization, Bent's rules and energetics of hybridization, Deduction of molecular shapes – VSEPR theory.
- M.O.theory, application to homo- and hetero-diatomic and -triatomic molecules.

UNIT -II:

- Alkali and alkaline earth metal complexes of crown ethers, cryptands and calixarenes and their biological significance.
- Halogens and Noble gas chemistry –interhalogens, psuedohalogens, polyhalide ions, oxyhalogen species, xenon oxides and fluorides. Oxy- and peroxy acids of N, P and S.
- Graphitic compounds, carbides, pure silicon, silica and silicates, zeolites.
- HSAB concept. super acids. Reactions in non-aqueous media: Liquid ammonia, anhydrous sulphuric acid, glacial acetic acid, anhydrous HF, bromine trifluoride, liquid sulphur dioxide and dinitrogen tetroxide. Reactions in molten salts.

UNIT- III:

- Precipitation phenomena: precipitation from homogeneous solutions, organic precipitants in inorganic analysis. Solvent extraction of metal ions, nature of extractant, distribution law, partition coefficients, types of extractions and applications.
- Theories of redox indicators, titration curves, feasibility of redox titrations.
- Chelometric titrations- titration curves with EDTA, feasibility of EDTA titrations, indicators for chelometric titrations, selective masking and demasking techniques, industrial applications of masking.
- Sampling techniques, preparation of samples for analysis. Nature of errors, statistical treatment of errors, the t- and F-tests, significant figures, rejection of data.

References:

1. J.E Huheey, Keiter, Keiter and Medhi: Inorganic Chemistry (4th ed.), Pearson Education, 2006.
2. Shriver, Atkins and Langford : Inorganic Chemistry (3rd edn.) OUP, 1999.
3. J.D.Lee: Concise Inorganic Chemistry, (5th edn.) Blackwell Science, 2000.
4. B.E.Douglas, D.McDaniel & A Alexander: Concepts & Models of Inorganic Chemistry, Wiley 2001
5. W.W.Porterfield: Inorganic chemistry – A Unified Approach, Elsevier, 2005.
6. R.A.Day and A.L. Underwood : Quantitative Analysis, 5th Ed. (Prentice Hall, India), 1998.

CH 102: ORGANIC CHEMISTRY

UNIT-I:

- **Bonding in organic systems:**

Theories of bonding-Valence and molecular orbital approaches. Resonance, hyper-conjugation and tautomerism, Huckel molecular orbital theory and its application to simple systems- ethylene, allyl, cyclopropyl, butadienyl, cyclopentadienyl, pentadienyl, hexatrienyl, heptatrienyl systems. Calculation of the total energy and M.O. coefficients of the systems.

- **Aromaticity:** Concept of aromaticity, Huckel's rule, Polygon rule, Homo-aromatic, non-aromatic and anti-aromatic systems. Aromaticity in benzenoid and non-benzenoid molecules. Annulenes & hetero-annulenes. Physical methods to study aromaticity-UV, IR & ^1H NM
- **Bonds weaker than covalent:** Addition compounds, crown ether complexes, ands, inclusion compounds, catenanes, fluxional molecules.
- **Structure and reactivity:** Effects of hydrogen hyperconjugation on strengths of acids and bases. bonding, resonance.

UNIT-II:

- **Methods of Determining Reaction Mechanism:** Kinetic and non-kinetic methods, Identification of products, detection of intermediates, isotopic labeling, stereochemical evidences, cross-over experiments, Limitation of reactions, kinetic evidences and kinetic isotopic effects.
- **Reaction Intermediates:** Generation, structure, stability, reactivity, detection, trapping and reactions of classical and non-classical carbocations, carbanions, free radicals, carbenes, nitrenes and arynes. Singlet oxygen-generation and reactions with organic molecules.
- **Aliphatic Nucleophilic Substitution Reactions:** Mechanism and scope of aliphatic nucleophilic substitution reactions- $\text{S}_{\text{N}}1$, $\text{S}_{\text{N}}2$ and $\text{S}_{\text{N}}i$. Stereochemistry of nucleophilic substitution reactions, allylic nucleophilic substitution reactions, Walden inversion, neighbouring group participation & anchimeric assistance. Factors influencing the rates of nucleophilic substitution reactions.

UNIT-III: Stereochemistry

- **Optical Isomerism:** Conformation and configuration of molecules, projection formulae, Fischer, Saw-horse, Newman and Flying wedge representations. Interconversion of these formulae. Absolute configuration (D,L) and (R,S) systems. Elements of symmetry, Psedoasymmetric centres, chirality, molecules with more than one chiral centre, threo and erythro isomers, methods of resolution, stereospecific and stereoselective synthesis, asymmetric synthesis, Cram's and Prelog's rules. Optical activity in the absence of chiral carbon-biphenyls, allenes and spiranes. Conformational analysis of cycloalkanes and

decalins. Effect of conformation on reactivity. Acyclic & cyclic systems-Substituted cyclohexanes, cyclohexanones, cyclohexanols, Curtin-Hammet Principle. Stereochemistry of compounds containing nitrogen, sulphur and phosphorus.

- **Geometrical Isomerism:** Cis-trans isomerism resulting from double bonds, monocyclic compounds & fused ring systems. E, Z-notations, determination of configuration of geometrical isomers, syn & anti isomers.

References:

- 1.Organic Chemistry-P.Y.Bruice (Pearson Education Pvt. Ltd.,New Delhi),2002.
- 2.Stereochemistry,Conformation and Mechanism-P.S.Kalsi (Wiley Eastern,New Delhi)1993.
- 3.Stereochemistry of Carbon Compounds-E.L.Eliel (Tata McGraw Hill, New. Delhi) 1994.
- 4.Advanced Organic Chemistry-Reactions, mechanisms & structure-J.March (Wiley, NY)2000.
- 5.Organic Chemistry-Vol. -1,2 &3-Mukherji, Singh and Kapoor. (Wiley Eastern,) 1994.
- 6.A guide book of mechanisms in Organic Chemistry-P.Sykes (Orient- Longman) 1985.
- 7.Organic Chemistry-R.T. Morrison and R.N. Boyd (Prentice Hall, New Delhi) 1994.
- 8.Organic Chemistry 4th Edn.–S.H. Pine et al (McGraw-Hill, London) 1987.
- 9.Advanced Organic Chemistry- R.A. Carey and R.J. Sundberg (Plenum, New York)1990.
- 10.Modern Concepts of Advanced Organic Chemistry-R.P. Narein (Vikas, Delhi) 1997.
- 11.A Text book of Organic Chemistry-Tewari, Vishnoi and Mehrotra (Vikas, New Delhi)1998.
- 12.A Text book of Organic Chemistry-3rd Edn.-R.K. Bansal, (New Age, New Delhi) 1997.
- 13.Organic Chemistry-3rd Edn- F.A. Carey (Tata McGraw Hill, New Delhi) 1996.
- 14.Stereochemistry by K. Mislow.
- 15.Organic Chemistry-H. Pine (Hendrickson, Cram and Hammond,Mc Graw Hill, New York) 1987.
16. Organic Chemistry-I.L. Finar (ELBS Longmann, Vol. I) 1984.

CH 103: PHYSICAL CHEMISTRY

UNIT-I: Catalysis

- **Catalysis:** Homogeneous Catalysis – equilibrium and steady state treatments, activation energies of catalysed reactions. Acid - base catalysis (general and specific), protolytic and prototropic mechanisms, catalytic activity and acid strength measurements. Kinetics of enzyme catalysed mechanisms – Michaelis – Menten mechanism. Effect of pH, temperature and inhibitors.
- **Acidity functions:** Hammett acidity function, Zucker – Hammett hypothesis, and Bunnett hypothesis.
- **Surface Chemistry:** A review of adsorption isotherms, uni- and bi- molecular reactions. Multilayer adsorption: BET equation – application in surface area determination. Harkin – Jura equation and application. Semiconductor catalysis, n- & p- type. Mechanism of surface reactions. Langmuir – Hinshelwood and Langmuir Rideal mechanisms.

UNIT – II

Chemical Kinetics:

- **Composite reactions:** Rate equation for composite reaction mechanisms (simultaneous and consecutive reactions, steady state treatment, rate determining steps and microscopic reversibility), Chain reactions (hydrogen-halogen reactions with comparison). Auto catalytic reactions (Hydrogen-Oxygen reaction) and Oscillatory reactions.
- **Reactions in solution:** Solvent effects on the reaction rates, Factors determining reaction rates in solution, reaction between ions (effect of dielectric constant and ionic strength), substitution and correlation effects (Hammett and Taft equations-linear free energy relations.) Ion-dipole and dipole-dipole reactions (Pre exp factors and influence of ionic strength) and diffusion controlled reactions.
- **Fast reactions**-Introduction, Study of fast reactions by-flow, relaxation, molecular beam, and spectroscopic and analytical methods

- **Theory of reaction rates-** Temperature dependence and the Arrhenius theory of reaction rates, collision theory of bimolecular reactions, its importance and limitations. Introduction to transition state theory.

UNIT-III:

- **Electrochemistry of solutions:** Ionic atmosphere-introduction, derivation and its effect on the theory of conductivity. Walden's rule. Debye-Huckel limiting law (DHL), its modification and verification. Bjerrum theory of ion association, triple ion formation and its significance.
- **Corrosion:** Introduction, Importance and principles, Forms of corrosion (Galvanic, Atmospheric, stress, microbial and soil). Techniques of Corrosion rate measurement (instrumental and non-instrumental). EMF series & Galvanic series and their limitations. Thermodynamics (Pourbaix diagram). Concept of mixed potential theory and its importance in terms of Kinetics (Tafel and Evans diagram), effect of oxidizer and passivity of corrosion. Protection against corrosion (Design improvement, Anodic and cathodic protection, inhibitors, coating).
- **Analytical Applications of Electrochemistry** -Principles and Applications of Polarography, Cyclic voltammetry, Coulometry, Amperometry and chrono systems.

References:

1. Chemical Kinetics, K. J. Laidler, Pearson Education, Anand Sons(India) 3rd ed., 2008.
2. Fundamentals of Chemical Kinetics, M.R.Wright, Harwood Publishing, Chichesrer, 1999.
3. Kinetics & Mechanisms of Chemical Transformations, J Rajaram & J C Kuriacose, Macmillan, Delhi, 42007.
4. Chemical &Electrochemical Energy Systems, R. Narayan & B. Viswanathan (University Press), 1998.
5. Industrial Electrochemistry, D. Peltcher & F. C. Walsh (Chapman & Hall)1990.
6. Principles and Applications of Electrochemistry–Crow (Chapman hall, New York) 2014
7. An Introduction to metallic corrosion and its prevention-Raj Narayan (Oxford-IBH, New Delhi), 1983.
8. Electrochemistry and Corrosion Science-Nebtor Ferez (Springer Pvt.Ltd.), Delhi, 2010.
9. Instrumental Methds of Chemical Analysis, Kudesia Sawhney, Pragati Prakasha(Meerut).

CH 104: SPECTROSCOPY AND ANALYTICAL TECHNIQUES

UNIT- I:

- **Electron Spin Resonance Spectroscopy:** Basic principles, hyperfine couplings, the 'g' values, factors affecting 'g' values, isotropic and anisotropic hyperfine coupling constants, Zero Field splitting and Kramer's degeneracy. Measurement techniques and Applications to simple inorganic and organic free radicals and to inorganic complexes.
- **NQR Spectroscopy:** Quadrupolar nuclei, electric field gradient, nuclear quadrupole coupling constants, energies of quadrupolar transitions, effect of magnetic field. Applications.
- **Mössbauer Spectroscopy:** The Mössbauer effect, chemical isomer shifts, quadrupole interactions, measurement techniques and spectrum display, application to the study of Fe^{2+} and Fe^{3+} compounds, Sn^{2+} and Sn^{4+} compounds(nature of M-L bond, coordination number and structure), detection of oxidation states and inequivalent Mössbauer atoms.
- **photoelectron spectroscopy:** Basic principles, valence & core binding energies, shifts in energies due to chemical forces, Photoelectron spectra of simple molecules, Auger transitions, measurement techniques, Applications.

UNIT-II

- **Ion Exchange Chromatography :** Definitions, requirements for ion-exchange resin, synthesis and types of ion-exchange resins, Principles, basic features of ion-exchange reactions, resin properties, ion-exchange capacity, resin selectivity and factors affecting the selectivity, applications of IEC in preparative, purification and recovery process. Separation of lanthanides.
- **Exclusion Chromatography:** Theory and principle of size exclusion chromatography, experimental techniques for gel-filtration chromatography (GFC) and gel-permeation chromatography (GPC), materials for packing-factors governing column efficiency, methodology and applications.
- **Thermal methods:** Thermogravimetric analysis, Instrumentation, factors affecting the results and applications. Differential thermal analysis, simultaneous DTA-TGA curves. Differential scanning calorimetry, applications.

UNIT – III:

- **Atomic Absorption Spectrometry:** Principle, Theory, working of AAS instruments, analytical applications, interferences.
- **Emission Spectroscopy:** Flame Emission Spectroscopy, plasma emission spectrometry, basic principles of flame photometry, evaluation methods in flame photometry, interferences.
- **Molecular Luminescence Spectroscopy:** Theory of fluorescence and phosphorescence, fluorimetry in quantitative analysis, instruments, fluorescence and structure, fluorescence quenching, phosphorescence method, applications in quantitative analysis.
- **Light-Scattering methods :** Nephelometry and turbidimetry- theory, effects of concentration, particle size and wavelength on scattering, instrumentation and applications. Activation analysis.

REFERENCES:

- 1.A. Salahuddin Kunju and G. Krishnan: Group Theory and its Applications in Chemistry, PHI Learning, N. Delhi, 2010.
- 2.Gurudeep Raj, Ajay Bhagi and Vinod Jain: Group Theory and Symmetry in Chemistry, 4th edn Krishna Meetut, 2012.
3. U.C. Agarwala, H.L.Nigam, Sudha Agarwal and S.S. Kalra: Molecular Symmetry in Chemistry via Group Theory, Anne Books, N. Delhi, 2013.
4. .G.D. Christian : Analytical Chemistry, (4th Ed.), (John Wiley),1986.
5. R.A.Day and A.L. Underwood : Quantitative Analysis, 5th Ed. (Prentice Hall, India), 1998.
6. H.H.Williard, L.L.Meritt and J.J.Dean, Instrumental methods of analysis,(7th Ed.) 1988
7. B.K.Sharma, Instrumental Methods of Chemical Analysis (Goel publishing), 2000.
8. Skoog, Holler and Nieman: Principles of Instrumental Analysis, (Harcourt Afca), 2001.

CH 105: ENVIRONMENTAL CHEMISTRY

UNIT-I

- Environmental segments, evolution of earth's atmosphere. Air pollution : Air pollutants, prevention and control, Green house gases and acid rain. Carbon monoxide, industrial sources and transportation sources. SO_x- sources, ambient concentration, test methods, control techniques scrubbing, , limestone injection process.
- Ozone hole and CFC's. Photochemical smog and PAN. NO_x - Sources, ambient concentration, test methods, thermodynamics and NO_x, control techniques. Particulates: Size distribution, particulate collection - settling chambers, centrifugal separators, wet scrubbers, electrostatic precipitators & fabric filters. Catalytic converters for mobile sources. Bhopal gas tragedy.

UNIT-II

- Hydrologic cycle, sources, chemistry of sea water, criteria and standards of water quality- safe drinking water, maximum contamination levels of inorganic and organic chemicals, radiological contaminants, turbidity, microbial contaminants. Public health significance and measurement of colour, turbidity, total solids, acidity, alkalinity, hardness, chloride, residual chlorine, sulphate, fluoride, phosphate and different forms of nitrogen in natural and polluted water.
- Chemical sources of taste and odour, treatment for their removal, sampling and monitoring techniques. Determination and significance of DO, BOD, COD and TOC. Water purification for drinking and industrial purposes, disinfection techniques, demineralization, desalination processes and reverse osmosis .

UNIT – III

- Toxic chemicals in the environment, impact of toxic chemicals on enzymes. Detergents- pollution aspects, eutrophication. Pesticides- pollution of surface water. Sewage and industrial effluent treatment, heavy metal pollution.

- Chemical speciation- biochemical effects of pesticides, insecticides, particulates, heavy metals (Hg, As, Pb, Se), carbon monoxide, nitrogen oxides, sulphur oxides, hydrocarbon, particulates, ozone, cyanide and PAN. Solid pollutants and its treatment and disposal. Radioactive waste management.

REFERENCES:

1. A.K. De: Environmental Chemistry, (Wiley Eastern).
2. S.K.Banerji : Environmental Chemistry, (Prentice Hall India), 1993.
- 3 S.D. Faust and O.M. Aly : Chemistry of Water Treatment, (Butterworths),1983.
4. Sawyer and McCarty, Chemistry for Environmental Engineering(McGraw Hill) 1978
5. I.Williams, Environmental Chemistry, John Wiley, 2001
6. S.M.Khopkar, Environmental Pollution Analysis, (Wiley Eastern).

CH 106-Molecular Spectroscopy & Diffraction Techniques

Unit-I

- **Introduction to spectroscopy**, intensity of spectral lines , Natural line width and broadening, Rotational, vibrational and electronic energy levels, selection rules.
- **Microwave Spectroscopy**- The rotation and classification of molecules, rotation spectra of diatomic and polyatomic molecules. Rigid and non-rigid rotator models. Determination of bond length, isotope effect on rotation spectra. Stark effect, nuclear and electron spin interaction. Microwave Spectrometer.
- **Vibration Spectroscopy**: Vibration spectra of diatomic molecules - linear harmonic oscillator, vibrational energies, zero point energy, force constants & bond strengths; anharmonicity of molecular vibrations- Morse PE diagram, selection rules, fundamental, overtones and hot bands. Vibrations of polyatomic molecules- normal modes of vibrations & nature of molecular vibrations (Ex-CO₂& H₂O).

UNIT-II:

- **Vibration-rotation spectra** of diatomic and polyatomic molecules, selection rules, PQR branches. IR Spectrophotometer-Instrumentation
- **Raman Spectroscopy**: Classical and quantum theories of Raman effect, concept of polarizability and polarizability ellipsoid. Rotational and vibrational Raman spectra, selection rules, Raman activity of vibrations, vibrational - rotational Raman spectra,

selection rules, mutual exclusion principle, polarization of Raman lines. An introduction to Laser Raman Spectroscopy. Raman Spectrometer – instrumentation. Applications of IR and Raman spectroscopy in elucidation of molecular structure (Ex - H₂O, N₂O & CO₂ molecules).

Unit III

- **Diffraction Techniques:** Introduction, production of X-ray, Bragg's law, Laue equations, Ewald's diagram, X-Ray diffraction experiments – diffraction of X-rays by a crystalline powder (Debye-Scherrer and flat plate camera), powder diffractometer. Interpretation of power patterns (analytical technique). Single crystal technique - :Laue and Rotation photographic methods. Moving Film method (Weissenberg method). Systematic absences. Crystalline X-ray diffractometer (4 angle), Intensities of diffracted X-rays and structural analysis, X-ray scattering atoms and molecules, Factors affecting X-ray intensities, introduction to Crystal structure analysis.
- **Electron Diffraction:** Introduction, Theory of electron diffraction, Wierl equation and its significance (qualitatively), Elucidation of structure of simple gas molecules. Structure of surfaces - (Low and high Energy Electron Diffraction, Transmission electron microscopy (TEM), SEM. Theory and applications of Neutron diffraction. Comparison between X-ray, electron and Neutron diffractions.

References:

1. Fundamentals of Molecular Spectroscopy, Banwell & McCash (Tata McGraw Hill, New Delhi) 2007.
2. Spectroscopy, H. Kaur (Pragathi Prakashana, Meerut), 2012.
3. Spectroscopy, Donald L. Pavia (Cengage learning India Pvt. Ltd., Delhi), 2007.
4. Spectroscopy, B.K. Sharma (Goel prakashan, Meerut), 2013.
5. A Basic Course in Crystallography, JAK Tareen and TRN Kutty, University Press, Hyderabad (2001).
6. Essentials of Crystallography, M.A. Waheb, Narosa Publishing House, New Delhi (2009),
7. X-ray methods, Clive Whiston, (John Wiley & Sons, New York) 1987.

CH P 101: INORGANIC CHEMISTRY PRACTICALS - I

1. Analysis of Hematite-insoluble residue by gravimetry and Iron by volumetry using Ce^{4+} .
2. Analysis of Dolomite - insoluble residue by gravimetry and Ca, Mg by complexometry.
3. Pyrolusite - Insoluble residue by gravimetry and Manganese content by oxalate method.
4. Analysis of solder - Pb and Sn by EDTA method.
5. Complexometric determination of Mn, Cu, Ni and Fe-Cr mixture
6. Hardness of water
7. Analysis of Halide Mixture - Iodide by KIO_3 and total halide by gravimetrically.
8. Colorimetric Determination of Iron by thiocyanate and Cu by aqueous ammonia.
9. Gravimetric Determinations of Mn, Ni, Mo, Pb/Cr, sulphide, thiocyanate.
10. Statistical Analysis of Data.

Reference:

1. Vogel's Text Book of Quantitative Chemical Analysis(5th Ed), G.H.Jeffrey,J.Bassette, J.Mendham and R.C.Denny, Longman, 1999.

CH P 103: PHYSICAL CHEMISTRY PRACTICALS - I

(Any 12 experiments are to be carried out)

1. (a) Determination of transport number of Cd^{2+} and SO_4^{2-} ions by EMF method.
(b) Determination of thermodynamic parameters of a cell reaction by EMF method.
2. Determination of pK values phosphoric acid by potentiometric/pH metric method
3. Potentiometric titration of halides in mixtures (Cl^- , Br^- and I^-) with silver nitrate
4. Verification of Nernst equation for Ag^+ , Cu^{2+} and Zn^{2+} species.
5. Determination of Solubility product and the Instability constant by potentiometric method.
6. Potentiometric determination of solubility of insoluble silver halide and the standard electrode potential using quinhydrone electrode.
7. Conductometric titrations of displacement and precipitation reactions.

8. Determination of equivalent conductance and dissociation constants of weak acid and base.
9. Determination of solubility of lead iodide at different T & hence molar heat of solution
10. Determination of hydrolysis constant of aniline hydrochloride.
11. Determination of degree of hydrolysis of CH_3COONa and NH_4Cl by conductivity method.
12. Determination of Critical Micelle concentration by conductometric method.
13. Determination of pH of buffer solutions with a pH meter & evaluation of pK_a of acid
14. Verification of Walden's rule (relation between viscosity of a solution and the electrical conductivity).
15. Study of variation of viscosity of a liquid with temperature
16. Determination of parachor value for CH_2 group and some elements by Surface Tension method,
17. Determination of the composition of a solution by S.T measurement.
18. Determination of the Critical Micelle Concentration by surface tension/spectrophotometric measurements.
19. Determination of the composition of Zinc Ferrocyanide complex by Potentiometric titrations.
20. Determination of Specific and molar refractivity of liquids and paracor value of a species by refractometric method.

References:

1. Findlay's Practical Physical Chemistry- B. P. Levitt (Longman, London).
2. Experiments in Physical Chemistry– James and Prichard.
3. Experimental Physical Chemistry - Daniels et al.
4. Experimental Physical Chemistry-Das & Behera (Tata McGraw Hill, New Delhi)1983.
5. Advanced Practical Physical Chemistry–Yadav (1989).
6. Experiments in Physical Chemistry–J. C. Ghosh (Bharathi Bhavan)1974.
7. Practical Physical Chemistry-B Viswanathan & P.S Raghavan,(ViVa Books, New Delhi) 2005.

CH P 102: ORGANIC CHEMISTRY PRACTICALS - II

Single and two stage organic preparations

1. Electrophilic substitution reactions—Preparations of p-bromoaniline, p-nitroaniline, 2,4,6-tribromophenol and picric acid.
2. Alkylations—Preparation of nerolin and N-methyl anthranilic acid.
3. Acetylations—Preparations of α -D-glucose penta-acetate and 2-naphthyl acetate.
4. Reactions with ring formation—Preparations of 1,2,3,4-tetrahydrocarbazole, 1-phenyl-3-methyl-5-pyrazolone and 7-hydroxy-4-methyl-coumarin.
5. Diazotisation reactions—Preparations of iodo, chloro and azo compounds.
6. Dehydration reactions—Preparations of cyclohexene and succinic anhydride
7. Condensation reactions—Condensations involving diethylmalonate and ethyl acetoacetate. Claisen-Schmidt, Aldol and Perkin condensation reactions.
8. Halogenation reactions-Preparation of n-butylbromide & α -bromocinnamic acid.
9. Reduction reactions—Reductions of nitro compounds and carbonyl compounds.
10. Oxidation reactions-Preparation of p-nitrobenzoic acid, p-benzoquinone and adipic acid.

References:

1. Laboratory Manual in Organic Chemistry—R. K. Bansal (New Age, New Delhi)1990.
2. Experimental Organic Chemistry—Vol. I & II—P. R. Singh et al (TMH New Delhi)1981
3. Laboratory Manual in Organic Chemistry—Dey & Sitaraman (Allied , New Delhi)1992.
4. Vogel's Text Book of Practical Organic Chemistry including Qualitative Organic Analysis - B. S. Furniss et al., (Longman - ELBS, London), 1989.
5. Manual of Organic Chemistry - Dey and Seetharaman.
6. A Text Book of Practical Organic Chemistry – A.I. Vogel, Vol.III.
7. Practical Organic Chemistry - Mann & Saunders.

Semester II

201 ADVANCED INORGANIC CHEMISTRY

UNIT - I:

Symmetry and Group Theory

Definitions of group, subgroup, relation between orders of a finite group and its subgroup. Conjugacy relation and classes, symmetry elements and symmetry operations, Schonflies symbols, Matrix representations of symmetry operations, products of symmetry operations, some properties of matrices and vectors, classification of molecules into point groups. Reducible and irreducible representations. The Great Orthogonality theorem (without proof), character tables. The direct product. Applications of group theory - Molecular vibrations, group theoretical selection rules for electronic transitions, for infra red and Raman spectra. Hybrid orbitals and Molecular orbitals, transformation properties of atomic orbitals.

UNIT - II:

Chemistry of higher boranes, classification, structures and M.O. description of bonding, framework electron counting, Wade's rules, chemistry of B_5H_9 , $B_{10}H_{14}$ and $B_nH_n^{2-}$. Carboranes and metallocarboranes. Cyclophosphazenes, phosphazene polymers, S-N compounds. Coordination numbers 2-10 and their geometry, crystal field theory of coordination compounds, d-orbital splittings in octahedral, square planar and tetrahedral fields, spectrochemical series, and Jahn-Teller effect.

Structural evidences for ligand field splittings – hydration, ligation and lattice energies, site preference energies. MO theory of coordination compounds- MO energy level diagrams for octahedral and tetrahedral complexes.

UNIT - III:

Trends in oxidation states, stereochemistry and ionic sizes of metals, comparison of 3d, 4d and 5d series by taking Ti and Ni subgroups as examples. Lanthanides and actinides: electronic structure, oxidation states, extraction and separation of lanthanides, stereochemistry, spectral and magnetic properties of lanthanide and actinide complexes, lanthanide complexes as NMR shift reagents. Comparison with d-block ions.

Methods of reduction of oxide ores, Ellingham diagram, chemical and electrolytic reductions,

reduction potentials, Latimer and Frost diagrams, effect of complexation on potential.

References:

1. J.E Huheey, E.A..Keiter, R.L.Keiter & O K Medhi: Inorganic Chemistry (4th edn.), Pearson, 2006.
2. Shriver, Atkins and Langford : Inorganic Chemistry (3rd edn.) OUP, 1999.
3. J.D.Lee: Concise Inorganic Chemistry, (5th edn.) Blackwell Science, 2000.
4. B.E.Douglas, D.McDaniel &A Alexander: Concepts & Models of Inorganic Chemistry, Wiley 2001
5. W.W.Porterfield: Inorganic chemistry – A Unified Approach, Elsevier, 2005.
- 6.N.N.Greenwood and A. Earnshaw, Chemistry of the Elements, First Edn(Pergamon Press)
7. Basallo & Johnson, Coordination Chemistry

202 ADVANCED ORGANIC CHEMISTRY

UNIT - I:

Aliphatic Electrophilic Substitution Reactions: Bimolecular mechanisms- S_E1 , S_E2 and S_{Ei} mechanism. Electrophilic substitution reactions accompanied by double bond shifts.

Aromatic Electrophilic and Nucleophilic Substitution Reactions: Mechanism of aromatic electrophilic substitution reactions-nitration, halogenation, sulphonation, Friedel-Crafts alkylation and acylation, orientation and reactivity, energy profile diagram. The ortho/para ratio, ipso attack, orientation in other ring systems. Mechanism of Vilsmeier-Haack reaction, Mannich reaction, Diazonium coupling, Pechmann reaction and Fries rearrangement. Mechanisms of aromatic nucleophilic substitution reactions- S_NAr , S_N1 & aryne mechanism. Von-Richter rearrangement, Sommelet-Hauser rearrangement, Smiles rearrangement.

UNIT- II:

Free Radical Reactions: Types, mechanisms of free radical substitution reactions & neighbouring group assistance. Reactivity for the aliphatic and aromatic substances at a bridgehead. Reactivity of attacking radical. Effect of solvent on reactivity. Auto-oxidation, coupling of alkynes. Arylation of

aromatic compounds by diazonium salts. Sandmeyer, Ullmann & Hunsdiecker reactions.

Elimination Reactions: Discussions of E1, E2 and E1cB mechanisms. Orientation during elimination reactions. Saytzeff and Hofmann rules. Reactivity-effects of substrate structures, attacking base, leaving group and solvent medium.

Pyrolytic Eliminations: Mechanisms of pyrolysis of esters of carboxylic acids. Chugaev reactions, Hofmann degradation, Cope elimination and xanthate pyrolysis.

UNIT- III:

Formation and Hydrolysis of Esters: Plurality of mechanism. Mechanism of esterification reactions. Ester hydrolysis-A_{AC}2, B_{AC}2, A_{AC}1 & A_{AL}1 mechanism. Transesterification.

Addition to Carbon-Carbon Multiple Bonds: Addition reactions involving electrophiles, nucleophiles and free radicals. Cyclic mechanisms. Orientation and stereochemistry. Addition of halogens, hydrogen halides, carboxylic acids and amines. Addition to cyclopropanes, hydroboration, Michael addition. Addition of oxygen across double bonds.

Addition to Carbon-Hetero Multiple Bonds: Electrophilic, nucleophilic and free radical additions to C=O and C=N systems. Addition of Grignard reagents. Reformsky reaction, aldol condensation, Knoevenagel condensation, Perkin reaction and Wittig reactions.

References:

1. Organic Reactions and Their Mechanisms- P.S. Kalsi (New Age, New Delhi), 1996.
2. Advanced Organic Chemistry 4th Edn- J. March (Wiley, NY) 2000.
3. Organic Reaction Mechanisms- Bansal (Tata McGraw Hill, New Delhi) 1978.
4. Organic Chemistry-Vol.-I & II-Mukherji, Singh and Kapoor (Wiley Eastern, New Delhi) 1985.
5. Mechanism and Theory in Organic Chemistry-Lowry and Richardson Harper and Row, 1987.
6. Reaction Mechanisms in Organic Chemistry-Mukherji, Singh and Kapoor (McMillan) 1978.
7. Organic Chemistry-P.Y. Bruice (Pearson Education, New Delhi) 2002.
8. Organic Reaction Mechanism-R.K. Bansal (Wiley Eastern Limited, New Delhi) 1993.
9. A Guide Book to Mechanism in Organic Chemistry-Petersykes.
10. Advanced Organic Chemistry –Carey and Sundberg, Part A & B, 3rd edition (Plenum Press,

New York) 1990.

11. Organic Chemistry-I.L. Finar (ELBS Longmann, Vol. I) 1984.

12. Advanced General Organic Chemistry-S.K. Ghosh (Book and Allied (P) Ltd) 1998.

203 ADVANCED PHYSICAL CHEMISTRY

UNIT I:

Chemical Thermodynamics:

Entropy: Physical significance, entropy change in an ideal gas. Variation of entropy with Temperature, Pressure and Volume. Entropy change in reversible and irreversible processes. Thermodynamic equations of state.

Free energy, Maxwell's relations and significance. Helmholtz's and Gibbs free energies, Gibbs – Helmholtz equation and its applications.

Nernst heat theorem : Its consequences and applications. Third law of thermodynamics – statements, applications and Comparison with Nernst Heat theorem.

Chemical affinity and thermodynamic functions. Effect of temperature and pressure on chemical equilibrium- van't Hoff reaction isochore and isotherms.

Partial molar properties: Physical significance, determination of partial molar volume and enthalpy.

Chemical potential: variation of chemical potential with temperature. Gibbs – Duhem equation.

Thermodynamic functions of mixing, Gibbs – Duhem – Margules equation.

Fugacity: Relationship between fugacity and pressure. Determination of fugacity- graphical method and Lewis Randall rule.

Activity and activity coefficient: Variation of activity and fugacity with temperature and pressure. Determination of activity by vapour pressure method.

UNIT - II: Statistical and Irreversible thermodynamics

Statistical Thermodynamics : Thermodynamic Probability, phase space, micro and macro states, statistical weight factor, assembly, ensemble-significance, classification and comparison. Distribution laws – Boltzmann law, Maxwell-Boltzmann distribution law. Bose-Einstein and Fermi-Dirac statistics, Limit of applicability of various laws. Relationship between partition function and thermodynamic functions -Average energy, heat capacity, free energy, chemical

potential. Introduction to Statistical mechanism of independent, independent and indistinguishable (non-localized) molecules or particles. .

Partition function for molecular particles. .

Thermodynamic quantities in terms of partition function of particles- Evaluation of Translational, vibrational, rotational, electronic and nuclear derivations of translational, rotational, vibrational and electronic partition functions. .

Law of equipartition principle. Partition function and equilibrium constant. .

Statistical thermodynamic properties of solids (Heat capacity)- Introduction, thermal characteristics of crystalline solid, Einstein model, Debye modification. Nuclear statistics - Introduction, symmetric and nuclear spin, ortho and para nuclear states. Applications of partition function to mono atomic gases, diatomic molecules, equilibrium constant.

Irreversible Thermodynamics – Introduction, Thermodynamics of irreversible processes, Entropy production-rate of entropy production. Phenomenological relations. The principle of microscopic reversibility, Onsager reciprocal relations – validity and applications (Electro kinetic, Thermoelectric phenomena). Irreversible thermodynamics of Non linear regime and biological systems.

UNIT III: Quantum Chemistry

Postulates of quantum Mechanics. Particle waves, its character and significance. Normalization and orthogonality of wave functions. Operators and their algebra, types and applications, operators for the dynamic variables of a system (position, linear momentum, angular momentum, Kinetic energy, potential energy and total energy) . Eigen values and Eigen functions. Quantum numbers and their characteristics. Shrodinger wave equation- significance and derivation. Statistical interpretation of ψ .

Solution of SWE for simple systems-particle in a box (1D & 3D), particle in a ring, simple harmonic oscillator, rigid rotor, the H atom (solution of r, θ, Φ equations). Chemical Bonding in diatomics: Covalent bond-Valence bond and molecular orbital approaches with comparison.

Molecular orbital theory applied to homonuclear and heteronuclear diatomic molecules. Introduction to Huckel molecular orbital theory of conjugated systems and its applications. 8hrs

References:

1. Thermodynamics for Chemists- S Glasstone(East West press) Physical Chemistry-P W Atkins.
2. Chemical Thermodynamics, Rajaram and Kuriokose (East-West)Pearson, Chennai, 2013.
3. Thermodynamics, 3rd Ed., R.C. Srivastava and Subit K Saha (Prentice-Hall of India, Delhi), 2007.
4. Statistical Thermodynamics, M. C. Gupta (New ge International, Delhi) 2007.
5. Principles of Physical chemistry;B.R.Puri, L.R.Sharma and M.S.Pathania, Vishal Publishers(2014)
6. Atomic Structure and Chemical Bond , Manasa Chanda, Tata McGraw Hill Publishers(1991). 8.Quantum Chemistry, R.K.Prasad, New Age International (1991)
7. Advanced Physical Chemistry- Gurdeep R Chatwal (Goel Publishes, Meerut), 1992. 10.Introductory Quantum Chemistry – A.K.Chandra (Tata McGraw Hill) 1994.
8. Quantum Chemistry, A.B.Sannigrahi (Book and Allied Pvt.Ltd., Kolkatt), 2013. 12.Quantum Chemistry, Donald A.P (Viva Books, Delhi), 2013.

204 ORGANIC SPECTROSCOPIC TECHNIQUES

UNIT-I:

UV/Electronic Spectroscopy: Basic principles, Chromophores, auxochromes, Instrumentation and application. Factors affecting the positions of UV bands. Electronic transitions and empirical correlations of predicting λ_{max} of organic compounds. Woodward–Fieser rules. UV absorption of aromatic compounds - effect of substituents and solvent effects. Empirical rules to calculate λ_{max} . Application of UV spectroscopy in the structural study of organic molecules.

IR Spectroscopy: Basic principles, Application of infrared spectroscopy in the structural study-identity by finger printing and identification of functional groups. Characteristic vibrational frequencies of common functional groups (alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines). Study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, anhydrides and acids). Factors affecting band positions and intensities such as effect of hydrogen bonding, phase and solvent on vibrational frequencies, overtones, combination bands and Fermi resonance.

UNIT-II: Nuclear Magnetic Resonance Spectroscopy

Theory and principle, NMR spectrometer, FT NMR and its advantages. Solvents used, chemical shift and its measurements, factors affecting chemical shift. Integration of NMR signals, spin-spin coupling, coupling constant. Shielding and deshielding. Chemical shift assignment of major functional groups, Classification (ABX, AMX, ABC, A₂B₂), spin decoupling, effects of chemical exchange, fluxional molecules, Hindered rotation through NMR spectrum, Karplus relationships (Karplus curve—variation of coupling constant with dihedral angle), double resonance techniques, NMR shift reagents, solvent effects and Nuclear Overhauser Effect. High resolution ¹H NMR. Applications of NMR spectroscopy in structure elucidation of simple organic and inorganic molecules. Pulse techniques in NMR, two dimensional and solid state NMR. Use of NMR in Medical diagnostics.

NMR of nuclei other than proton: ¹³C chemical shift & factors affecting it. Decoupling-Noise decoupling & broad band decoupling. Off-resonance proton decoupling-some representative examples. Introduction to ¹⁹F & ³¹P NMR.

UNIT-III: Mass Spectrometry

Basic principles, Instrumentation, interpretation of mass spectra, resolution, exact masses of nucleides, molecular ions, meta-stable ions and isotope ions. Fragmentation processes-representation of fragmentation, basic fragmentation types and rules. Factors influencing fragmentations and reaction pathways. McLafferty rearrangement. Fragmentations associated with functional groups- alkanes, alkenes, cycloalkanes, aromatic hydrocarbons, halides, alcohols, phenols, ethers, acetals, ketals, aldehydes, ketones, quinines, carboxylic acids, esters, amides, acid chlorides, nitro compounds and amines. Ion analysis, ion abundance, retro Diels-Alder fragmentation. Nitrogen rule. High resolution mass spectroscopy. Composite problems involving

the applications of UV, IR, ^1H and ^{13}C NMR and mass spectroscopic techniques. Structural elucidation of organic molecules.

REFERENCES:

1. Spectrometric Identification of Organic Compounds - Silverstein, Bassler & Monnill (Wiley)1981.
2. Applications of Absorption Spectroscopy of Organic Compounds-Dyer(Prentice Hall,NY) 1965.
3. Spectroscopy of Organic Compounds-3rd Ed.-P.S.Kalsi (New Age, New Delhi) 2000.
4. Analytical Chemistry-Open Learning : Mass spectrometry.
5. Spectroscopic Methods in Organic Chemistry - Williams and Fleming, TMH.
6. Spectroscopy, Donald L.Pavia (Cengage learning India Pvt.Ltd., Delhi), 2007.
7. Organic Spectroscopy-3rd ed.-W.Kemp (Pagrave Publishers, New York), 1991.

205 ANALYTICAL AND GREEN CHEMISTRY

UNIT I:

Cell Structure and Functions: Structure of prokaryotic and eukaryotic cells, intra cellular organelles and their functions, comparison of animal and plant cells. Overview of metabolic processes – catabolism and anabolism. ATP- the biological energy currency. Origin of life – unique properties of carbon, chemical evolution and rise of living systems.

Lipids: Fatty acids, essential fatty acids, structure and function of triacylglycerides, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins.

Lipoproteins: composition and function, role in atherosclerosis, properties of lipid aggregates, micelles, bilayers, liposomes and their biological functions. Biological membranes- Fluid mosaic model of membrane structure. Lipid metabolism(-oxidation of fatty acids).

Unit II:

Enzymes: Introduction, Classification, Enzyme substrate complex formation models: Lock and Key model, Host-Guest and Induced- Fit model. Factors affecting enzyme activity (pH, temperature), enzyme inhibition (reversible and irreversible) and immobilised enzymes. Examples of some typical enzyme mechanisms for Triose phosphate isomerase, α - Carboxy peptidase-A and Ribonuclease. Enzymatic synthesis of α -amino acids and peptides. Transformations of lipases and esterases. Kinetic resolutions of carboxylic acids, esters and alcohols-Transesterification. Enzymatic synthesis of α -amino acids and peptides. Transformations of lipases and esterases.

Coenzymes

Introduction. Co factors - cosubstrates - prosthetic groups. Classification-Vitamin derived coenzymes and metabolite coenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate (TPP), pyridoxal phosphate (PLP), oxidized and reduced forms of nicotinamide adenosine dinucleotide / their phosphates (NAD, NADH, NADP⁺, NADPH), Flavin adenine nucleotide (FAD, FADH₂), Flavin mononucleotide (FMN, FMNH₂) and

tetrahydrofolate. Adenosine triphosphate (ATP) and adenosine diphosphate (ADP). Mechanism of reactions catalyzed by the above coenzymes.

References:

1. Principles of Biochemistry – A L Lehninger, Worth Publishers.
2. Biochemistry – L Stryer, W H Freeman.
3. Biochemistry – J David Rawn and Neil Patters.
4. Biochemistry – Voet and Voet, John Wiley.
5. Outlines of Biochemistry – E E Conn and P K Stumpf. John Wiley.
6. Enzyme structure and mechanism - Fersht and Freeman
7. Outlines of Biochemistry - Conn and Stumpf
8. Principles of Biochemistry - Horton & others.
9. Bioorganic chemistry - A chemical approach to enzyme action - Herman Dugas and Christopher Penney.

206 ENVIRONMENTAL, ELECTRO AND POLYMER CHEMISTRY

UNIT-I:

Environmental segments, evolution of earth's atmosphere. Air pollution : Air pollutants, prevention and control, Green house gases and acid rain. Carbon monoxide, industrial sources and transportation sources. SO_x- sources, ambient concentration, test methods, control techniques - scrubbing, limestone injection process. Ozone hole and CFC's. Photochemical smog and PAN. NO_x - Sources, ambient concentration, test methods, thermodynamics and NO_x, control techniques. Particulates : Size distribution, particulate collection - settling chambers, centrifugal separators, wet scrubbers, electrostatic precipitators & fabric filters. Catalytic converters for mobile sources. Bhopal gas tragedy.

UNIT-II

Corrosion - Introduction, consequence, types, prevention and measurement. Conventional sources of energy, limitations, Importance of storage, Battery-Electrodes, Cell, battery Brief account of primary, secondary, lithium battery and fuel cells. Semiconductor electrodes and Solar energy system. Introduction to bioelectrochemistry, electrochemical communication in biological organisms. Theory and applications of Electroplating and electroless plating. Reaction Kinetics-Theory and

applications of different types of reactions- Oscillatory, chain reaction, branched chain reaction. Energy of activation and thermodynamic parameters, Collision theory of reaction rates, limitations and basics of transition state theory.

UNIT- III

Polymers:

Introduction- Basic concepts and classification of polymers, Molecular weight and its distribution, Chemistry of polymerization- Step, chain, Coordination, Copolymerization. Polymerization techniques- bulk, solution, suspension, emulsion, poly-condensation, solid and gas phase polymerization.

Chemical and geometrical structure of polymer molecules, Structure property relationship- Physical, Thermal and mechanical properties

Synthesis, properties, structural features and applications of some important commercial polymers (PE, PP, PS, PVC, PMMA, PET, Nylon-6, Nylon-6,6), Engineering polymers (Kevlar, Nomex, ABS, PC, Teflon). Applications of polymers in separations: reverse osmosis, ultra and nano-filtration. Applications in electronics- conducting polymers and electronic shielding, Applications of polymers in medicine. Management of plastics in environment- recycling, incineration and biodegradation.

References:

1. A.K. De : Environmental Chemistry, (Wiley Eastern).
2. S.K. Banerji : Environmental Chemistry, (Prentice Hall India), 1993.
3. Sawyer and McCarty, Chemistry for Environmental Engineering (McGraw Hill) 1978.
4. An Introduction to metallic corrosion and its prevention- Raj Narayan (Oxford-IBH, New Delhi), 1983.
5. Chemical & Electrochemical Energy Systems, R. Narayan & B. Viswanathan (University Press), 1998.
6. Industrial Electrochemistry, D. Peltcher & F. C. Walsh (Chapman & Hall) 1990.
7. F.W. Billmeyer, Text book of Polymer science, 3rd Edn, A Wiley- Interscience Publication, New York, 2005
8. V.R. Gowariker, Polymer Science, New Age International (P) Ltd., New Delhi, 2012
9. R.W. Dyson, Specialty Polymers, Chapman and Hall, New York, 1987
10. J.R. Fried, Polymer Science and Technology, Prentice Hall of India Pvt. Ltd., New Delhi, 1999

11. P. Ghosh, Polymer Science and Technology, Tata - McGraw Hill, New Delhi, 1995

201 INORGANIC CHEMISTRY PRACTICALS-II

Qualitative Analysis of mixtures of Inorganic Salts containing 3 cations and 2 anions (1 less common metal ions like Tl, W, Mo, V, Zr, Th, U, Ce, Ti and Li to be included among anions organic acid radicals, phosphate, borate and fluoride separation included).

References:

1. Vogel's Text Book of Quantitative Chemical Analysis (5th Ed), G. H. Jeffrey, J. Bassette, J. Mendham and R. C. Denny, Longman, 1999
2. Vogel's Qualitative Inorganic Analysis (7th Ed), G. Svehla, Longman (2001).

202 ORGANIC CHEMISTRY PRACTICALS-II

Separation and systematic qualitative analysis of binary mixtures of organic compounds containing both mono and bifunctional groups and preparation of suitable derivatives.

References:

1. Practical Organic Chemistry-F .G. Mann and B. C. Saunders (ELBS, England), 2001.
2. Practical Organic Chemistry - A. I. Vogel (Longman-ELBS, England), 1971.
3. Experimental Organic Chemistry–Vol.I&II Singh et al(TMH, New Delhi)1981.
4. Semimicro Qualitative Organic Analysis–Cheronis et al Wiley-Eastern, New Delhi) 1964.
5. Vogel's Text Book of Practical Organic Chemistry Including Qualitative Organic Analysis- B. S. Furniss *et al* (Longman-ELBS, England), 1978.
6. Manual of Organic Chemistry - Dey and Seetharaman.
7. Modern Experimental Organic Chemistry-John H. Miller and E.F. Neugil.

203 PHYSICAL CHEMISTRY PRACTICALS- II

(At least 12 experiments are to be carried out)

1. Determination of cryoscopic constants of solvents and molecular weight of non volatile substances by thermal method.
 2. Determination of degree of dissociation, Vant Hoff factor and molecular weight of an electrolyte by cryoscopy method using copper calorimeter/Dewar flask..
 3. Heat of solution of a sparingly soluble compound in water by solubility method.
 4. Phase diagram of two component systems by thermal analysis.
 5. Phase diagram of three component system (a) 3 liquids with single binodal curve, and b) two liquids and one solid
 6. Kinetics of acid catalyzed hydrolysis of methyl acetate and determination of (a) order and rate constant and (b) Energy of activation.
 7. Determination of a) Energy of activation & b) rate constant for the First and second order kinetics of reaction between potassium persulphate and potassium iodide.
 8. Kinetics of sodium formate – iodine reaction.
 9. Determination of the latent heat of evaporation of carbon tetrachloride.
 10. Preparation of colloidal solutions.
 11. Verification of F & L adsorption isotherms for acetic acid on activated charcoal.
 12. To study the adsorption of iodine on charcoal from alcoholic solution.
 13. To study the effects of gelatin solution on the precipitation values.
 14. Comparison of detergent action of detergents and determination of interfacial tension.
 15. Thermodynamic prediction and measurement of the solubility of naphthalene in benzene.
 16. Study of association of benzoic acid in benzene/toluene.
- Any other relevant experiments of interest.

References:-

1. Practical Physical Chemistry- B Viswanathan & P.S Raghavan,(ViVa Books, Delhi) 2005.
2. Findlay's Practical Physical Chemistry- B. P. Levitt (Longman, London).
3. Experiments in Physical Chemistry– James and Prichard.
4. Experimental Physical Chemistry - Daniels et al.
4. Experimental Physical Chemistry-Das & Behera (Tata McGraw Hill, New Delhi)1983.
5. Advanced Practical Physical Chemistry–Yadav (1989).
6. Experiments in Physical Chemistry–J. C. Ghosh (Bharathi Bhavan)1974.