For Affiliated Colleges

M.Sc. Chemistry First Year 2015

(I & II semester, each semester of 15 weeks)

	Total pds. 45 minutes
I SEMESTER:	
Four theory courses	
Paper I CH 401 Inorganic Chemistry	**90**
Paper II CH 403 Organic Chemistry	**90**
Paper III CH 405 Physical Chemistry	**90**
Paper IV CH 407 Analytical Chemistry	**90**
	360

PRACTICALS:

	4 pds/ day		24 pds./ week	360 pds./ semester
CH 409 Inorganic Chemistry	**4 day/week**			
CH 410 Physical Chemistry	**2 day/week**			

II SEMESTER:

Four theory courses

	Total pds. 45 minutes
Paper I CH 402 Inorganic Chemistry	**90**
Paper II CH 404 Organic Chemistry	**90**
Paper III CH 406 Physical Chemistry	**90**
Paper IV CH 408 Analytical Chemistry	**90**
	360

PRACTICALS:

	4 pds/ day		24 pds./ week	360 pds./ semester
CH 411 Organic Chemistry		**…**	**4 days/week**	
CH 412 Physical Chemistry		**…**	**2 days/week**	

EXAMINATION SCHEME:

I SEMESTER:

FOUR THEORY PAPERS

CH 401		**3 Hrs. 50 marks**
CH 403		**3 Hrs. 50 marks**
CH 405		**3 Hrs. 50 marks**
CH 407		**3 Hrs. 50 marks**
		200

PRACTICAL EXAMINATIONS:

(A) Inorganic Chemistry	**12 Hrs. (2 days)**	**67 marks**
(B) Physical Chemistry	**6 Hrs. (1 day)**	**33 marks**
Total		**100**

II SEMESTER:

FOUR THEORY PAPERS:

CH 402	**3 Hrs. 50 marks**
CH 404	**3 Hrs. 50 marks**
CH 406	**3 Hrs. 50 marks**
CH 408	**3 Hrs. 50 marks**
	200

PRACTICAL EXAMINATIONS:

(A) Organic Chemistry	**12 Hrs. (2 days)**	**66 marks**
(B) Physical Chemistry	**6 Hrs. (1 day)**	**34 marks**
Total		**100**
Total marks of M.Sc. Previous:		**600**

M.Sc. (Final) Chemistry (2015)

(III & IV semester each Semester of 15 weeks)

III SEMESTER

		Total pds. of 45 minutes
Paper I	**CH 501 Spectroscopy**	**90**
Paper II	**CH 502 Photochemistry & Solid State Chemistry**	**90**
Paper III	**CH 503 Environmental Chemistry**	**90**
Paper IV	**CH 504 Biochemistry**	**90**
		360 periods

Practicals **4 pds.** **24 pds./week** **360 pds./semester**

There will be 2 Lab curses. Students will work for 7 weeks each in lab 1 and 2 in III sem.

CH 511 **Lab. Course 1 (Inorganic)**
CH 512 **Lab. Course 2 (Analytical)**

IV SEMESTER

A student will opt for any one of the four elective groups.

Elective Group A	**C.No. 601/602/603/604**	**90**
Elective Group B	**C.No.611/612/613/614**	**90**
Elective Group C	**C.No.621/622/623/624**	**90**
Elective Group D	**C.No.631/632/633/634**	**90**
		360 periods

Practicals **4 pds./day** **24 pds./week** **360 pds./semester**

There will be 2 Lab curses. Students will work for 7 weeks each in Lab 3 and Lab 4 in IV sem.

CH 513 **Lab. Course 3 (Organic)**
CH 514 **Lab. Course 4 (Physical)**

Examination Scheme

M.Sc. III Semester:

4 theory papers of:

CH 501	**3 Hrs.**	**50 marks**
CH 502	**3 Hrs.**	**50 marks**
CH 503	**3 Hrs.**	**50 marks**
CH 504	**3 Hrs.**	**50 marks**
		200 marks

Practical examinations: **12 Hrs. (2 days)** **100 marks.**

(a) Lab. 1 **Lab.2**
6 Hrs. **6 Hrs.**
50 marks **50 marks**

IV Semester:

4 Theory papers (Elective) 50 marks total 200 marks.

Practical examinations: **12 Hrs. (2 days)** **100 marks.**

Lab. 3 **Lab. 4**

6 Hrs. **6 Hrs.**
50 marks **50 marks**

Total Marks of M.Sc. (F) **600**

M.Sc Chemistry (For Affiliated Colleges)
M.Sc. I YEAR-2015
SEMESTER – I

CH 401- INORGANIC CHEMISTRY

Unit I

Stereochemistry and bonding in compounds of main group elements: Walsh diagram of tri atomic molecules, dπ -pπ bonds and synergic bonding, equivalent and in equivalent hybridization and Bent-rule. Energetics of hybridization Simple reactions of covalently bonded molecules, atomic inversion. Berry pseudo rotation and Nucleophilic displacement, Free radical reactions. Applications of valance shell election pair repulsion(VSEPR) theory in structure elucidation.

Unit II

Metal Ligand Bonding :Limitations of crystal field theory, Jahn Tellor theorem. and distortion of molecules. Molecular orbital theory of hetero triatomic molecules viz . BeH_2 , CO_2 ,NO_2 , H_2O, Coulson diagrams of tri atomic molecules CO_2 , NO_2 , H_2O. Molecular orbital theory (MOT): octahedral, tetrahedral and square planer complexes and π - bonding complexes, Comparison with CFT.

Unit III

Metal Ligand Equilibrium in solution : stepwise and overall formation constant and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, Chelate effect and its thermodynamic origin, determination of binary formation constants by pH metry and spectrophotometry.

Unit IV

Correlation diagrams of Transition Metal Complexes:Types of transitions, selection rules for electronic transition, Spectroscopic ,ground States, correlation diagrams, Orgel and Tanabe sugano diagrams for d^1 to d^9 states in Transitions metal complexes. Calculations of Dq. B and β parameters.

Unit V

Electronic spectra and Magnetic properties of transitions metal Complexes, Spectroscopic methods of assignment of absolute configuration in optically active, metal chelates and their stereo chemical information, Charge transfer spectra, Anomalous magnetic moments, magnetic exchange coupling and spin crossover.

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements, N.N. greenwood and A.Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. lever, Elsevier.
5. Magnetochemistry, R.L.Carlin, Springer Verlag.

6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and LA McCleverty, Pergamon.

CH 403- ORGANIC CHEMISTRY

UNIT I

Nature of Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, reasonance hyperconjugation, bonding in fullerenes, tautromerism.

Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbvonds, Huckel's rule, energy level of π-molecular orbitals, annulenes aromaticity, homo-aromaticity, PMO (approach).

Bonds weaker than covalent- addition compounds, crown ether complexes, cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.

UNIT II

Stereochemistry I

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity conformation of sugars, steric strain due to unavoidable crowding. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

UNIT III

Stereochemistry II

Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape.

UNIT IV

Reaction Mechanism: Structure and Reactivity

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control. Hammond's postulate, Curtin-Hammett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanism isotope effects. Hard and Soft acids and bases.

Generation, structure, stability and reactivity of carbocations, carbanions free radicals, carbenes and nitrenes.

Effect of structure on reactivity – resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship. substituent and reaction constants. Taft equation.

UNIT V

Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, buta-1,3- diene, hexa-1,3,5-triene and allyl system. Classification of pericyclic reactions. Woodward – Hoffmann correlation diagrams, FMO and PMO approach. Electrocyclic reactions – conrotatory and disrotatory motions, 4n, 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements – suprafacial and antrafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements. Fluxional tautomerism. Ene reaction.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J.Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K.Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
8. Pericyclic Reactions, S.M.Mukherji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry S.M.Mukherji and S.P. Singh, Macmillan.
10. Stereochemistry Organic Compounds, D.N.asipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S.Kalsi, New Age Internationa.
12. Pericyclic Reactions by Jagdama Singh.

CH 405 - PHYSICAL CHEMISTRY

UNIT I

Chemical Kinetics-I

Chemical Dynamics: Ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions.

Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde). photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and oscillagtory reactions (Belousov Zhabotinsky reaction).

UNIT II

Chemical Kinetics-I

Homogeneous and heterogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, and flash photolysis method.

Dynamics of molecular motions, probing the transition state, dynamics of barrierless chemical reactions in solution, dynamics of unimolecular reaction, Lindemann and Hinshelweed theories of unimolelcular reactions.

UNIT III

Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation) Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids Electro-kinetic phenomenon and quantitative treatment of Zeeta potential.

Micelles: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micelle concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles,

UNIT IV

Macromolecules

Polymer – definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerisation.

Molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimention, chain configuration of macromolecules, calculation of average dimensions of various chain structures.

UNIT V

Electrochemistry

Electrochemistry of solutions. Debye-Huckel – Onsagar treatment and its extension, Debye-Huckel-Jerrum mode, ion - solvent interactions, Born model.

Thermodynamics of electrified interface; Derivation of electrocapillary Lippmann equation (surface excess), Structure of electrified interfaces. Helmholtz, Guoy-Chapman and Stern models.

Over potentials, exchange current density, Butler – Volmer equation, Tafel plot.

Introduction to corrosion, theories, forms of corrosion, corrosion monitoring and prevention methods.

Books Suggested:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Chemical Kinetics, K.J.Laidler, Megraw-Hill
3. Kinetics and Mechanism of Chemical Transformation, J.Rajaraman and J.Kuriacose, McMillan.
4. Micelles, Theoretical and Applied Aspects, V.Moroi, Plenum.
5. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N.Reddy, Plenum.
6. Introduction to Polymer Science, V.R.Gowarkar, N.V.Vishwananathan and J.Sridhar, Wiley Eastern.

CH 407- ANALYTICAL CHEMISTRY

Unit I

Fundamentals of Chemical Analysis

Analytical method: Types and range of determination, Sampling Data handling: Significant figures, Accuracy & Precision, Standard Deviation, Student 't' test., Analysis of Variance (ANOVA) ; Quantitation: Calibration Curve, Correlation Coefficient, Linear regression, Standard Addition Method; Numericals based on above methods.

Unit II

Solvent Extraction

Distribution Coefficient(K_D), Distribution ratio(D), Percent Extraction (%E), Multiple batch extraction; Solvent Extraction of metals and separation efficiency (β) of metal complexes, Important examples: Oxime for determination of Iron, Acetylacetone for determination of Beryllium, Diethyldithiocarbamate for determination of Copper, Dithizone for determination of Lead. Ion Association Complexes, determination of Boron as ion association complex; Synergistic Extraction, determination of Ni by Synergistic Extraction.

Unit III

Atomic Spectroanalytical Techniques:

Atomic Absorption Spectroscopy: Theory, instrumentation, methodology and applications.
Emission Spectroscopy based on flame, arc, Spark and Plasma: Theory, instrumentation, methodology and applications.

Unit IV

Chromatography–I

Ion Chromatography (IC): Principle, layout of instrument and applications, Determination of anions by IC. Gas Chromatography (GC): Principle, layout of instrument, column, detectors (TCD, FID, Electron Capture, MS), Quantitation and applications of GC & GC-MS.

Unit V

Chromatography –II

High-performance liquid Chromatography (HPLC): Principle, layout of instrument, column, detectors (UV-Vis, RI, Amperometric,), Quantitation and applications.
Supercritical Fluid Chromatography: theory &application.

Books Suggested:

1. Vogel's Textbook of Quantitative Chemical Analysis, G.H.Jeffery, J.Bassett, J. Mendham and R.C. Denney, Publ ELBS, Longman, UK
2. Basic Concepts of Analytical Chemistry, S. M. Khopkar, Wiely Eastern.

3. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J.Holler. Publ. W B Saunders.
4. Analytical Chemistry, G.D. Christian, John Willy & Sons.

LABORATORY COURSE-I

CH 409- INORGANIC CHEMISTRY

Qualitative Analysis.

Eight component mixture including two less common metal ions (TI, Mo, W, Ti, Zr, Th, V, U in cationic/anionic forms) and insoluble – oxides, sulphates and halides.

Quantitative Analysis

Separation and estimation of metal ions in a binary mixture Cu-Ni, Ni-Zn, Cu-Ag etc. involving volumetric and gravimetric methods.

Chromatography

Separation of cations and anions by

(a) Paper Chromatography: Separation of chloride, bromide and iodide
(b) Column Chromatography – separation of Cu, Ni, Co by Ion exchange.

Preparations

Preparation of selected inorganic compounds and their studies by I.R., electronic Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds.

(1) $[VO(acac)_2]$
(2) Cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
(3) $Mn(acac)_3$
(4) $K_3[Fe(C_2O_4)_3]$
(5) $Fe_4[Fe(CN)_6]_3$; $KFe[Fe(CN)_6]$
(6) $[Co(NH_3)_6][Co(NO_2)_6]$
(7) Cis-$[Co(trine)(NO_2)_2]Cl.H_2O$
(8) $Hg[Co(SCN)_4]$
(9) $\{Co(Py)_2Cl_2]$
(10) $[Ni(NH_3)_6]Cl_2$
(11) $[Ni(dmg)_2]$
(12) $[Cu(NH_3)_4]SO_4.H_2O$

CH 410 - PHYSICAL CHEMISTRY

Chemical Kinetics

(i) To compare the strengths of HCl and H_2SO_4 by studying the kinetics of hydrolysis of an ester.

(ii) Determination of the effect of (a) Change of temperature (b) Change of concentration of reactant and catalyst and (c) Ionic strength of the media on the velocity constant of an acid hydrolysis of an ester.

(iii) Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.

(iv) Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide by studying the kinetics as an iodine clock reaction.

(v) To study the effect of acid strength on the reaction of acetone and iodine.

Colorimeter

(i) To test the validity of Beer-Lambert law using colorimeter/spectrophotometer and determination of the unknown concentration of a solution.

Surface Tension

(i) To determine the parachor of carbon and hydrogen atoms by drop weight method.

(ii) To determine the relative efficiencies of different detergents by suface tension measurements.

Book Suggested:

1. Vogel's Textbook of Quantitative Analysis, revised, J.Bassett, R.C. Denney, GH.H. Jeffery and J. mENDHAM, elbs.
2. Synthesis and Characterization of Inorganic Compounds, W.L.Jolly, Prentice Hall.
3. Experiments and Techniques in Organic Chemistry, D. Pasto, C.Johnson and M.Miller, Prentice Hall
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
5. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
6. Handbook of Organic Analysis – Qualitative and Quantitative, H. Clark, Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry, John Wiley.
8. Practical Physical Chemistry, A.M.James and F.E. Prichard, Longman.
9. Findley's Practical Physical Chemistry, B.P.Levitt, Longman.
10. Experimental Physical Chemistry, R.C.Das and B.Behera, Tata McGraw Hill.
11. Advanced Practical Physical Chemistry, J.B.Yadav, Goel Publishing House.
12. Advanced Experimental Chemistry, Vol. I – Physical, J.N.Gurtu and R.Kapoor, S.Chand & Co.

M.Sc Chemistry (For Affiliated Colleges)
M.Sc. I YEAR-2015
SEMESTER II

CH 402-INORGANIC CHEMISTRY

UNIT I

Reaction mechanism of Transitions metal complexes: Energy profile of a reaction (transition state or activated complex), Nucleophilic and Electrophilic Substitution, factors responsible for including $S_N1$and S_N2 reaction, Lability and inertness of octahedral complexes acc to VBT and CFT. Acid hydrolysis, factor affecting acid hydrolysis, Base hydrolysis, Conjugate base mechanism (S_N1CB), Evidences in favour of conjugate base mechanism, anation reactions, Substitution reaction without metal-ligand bond cleavage (Special reference to Co(III) complexes).

UNIT II

Substitution in square planer complexes: Trans effect, mechanism of substitution reaction, polarization theory and π bonding theory. Redox reaction: electron transfer reaction, mechanism of 1electron-transfer reaction, outer sphere reaction, Inner sphere reaction, bridge intermediate mechanism.

UNIT III

Metal π-complexes: Metal carbonyls, structure and bonding in metal carbonyls, vibrational spectra of metal carbonyls for bonding and structure elucidation. Preparation, bonding, structure and important reactions of transition metal nitrosyls.

UNIT IV

Boranes : Structure and bonding in diborane, preparations of higher boranes, Lipscomb's concept of bonding elements in higher boranes. Preparation, properties and structure of borazines.

UNIT V

Metal clusters: Metal carbonyl and halide type clusters, compounds with metal-metal multiple bonds, Metalloboranes, Carboranes, Silicates: types and Uses

Books Suggested:

1. F.A. Cotton and Wilkinson: Advanced Inorganic Chemistry, John Wiley.
2. J.E. Huhey: Inorganic Chemistry, Harper and Row.
3. N.N.Green Wood and A. Eafnshow: Chemisry of the element, Pergamon.
4. A.B.P. Lever: Inorganic Electronic Spectroscopy, Elsevier
5. R.L.Carlin: Magnetochemistry, Verlag.

6. G. Wilkinson, R.D. Gillars and J.A. MCeLEVERTY: Comprehensive Coordination Chemistry eds. Pergamon.
7. F. Basolo and R.G. Pearson: Mechanism of Inorganic Reaction, Wiley Eastern

CH 404- ORGANIC CHEMISTRY

UNIT I

Aliphatic Nucleophilic Substitution

The S_N2, S_N1, mixed $S_N1$and $S_N2$and SET mechanisms.
The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance.
Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations.
The S_Ni mechanism.
Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon.
Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

Aliphatic Electrophilic Substitution

Bimolecular mechanisms- S_E2 and S_EiThe S_E1 mechanism, electrophilic substitution accompanied by double shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

UNIT II

Aromatic Electrophilic Substitution

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. Diazonium coupling, Vilsmeir reaction, Gattermann-Koch reaction.

Aromatic Nucleophilic Substitution

The S_NAr S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity – effect of substrate structure, leaving group and attacking nucleophile. The von Ritcher, Sommelet-Hauser, and Smiles rearrangements.

UNIT III

Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance.
Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity.

Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

UNIT IV

Addition to Carbon-Carbon Multiple Bouds

Mechanistic and sterochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidatio.

Addition to Carbon-Hetero Multiple Bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, Organozinc and Organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction.

Meehanism of condensation reactions involving enolates – Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

Hydrolysis of esters and amides, ammonolysis of esters.

UNIT V

Elimination Reactions

The E2, E1 and E1C_B mechanisms and their spectrum, Orientation of the double bond.

Reactivity – effects of substrate structures, attacking base, the leaving group and the medium.

Mechanism and orientation in pyrolytic elimination.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J.Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K.Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M.Coxon, Blackie Academic & Professional.
8. Pericyclic Reactions, S.M. Mukherji, Macmillan, India.
9. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.

CH 406 -PHYSICAL CHEMISTRY

UNIT-I

Quantum Chemistry I

Introduction to Exact Quantum Mechanical Results:
The Schrodinger equation and the postulates of quantum mechanics. Physical Interpretation of the wave function, Discussion of solutions of the Schrodinger equation to some model systems viz., particle in 1 and 3-dimensional box, the harmonic oscillator, the hydrogen atom.
Approximate methods of quantum mechanics: Variation principle; perturbation theory up to first order in energy.

UNIT- II

Quantum Chemistry II

Electronic Structure of Atoms
Russell-Saunders terms and coupling schemes, spectral terms for p^n and d^n configurations, Magnetic effects: Normal and anomalous Zeeman effects.

Molecular Orbital Theory
Huckel theory of linear conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene.

UNIT - III

Classical Thermodynamics:
Partial molal properties; free energy – chemical potential, partial molal volume and partial molal heat content. Gibbs – Duhem equation, variation of chemical potential with temperature and pressure, chemical potential for ideal gas. Thermodynamic derivation of law of mass action. Concept of fugacity, Change in fugacity with temperature and pressure, determination of fugacity (graphical method).
Themodynamic derivation of phase rule, application of phase rule to three component systems.

UNIT - IV

Statistical Thermodynamics I

Concepts of phase space, microstate and macrostate, ensemble, canonical, grand canonical and microcanonical ensembles, ensemble averaging, Maxwell-Boltzmann distribution law using Lagrange's method of undetermined multipliers.
Bose-Einstein statistics, Fermi-Dirac statistics, Maxwell-Boltzman statistics, comparison of three statistics.

UNIT – V

Statistical Thermodynamics II

Partition functions – translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions- Energy, specific heat at constant volume and constant pressure, entropy, work function, pressure, Gibb's free energy and chemical potential.
Chemical equilibria and equilibrium constant in terms of partition functions.

Books Suggested:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantium Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Theoretical Chemistry, S. Glasston, Princeton, London.
6. Fundamentals of Chemical Thermodynamics, E.N.Yeremin, Mir Publishers.

CH 408-ANALYTICAL CHEMISTRY

Unit I

Introduction to Basic components of analytical instruments, Analog &digital signals
Electronic Spectroanalytical Technique: Fluorescence Spectrophotometry: Principle of fluorescence, Chemical structure & fluorescence, instrumentation and applications; Fluorimetric determination of riboflavin (vitamine B_2), Fluorimetric determination of Zn using oxine.

Unit II

Thermal and Radiochemical Methods
Introduction to thermal methods of analysis TGA and DTA Principle with illustration design of instruments and application in relevant fields.
Neutron activation analysis and Iso topic dilution analysis

Unit III

Potentiometry & Coulometry
Electrochemical Cell, Measurement of Potential, Determination of Concentration from potential measurements, theory and application of Ion selective electrodes Controlled-potential Coulometry ; Controlled-current Coulometry.

Unit IV

Voltammetry-I
Voltammetric Cell, Wave form & Current-Voltage Curves, Supporting Electrolyte, Reversible and Irreversible redox process, Working Potential range. Polarography: DME, Residual Current, Oxygen wave, Ilkovic Equation, Half wave potential.

Cyclic Voltammetry(CV), Randle-Sevick Equation, Determination of Heterogenous Rate Constant (K_s), Criteria of reversibility by CV.

Unit V

Voltammetry-II

Normal Pulse Voltammetry, Differential Pulse Voltammetry, Voltammetry in Inorganic Analysis, Voltammetry in Organic Analysis.

Stripping Voltammetry: Anodic, Cathodic and Adsorptive Stripping techniques..

Books Suggested:

1. Instrumental Methods of Analysis, H.H. Willard, L.L. Merritt, J.A. Dean and F.A. Settle, CBS Publ. Delhi.
2. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, Publ. W B Saunders
3. Instrumental Methods of Analysis, Strobel
4. Vogel's Textbook of Quantitative Chemical Analysis, G.H.Jeffery, J.Bassett, J. Mendham and R.C. Denney, Publ ELBS, Longman, UK

LABORATORY COURSE II

CH 411-ORGANIC CHEMISTRY

Qualitative Analysis

Separation, purification and identification of compounds of binary mixture (one liquid and one solid), chemical tests, Interpretation of IR Spectra of simple compounds.

Organic Synthesis

Acetylation: Acetylation of glucose and hydroquinone.

Oxidation: Adipic acid by chromic acid, oxidation of cyclohexanol.

Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate.

Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline.

Quantitative Analysis

Determination of the percentage or number of hydroxyl group in an organic compound by acetylation method.

Estimation of amines/phenols using bromate bromide solution/or acetylation method.

Determination of Iodine and Saponification values of an oil sample.

Determination of DO, COD and BOD of water sample.

CH 412-PHYSICAL CHEMISTRY

Adsorption

(a) To study surface tension – concentration relationship for solutions (Gibbs equation) and hence determine the limiting cross-sectional area of molecule.
(b) To study the adsorption of acetic acid/oxalic acid by activated charcoal and verification of Freundlich and Langmuir's isotherms.

Phase Equilibria

(i) Determination of congruent composition and temperature of a binary system (e.g. diphenylamine-benzophenone system).
(ii) Determination of glass transition temperature of a given salt (e.g. $CaCl_2$) by solubility method.
(iii) To construct the phase diagram for three component system (e.g. Chloroformic acid-acetic acid-water)

Conductometry

(i) To determine the strength of weak acid using NaOH conductometrically.
(ii) To determine the strength of strong and weak acids in a given mixture conductometrically.
(iii) To find out basicity of given acid (mono- di-and tribasic) conductometrically.

Polarimetry/Refractometry

(i) To determine the specific rotation of a given optically active compound.
(ii) To verify the law of refraction of mixture (e.g. glycerol and water) using Abbe's refractometer.

Books Suggested:

1. Vogel's Textbook of Quantitative Analysis, (revised)
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly Prentice Hall.
3. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
5. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
6. Handbook of Organic Analysis – Qualitative and Quantitative, H. Clark, Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
8. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman
9. Findley's Practical Physical Chemistry, B.P.Levitt, Longman
10. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill
11. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.
12. Adevanced Experimental Chemistry, Vol. I – Physical J.N.Gurtu and R.Kapoor, S. Chand & Co.