AKS, University, Satna (M.P.)
Faculty of Basic Science,
Department of Chemistry,

M.Sc. Chemistry

Scheme and Subjects

Semester-I

			Period			Credit
S. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	
1	**76CH101**	Inorganic Chemistry-I	**3**	**1**	**-**	**4**
2	**76CH102**	Organic Chemistry-I	**3**	**1**	**-**	**4**
3	**76CH103**	Physical Chemistry-I	**3**	**1**	**-**	**4**
4	**76CH104**	Analytical Chemistry	**3**	**1**		**4**
5	**76MS105**	Mathematics for Chemist	**3**	**1**		**4**
	76BI105	Biology for Chemist				
6	**76CH151**	Inorganic Chemistry-I	**-**	**-**	**2**	**1**
7	**76CH152**	Organic Chemistry-I	**-**	**-**	**2**	**1**
8	**76CH153**	Physical Chemistry-I	**-**	**-**	**2**	**1**
Total						**23**

Sr.No.	**Paper Code**	**Semester-II**				**Credit**
1	**76CH201**	Inorganic Chemistry-II	**3**	**1**	**-**	**4**
2	**76CH202**	Organic Chemistry-II	**3**	**1**	**-**	**4**
3	**76CH203**	Physical Chemistry-II	**3**	**1**	**-**	**4**
4	**76CH204**	Group theory and spectroscopy	**3**	**1**		**4**
5	**76CA205**	Computer application in chemistry	**3**	**1**		**4**
6	**76CH251**	Inorganic Chemistry-II	**-**	**-**	**2**	**1**
7	**76CH252**	Organic Chemistry-II	**-**	**-**	**2**	**1**
8	**76CH253**	Physical Chemistry-II	**-**	**-**	**2**	**1**
Total						**23**

AKS, University, Satna (M.P.)

Faculty of Basic Science

Department of Chemistry, ,

M.Sc. Chemistry

Scheme and Subjects

Sr.No.	Paper Code	Semester-III				Credit
1	**76CH301**	Applications of spectroscopy	3	1	-	4
2	**76CH302**	Photochemistry & solid state chemistry	3	1	-	4
3	**76CH303**	Chemistry of Natural Products	3	1	-	4
4	**76CH304**	Polymer Chemistry	3	1		4
5	**76CH351**	Applications of spectroscopy –Lab	-	-	3	2
6	**76CH352**	Photochemistry & solid state chemistry –Lab	-	-	3	2
7	**76CH353**	Chemistry of Natural Products –Lab	-	-	3	2
Total						**22**

Sr.No.	Paper Code	Semester-IV				Credit
1	**76CH401**	Medicinal Chemistry	**3**	**1**		**4**
2	**76CH402**	Industrial Chemistry	**3**	**1**		**4**
3	**76CH403**	Environmental Chemistry	**3**	**1**		**4**
4	**76CH404**	Chemistry of Materials	**3**	**1**		**4**
5	**76CH451**	Project Work				**10**
Total						**26**
Total Credit						**94**

M.Sc. Chemistry Semester I

Inorganic Chemistry-I

Unit- I

Stereochemistry and Bonding in Main Group Compounds VSEPR Theory and its application for treating structures of inorganic molecules and ions containing lone pairs of electrons, shortcomings of VSEPR model., Walsh diagrams (tri- and penta- atomic molecules), dp-pp bonds. Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

Unit-II

Metal-Ligand Equilibria in Solution Stepwise and overall formation constants 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-III

Metal - Ligand Bonding Limitation of Crystal field theory, Molecular orbital theory, octahedral, tetrahedral and square planer complexes, p bonding and molecular orbital theory. (MOT).

Unit-IV

Reaction Mechanism of Transition Metal Complexes. Inert and labile complexes, interpretation of lability and inertness of transition metal complexeson the basis of valence bond and crystal field theories. Kinetics of octahedral substitution: acid hydrolysis, Base hydrolysis, factors affecting acid hydrolysis.

Unit-V

Metal p-Complexes Metal carbonyls, structure and bonding, Vibrational spectra of metal carbonyls for bonding and structural elucidation & important reactions of metal carbonyls; dinitrogen and di oxygen complexes.

Reference Book:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E.Huhey, Harpes & Row.
3. Chemistry of 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 J.A.McCleverty, Pergamon.
7. Coordination Chemistry, D.Banerjee, TMH,N.Delhi,1995
8. Coordination Chemistry, M.Satake, Discovery Publication House N.Delhi.
9. Essential Trends in Inorganic Chemistry, D.M.P. Mingos, Oxford Univ. Press, N.Delhi 95.
10. Structural Inorganic Chemistry, A.F.Wells, ELBS
11. Modern Aspects of Inorganic Chemistry, H.J.Emeleus, UBSID, N.Delhi
12. Inorganic chemistry, S.C.Tripathi& Archna Pandey

M.Sc. Chemistry Semester I

Organic Chemistry-I

Unit- I

Nature of Bonding in Organic Molecules:

Delocalized chemical bonding, conjugation, resonance, hyper-conjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, energy level of p-molecular orbitals, annulenes, anti-aromaticity, y-aromaticity, Hydrogen bonding, homo-aromaticity, PMO approach, Bonds weaker than covelent-addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins.

UNIT II

Stereochemistry. *C*hirality, elements of symmetry, molecules with more than one chiral center, threo and erythro isomers. R and S configuration.Separation of enantiomers. Regioselective, stereospecific and stereoselective rections. Asymmetric synthesis. Optical activity in the absence of chiral carbon(atropisomerism)-biphenyls, allenes and spiranes, and their nomenclature.Conformational analysis of cyclohexanes and decalins. Effect of conformation on reactivity.

Unit- III

Reaction Mechanism; Structure and Reactivity: Types of mechanism, types of reactions. Potential energy diagrams, transition states and intermediates, 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- IV

Aliphatic Nucleophilic Substitution:

The S_N2, S_N1, mixed S_N1 and S_N2 and SET mechanisms. The neighbouring group-mechanism: neighbouring group participations by p and s bonds, anchimeric assistance, Classical and nonclassical carbocations, norbornyl system, common carbocation rearrangements. The S_{Ni} mechanism: Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity: The effects of substrate structure, Attacking nucleophile, Leaving group and Reaction medium; Phase transfer catalysis.

UNIT V

Aliphatic Electrophilic Substitution. Bimolecular mechanisms, SE2 and SEi mechanisms. The SE1 mechanism, electrophilic substitution accompaniedby double bond shifts. Effect of substrates, leaving group and solvent polarity on the reactivity.

Aromatic Electrophilic Substitution. The arenium ion mechanism, orientation and reactivity. The ortho/para ratio, ipso attack. Vilsmeier reaction, Friesrearrangement.

Reference Book:

1. Advanced Organic Chemistry-Reactions. Jerry March, John Wile
2. Advanced Organic Chemistry, F.A. Carey and n 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.Byd. 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 of Organic Compounds D. Nasipuri, New Age International

11 Setereochemistry of Organic Compounds, P.S.Kalsi, New Age International

12 Basic Stereochemistry of Organic Molecules, S.Sengupta, Book, Syndicate Pvt.Ltd. Kolkata, 1987.

13 Organic Photochemistry and Pericyclic Reactions, M.G.Arora, Anmol Publications, N.Delhi, 1994.

M.Sc. Chemistry Semester I

Physical Chemistry-I

Unit- I

Quantum Chemistry

Introduction to Exact Quantum Mechanical Results The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor,

Unit- II

Molecular Orbital Theory

Introduction and rule of HMO(Huckel Molecular Orbital) theory, Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc.

Unit- III

Classical Thermodynamics Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties; partial molar free energy, partial molar volume and partial molar heat content and their significance. Determination of these quantities. Concept of fugacity and determination of fugacity Non-ideal systems: Excess functions for non ideal solutions. Activity and activity coefficient, Debye-Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength.

Unit- IV

Surface Chemistry Surface tension, capillary action, pressure difference across curved surface (Laplace euqation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation) surface films on liquids (Electro-kinetic phenomenon), catalytic activity at surfaces.

Unit-V

Electrochemistry Electrochemistry of solution. Debye-Huckel. Onsagar treatment and its extension, ion solvent interactions. Dye-Huckel- Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro-capillarity. Lippmann equations (surface excess), Over potentials, exchange current density, derivation of butler-Volmer equation, Tafel plot.

Reference Book:

1. Physical Chemistry, P. W. Atkins, ELBS. .
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentce Hall.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Chemical Kinetics, K. J. Laidler, Mcgraw-Hill.
6. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
7. Micelles, Theoretical and Applied Aspects, V. Moroi, Plentm
8. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N. Reddy, Plenum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
10. Physical Chemistry, W.J. Moore, Prentice-Hall, India.
11. Physical Chemistry, P.C. Rakshit.
12. Quantum Chemistry, Eyring and Kimball.
13. Physical chemistry,G.N.Gurtu ,Pragti Prakashan
14. Advance Physical chemistry,S.C. Tripathi,Anusandhan Prakashan

M.Sc. Chemistry Semester I

Analytical Chemistry

UNIT Introduction Role of analytical chemistry,classification of analytical instrument. Techniques of weighing ,errors, volumetric glassware cleaning and calibration. Selecting and handling of reagent.laboratory notebook.Safety in the analyticl laboratory.Errors- Definition of terms in mean and median, standard deviation.types of error.Accuracy and precision, systematic and random errors in experimental data . The uses of error in statistics.

UNIT II

Chromatography. Concept of chromatography, principle, instrumentation and application of paperchomatography,*GasChromatography.*InstrumentationColumns.Detection:flameionisatin detector, thermal conductivity detector and mass spectrometricdetector.*High-Performance Liquid Chromatography.* Instrumentation. Pumping systems. Sample injection system. UV-Vis detector,photodiode array detector, fluorescence detector, refractive index detector and mass spectrometric detection.

UNIT III

Ion Exchange. Cation and anion exchangers. Action of ion exchange resins. Ion exchange equilibria and ion exchange capacity. Strongly and weaklyacidic cation exchangers. Strongly and weakly basic anion exchangers. Liquid ion exchangers. Ion chromatography. column.*Solvent Extraction.* The distribution coefficient. Factors favouring solvent extraction. Extraction reagents.

UNIT IV

Different types of solution and their preparation, measurement of pH, buffers,osmossis, diffusion.Principle intrumentation and application of atomic absorbtion spectroscopy and flame photometery and X-ray analysis.

UNIT V

Acidbase titrations.Kjeldahl method for determination of nitrogen. Determination involving acetylation (amino and hydroxyl groups); and oximation(carbonyl group).

Precipitation Titrations. Argentometric titrations. Mohr titration. Volhard titration. Fajan titration.

Complexometric Titrations. Titration with EDTA. Indicators for EDTA titrations. Titration methods: direct and back titrations, and displacement methods.Masking and demasking agents, and their use in EDTA titrations.

Redox Titrations. Karl Fischer titration of water. Determination of DO, BOD and COD.

Reference Book:

1. Analytical Chemistry, G.D. Christian, J.Wicy.
2. Fundamentals o analytical Chemistry. D.A. Skoog. D.M. West and F.J. Hooler, W.B. Saunders.
3. Analytical Chemistry-Principles. J.H. Kennedy. W.B. Saunders.
4. Analytical Chemistry-Principles and Techniques. LG. Hargis. Prentice Hall.
5. Principles of Instrumental analysis D.A. Skoog and J.L. Loary, W.B. Saunders.
6. Principles of Instrumental Analysis D.A. Skoog W.B. Saunders.
7. Quantitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
8. Environmental Solution, S.M. Khopkar, Wiley Eastern.
9. Basic Concepts of Analysis Chemistry, S.M. Khopkar, Wiley Eastern.
10. Handbook of Instrumental Techniques for Analytical Chemistry, F. Settle, PrenticeHall.

M.Sc. Chemistry Semester I

Mathematics for Chemists (For Students without Mathematics in B. Sc.)

Unit I

Vectors. Vectors, dot, cross and triple products etc. gradient, divergence and curl, Vector Calculus.

Matrix Algebra. Addition and multiplication; inverse, adjoint and transpose of matrices.

Unit II

Differential Calculus. Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima andminima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.).

Unit III

Integral calculus. Basic rules for integration, integration by parts, partial fractions and substitution. Reduction formulae, applications of integralcalculus. Functions of several variables, partial differentiation, co-ordinate transformations (e.g. Cartesian to spherical polar).

Unit IV

Elementary Differential equations. First-order and first degree differential equations, homogenous, exact and linear equations. Applications to chemicalkinetics, secular equilibria, quantum chemistry etc. second order differential equation and their solutions.

Unit V

Permutation and Probability. Permutations and combinations, probability and probability theorems average, variance root means square deviationexamples from the kinetic theory of gases etc., fitting (including least squares fit etc with a general polynomial fit.

Reference Book:

1. The chemistry Mathematics Book, E.Steiner, Oxford University Press.

2. Mathematics for chemistry, Doggett and Suiclific, Logman.

3. Mathematical for Physical chemistry : F. Daniels, Mc. Graw Hill.

4. Chemical Mathematics D.M. Hirst, Longman.

5. Applied Mathematics for Physical Chemistry, J.R. Barante, Prentice Hall.

6. Basic Mathematics for Chemists, Tebbutt, Wiley.

7. Mathematics for Chemists: Bhupendra Singh, Pragati Prakashan

M.Sc. Chemistry Semester I

Biology for Chemists (For Students without Biology in B. Sc.)

Unit-I

Cell Structures and Functions: Structure of prokaryotic and eukaryotic cells, inter cellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes – catabolism and anabolism. ATP a biological energy currency. Origin of life – unique properties of carbon, chemical evolution and rise of living systems, Introduction to bio-molecules, building block of bio-macro molecules.

Unit-II

Carbohydrates: Conformation of mono saccharides, structure and functions of important derivatives of mono- saccharides viz., glycosides, deoxy sugars, myoinositol, amino sugars. N acetyl muramic acid, sialic acid, di- saccharides and ploy saccharides,. Sturctural poly saccharides, cellulose and chitin.storage poly saccharides – starch and glycogen. Structural and biological functions of glucosaminoglycans or mucoploy saccharides. Carbohydrates of glycoproteins and glycol lipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism – Kreb's cycle, glycosis, glycogenisis and glycogenolysis, gluco neogenisis, pentose phosphate pathway.

Unit-III

Lipids Fatty acids, essential fatty acids, structure and function of triglycerols, glycerol phospholipids. Sphingolipids, cholesterol, bile acids, prosta glandins, lipoproteins – composition and function, role in atherosclerosis. Properties of lipd aggregates – micelles, bilayers liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism, b - oxidation of fatty acids.

Unit-IV

Amino acids, Peptides and Proteins Chemical and enzymatic hydrolysis of proteins to peptides, amino and sequencing. Secondary structure of proteins, forces responsible for holding of secondary structures, a -helix, b - sheets , super secondary structure, triple helix structure of collagen. Tertiary structures of proteins- folding and domain structures. Quaternary structures. Amino acid metabolism – degradation and biosynthesis of amino acids, sequence determination: chemical / enzymatic / mass spectral , racemization/ detection. Chemistry of oxy tocin and tryptophan releasing hormones (TRH).

Unit-V

Nucleic Acids Purine and pyramidine bases of nucleic acid, base pairing via H-bonding. Structure of ribonucleic acid (RNA) and di oxyribo nucleic acid (DNA), double helix model of DNA and forces responsible for holding it, an over view of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.

Reference Book:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.

2. Biochemistry, L. Stryer, W.H. Freeman.

3. Biochemistry, J. David Rawan, Neil Patterson.

4. Biochemistry, Voet and Voet, John Wiley.

5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

M.Sc. Chemistry II-Semester

Inorganic Chemistry-II

Unit I

Electronic Spectra and of Transition Metal Complexes. Spectroscopic term, terms and microstates for the p^2 and d^2 configurations, Hund'srules for ground state terms, the correlation of spectroscopic terms into Mulliken symbols, electronic transition selection rules, Orgel diagramsfor transition metal complexes (d^1-d^9 states). Jahn-teller effect and electronic spectra of complexes.

UNIT II

Reaction Mechanism of Transition Metal Complexes. Base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugatemechanism. Substitution reactions in square planar complexes: The Trans effect and the *trans* influence: Polarization and p-Bonding theories, applications ofTrans effect in synthesis, Kurnakove's test of distinguishing *cis* and *trans* isomers using the concept of trans effect, mechanism of substitution reactions insquare planar complexes, factors affecting substitution reactions. Acquaintance of Trans effect in octahedral complexes

UNIT III

Metal-Ligand Bonding. Limitation of Crystal field theory and Molecular orbital theoryElectronic Spectra and Magnetic Properties of Transition Metal Complexes. Calculations of Dq, B and B'parameters for Cr(III), Co(II) and Ni(II)complexes using electronic spectral data. Charge transfer spectra: ligand to metal and metal to ligand.

UNIT IV

Metal* p*-Complexes. Metal nitrosyls: preparation, bonding structure and important reactions of transition metal nitrosyl; Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and x-ray diffraction studies of metalnitrosyls for bonding and structure elucidation, important reactions of transition metal nitrosyl. Biomedical applications.

UNIT V

Borane Chemistry Metal Clusters. Bonding and topology of boranes, 4-digit coding (s, t, y, x) numbers for B_2H_6, B_4H_{10}, B_5H_9, B_5H_{11} and B_6H_{10} and theirutilities. Acquaintance with carboranes and metallocarboranes. Metal clusters: synthesis, reactivity and bonding.

Reference Book:

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 J.A. McCleverty, Pergamon.
7. Synthesis and characterization of some novel nitrosyl compounds, R. C. Maurya Pioneer Publications, Jabalpur, 2000.
8. Chemical Applications of Group Theory, F.A. Cotton, John Wiley.
9.Inorganic chemistry,S.C. Tripathi &Archna Pandey,Anusandhan Prakashan

M.Sc. Chemistry II-Semester

Organic Chemistry-II

UNIT I

Aromatic Nucleophilic Substitution. The SNAr, SN1, benzyne and SRN1 mechanisms. Reactivity, effect of substrate structure, leaving group andattacking nucleophile. Bucherer reaction, alkylation, and amination. The Bamberger rearrangement. The von Richter rearrangement.

UNIT II

Free Radical Reactions:

Types of free radical reactions and their detection. Free radical substitution mechanism, mechanism at aromatic substrates. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenations (NBS) oxidation of aldehydes to carboxylic acids, auto-oxidation, Radical coupling, arylation of aromatic compounds by diazonium salts. Sand Meyer reaction. Free radical rearrangement. Hunsdiecker reaction.

UNIT III

Addition to Carbon-Carbon Multiple Bonds. Mechanistic and stereochemical aspects of addition reactions. Hydroboration. Michael reaction. Sharplessasymmetric epoxidation.

Addition to Carbon-Hetero atom Multiple Bonds. Mechanism of metal hydride reduction of carbonyl compounds, acids, esters and nitriles. Wittigreaction.Mechanism of condensation reactions involving enolates. Mannich, Benzoin, Perkin, and Stobbe reactions.

UNIT IV

Elimination Reactions

The E2,E1 And E1CB mechanisms,orientation of the double bond. Reactivity- effects of substrate structers,attacking base,the leaving group and the medium.Mechanism and orientation in pyrolytic Elimination

UNIT V

Pericyclic Reactions: *Molecular orbitals and their symmetry.* Molecular orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system, their symmetry properties.Characteristics and classification. Electrocyclic reactions: conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems.

Woodward-Hoffmann correlation diagrams. FMO and PMO approach.

Cycloaddditions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Antarafacial andsuprafacial additions. 4n and 4n+2 systems, 2+2 addition of ketenes. Ene synthesis.*Sigmatropic Rearrangements.* Suprafacial and antarafacial 1,3- and 1,5- shifts of H, sigmatropic shifts involving carbon moieties, 2,3-, and 3,3-sigmatropic rearrangements. Claisen, Cope, aza-Cope, Sommlet-Hauser, and Fisher Indole rearrangements.

Reference Book:

1. Organic Chemistry, J. Claden, N. Greeves, S. Warren, P. Wothers, Oxford University Press.

2. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, Wiley-Interscience.

3. Organic Chemistry, P.Y. Bruice, Pearson Education Asia.

4. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.

5. Organic Chemistry, J. McMurry, Thomson Asia.

6. Organic Chemistry, T.W.G. Solomons and C.B. Fryhle, John Wiley (Asia).

7. Organic Chemistry, L.G. Wade, Jr., Pearson Education.

8. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.

9. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.

10. Stereochemistry of Organic Compounds, E.L. Eliel and S.H. Wilen, John Wiley (Asia).

11. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.

12. Stereochemistry of Organic Compounds, P .S. Kalsi, New Age International.

13. Introduction to Spectroscopy, D.L. Pavia, G.M. Lampman and G.S. Kriz, Thomson, Brooks/Cole.

14. Organic Spectroscopy, W. Kemp, ELBS, Macmillan.

15. Spectrometric Identification of Organic Compounds, R. M. Silverstein, G. C. Bassler and T. C, Morrill, John Wiley

16. Application of Spectroscopy of Organic Compounds, J. R. Dyer, Prentice Hall.

17. Spectroscopic Methods in Organic Chemistry, D. H. Williams, I. Fleming, Tata McGraw-Hili.

M.Sc. Chemistry II-Semester

Physical Chemistry-II

UNIT I

Chemical Dynamics Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dymanics of unimolecular reactions; Lindemann-Hinshelwood and Rice-Ramsperger-Kassel-Marcus and Slater theories of unimolecular reactions.

UNIT II

Statistical Thermodynamics Aims of statistical thermodynamics – thermodynamic probability – probability theorem – definitions of state of a system – ensembles (micro, macro and grand canonical) – Boltzmann distribution law and its derivations – Boltzmann-Planck equation – Partition functions – thermodynamic properties from partition functions – partition function and equilibrium constant – Quantum statistics – Fermi-Dirac and Bose-Einstein statistics – population inversion.

UNIT III

Macromolecules. Polymers, types of polymers, kinetics of polymerization, mechanism of polymerization reactions. Molecular mass ofmacromolecues, number and mass average molecular mass; molecular mass determination (osmometry, viscometry, diffusion and light scattering methods),sedimentation, chain structures and their configuration.

UNIT IV

Approximate Methods

The variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to the Helium atom

Angular Momentum. Ordinary angular momentum, generalized angular momentum, eigen functions for angular momentum, eigen values of angularmomentum, addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

UNIT V

Ion size factor and ion-solvent interactions. Decomposition voltage and overvoltage. Consecutive electrode processes. Exchange current density. Electrokinetic potential, its determination and significance.Butler-Volmer's equation. Tafel's plot. Theory of polarography. Ilkovic equation. Half wave potential and its significance.Introduction to corrosion. Forms of corrosion. Corrosion monitoring and prevention.Application of corrosion.

Reference Book:

1. Physical Chemistry, P. W. Atkins, ELBS. .

2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.

3. Quantum Chemistry, Ira N. Levine, Prentce Hall.

4. Coulson's Valence, R. McWeeny, ELBS.

5. Chemical Kinetics, K. J. Laidler, Mcgraw-Hill.

6. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.

7. Micelles, Theoretical and Applied Aspects, V. Moroi, Plentm

8. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N. Reddy, Plenum.

9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.

10. Physical Chemistry, W.J. Moore, Prentice-Hall, India.

11. Physical Chemistry, P.C. Rakshit.

12. Quantum Chemistry, Eyring and Kimball.

13. Physical chemistry,G.N.Gurtu ,Pragti Prakashan

14. Advance Physical chemistry,S.C. Tripathi,Anusandhan Prakashan

M.Sc. Chemistry II-Semester

Group Theory and Spectroscopy

Unit-I

Symmetry and Group Theory: Symmetry elements and Symmetry operations, definitions of group, subgroups, relationship between orders of finite group and its subgroup. Schonflies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, etc groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use in spectroscopy.

Unit-II

Electromagnetic radiation, interaction of electromagnetic radiation with matter – absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering. Uncertainty relation and natural line width and natural line broadening, transition probability, results of time dependent perturbation theory, transition moment, selection rules, Intensity of spectral lines, Born Oppenheimer approximation, rotational, vibrational and electronic levels.

Unit-III

Microwave Spectroscopy: Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities , non rigid rotors. Stark effect and effect of external field. Applications.

Unit-IV

Infrared Spectroscopy: Review of linear harmonic oscillator, vibrational energies of di atomic molecules, Zero point energy force constants, anharmonicity, Morse potential energy diagrams, vibration-rotation spectroscopy, PQR branches, breakdown of Oppenhimer approximation, vibration of poly atomic molecules, selection rules, normal modes of vibrations, group frequencies, overtones, hot bands, factors affecting band positions and intensities, far IR region, metal ligand vibrations, normal coordinate analysis. **Raman Spectroscopy**: Classical and quantum theories of Raman effect. Pure vibrational- rotational Raman Spectra, mutual exclusion principle, Resonance Raman Spectroscopy, coherent anti-stokes Raman Spectroscopy (CARS).

Unit-V

Electronic Spectroscopy: Atomic Spectroscopy Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atoms and alkali metal atoms. **Photo electron spectroscopy:** Basic principles, photo-electric effect, ionization process, Koopman's theorem, photo electron spectra of simple molecules,

M.Sc. Chemistry II-Semester

Computers for Chemists

Unit I

Introduction to Computers and Computing. Basic structure and functioning of computer with a PC as illustrative example. Memory I/O devices. Secondary storage Computer languages. Operating systems with DOS as an example Introduction to UNIX and WINDOWS. Principles of programmingAlogrithms and flow-charts.

Unit II

Computer Programming in FORTRAN/C/BASIC. (the language features are listed here with reference to FORTRAN. The instructor may choose another language such as BASIC or C the features may be replaced appropriately). Elements of the compute language. Constants and variables. Operations and symbols Expressions. Arithmetic assignment statement. Input and output Format statement. Termination statements. Branching statements as IF or GOTO statement. LOGICAL variables. Double precession variables. Subscripted variables and DIMENSION. DO statement FUNCTION AND SUBROUTINE.COMMON and DATA statement (Student learn the programming logic and these language feature by hands on experience on a personal computer from thebeginning of this topic.)

Unit III

Programming in Chemistry. Developing of small computer codes using any one of the languages FORTRAN/C/BASIC involving simple formulae in Chemistry, such as Van der Waals equation. Chemical kinetics (determination of Rate constant) Radioactive decay (Half Life and Average Life). Determination Normality, Molarity nd Molality of solutions. Evaluation Electronegativity of atom and Lattice Energy from experimental determination of molecular weight and percentage of element organic compounds using data from experimental metal representation of molecules in terms of elementary structural features such as
bond lengths, bond angles.

Unit IV

Use of Computer programmes. Operation of PC. Data Processing. Running of standard Programs and Packages such as MS WORD, MS EXCEL -special emphasis on calculations and chart formations. X-Y plot. Simpson's Numerical Integration method. Programmes with data preferably from physicalchemistry laboratory.

Unit V

Internet. Application of Internet for Chemistry with search engines, various types of files like PDF, JPG, RTF and Bitmap. Scanning, OMR, Web camera.

Reference Book:

1. Fundamentals of Computer : V. Rajaraman, Prentice Hall.
2. Computers in Chemistry : K.V. Raman, Tata Mc Graw Hill).
3. Computer Programming in FORTRAN IV-V Rajaraman, Prentice Hall.
4. Computers and Common Sense, R. Hunt and J. Shelley, Prentice Hall.
5. Computational Chemistry, A.C. Norris.
6. Microcomputer Quantum Mechanics, J.P. Killngbeck, Adam Hilger.
7. An Introduction to Digital Computer Design, V. Rajaraman and T. Radhakrishnan, Prentice Hall.

M.Sc. Chemistry Semester-III

APPLICATIONS OF SPECTROSCOPY

Unit – 1 **Ultraviolet and Visible spectroscopy**

Effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fieser Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls.

Electronic Spectroscopy: Electronic Spectral Studies for d1 – d9 systems in octahedral, tetrahedral and square planer complexes,

Unit – 2 **Vibrational Spectroscopy**

Symmetry and shapes of AB2, AB3 , AB4, AB5 and AB6, mode of bonding of ambidentate ligands, nitrosyl, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy and its applications.

Infrared Spectroscopy

Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance.

Unit – 3 **Nuclear Magnetic Resonance Spectroscopy**

General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with disordered angle. NMR shift reagents, solvent effects. nuclear overhauser effect (NOE).Nuclear Magnetic Resonance of Paramagnetic Substances in Solution The contact and Pseudo contact shifts, factors affecting nuclear relaxation, some applications includingbiochemical systems, an overview of NMR of metal nuclide with emphasis on 195Pt and 119Sn NMR.Carbon-13 NMR Spectroscopy General considerations, chemical shift (aliphatic olefinic , alkyne, aromatic, heteroaromatic and carboynl carbon), coupling constants. Two dimension NMR spectroscopy-COSY, NOESY, DEPT, HMBC and HMQC techniques.

Unit – 4 **Mössbauer Spectroscopy**

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

Unit – 5 **Mass Spectrometry**

Introduction ion production E1, C1 FD, ESI and FAB, factors affecting fragmentation, ion analysis, ion abundance Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak. Me Lafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Structure elucidation of simple molecules using UV – Visible, IR, NMR and mass spectral techniques.

eference Book:

1. Physical Methods for Chemistry, R.S. Drago, Saunders Compnay.
2. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS.
3. Infrared and Raman Spectral : Inorganic and Coordination Compounds K. Nakamoto, Wiley.
4. Progress in Inorganic Chemistry vol., 8, ed., F.A. Cotton, vol., 15 ed. S.J. Lippard, Wiley.
5. Transition Metal Chemistry ed. R.L. Carlin vol. 3 dekker.
6. Inorganic Electronic Spectroscopy, A.P.B. Lever, Elsevier.
7. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, .V. Parish, Ellis Haywood.
8. Practical NMR Spectroscopy, M.L. Martin. J.J. Deepish and G.J. Martin, Heyden.
9. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler adn T.C. Morrill, John Wiley.
10. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
11. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
12. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.
13. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS.
14. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.

M.Sc. Chemistry Semester-III

PHOTOCHEMISTRY & SOLID STATE CHEMISTRY

Unit - 1

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

Determination of Reaction Mechanism Classification, rate constants and life times of reactive energy state determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions-photo dissociation, gas-phase photolysis. Photo chemical formation of smog, photochemistry of vision

Unit - 2

Photochemistry of Alkene Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes. **Photochemistry of Aromatic Compounds** Isomerisations, additions and substitutions.

Photochemistry of Carbonyl Compounds Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, b,g unsaturated and a, b unsaturated compounds, Intermolecular cyloaddition reactions-dimerisations and oxetane formation. Singlet molecular Oxygen reaction.

Unit - 3

Solid State Reactions General principles, experimental procedure, co-precipitation as a precursory to solid state reactions, kinetics of solid state reactions.

Crystal Defects and Non-Stoichiometry Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schottky detects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centres, non-stoichiometry and defects.

Unit - 4

Electronic Properties and Band Theory Metal,s insulators and semiconductors, electronic structure of solidsband theory band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Optical properties-Application of optical and electron microscopy. Magnetic Properties-Classification of materials : Effect of temperature calculation of magnetic moment, mechanism of ferro and anti ferromagnetic ordering super exchange.

Unit – 5 Organic Solids

Electrically conducting solids. organic charge transfer complex, organic metals, new superconductors. Liquid Crystals: Types of liquid crystals: Nematic, Smectic, Ferroelectric, Antiferroelectric, Various theories of LC, Liquid crystal display, Newmaterials.

Reference Book:

1. Fundamentals of photochemistry, K.K. Rothagi-Mukheriji, Wiley-Eastern.

2. Essentials of Molecular Photochemistry, A Gilbert and J. Baggott, Blackwell Scientific Publication.
3. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
4. Introductory Photochemistry, A. Cox and t. Camp, McGraw Hill.
5. Photochemistry, R.P. Kundall and A. Gilbert. Thomson Nelson.
6. Organic Photochemistry, J. Coxon and B.halton, Cambridge University Press.
7. Solid state chemistry and its applications, A.R. West. Peenum.
8. Principles of the Solid State, H.V. Keer, Wiley Eastern.
9. Solid State Chemistry, N.B. Hannay.

10. Solid State Chemistry, D.K. Chakrabarty, New Wiley Eastern.

M.Sc. Chemistry Semester-III

Subject: Chemistry of Natural Products

Unit - 1

Terpenoids and Carotenoids Calcificationsnomenclature, occurrence, isolation, generalmethods of structuredetermination,isoprene rule. Structure determination, stereochemistry biosynthesis andsynthesis of the following representative molecules : Citral, Geraniol a-Terpeneol, Menthol,Farnesol,Zingiberence,Santonin,Phytol,Abieticacid andb-Carotene.

Unit - 2 Alkaloids

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following : Ephedrine , (+)- Coniine, Nicotine, Atropine, Quinine and Morphine.

Unit - 3 Steroids

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone, Biosynthesis of Steroids.

Unit - 4 Plant Pigments

Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin Quercetin, Myrcetin, Quercetin 3-glucoside, Vitexin, Diadzein, Aureusin, Cyanidin-7arabinoside, Cyanidin, Hirsutidin, Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

Prophyrins Structure and synthesis of Haemoglobin and Chlorophyll.

Unit - 5 Prostaglandis

Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF2a.

Pyrethroids and Rotenones

Synthesis and reactions of Pyrethroids and Rotenones. (For structure elucidation, emphasis is to be placed on the use of spectral parameters wherever possible).

Reference Book:

1. Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope adn J.B. Harbome, Longman, Esses.
2. Organic Chemistry : Vol. 2 1L. Finar, ELBS
3. Stereoselective Synthesis : A Practical Approach, M. Norgradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston. harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm. Harwood Academic Publishers.
7. New Trends in Natural Product chemistry, Ataaur Rahman and M.L. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.

M.Sc. Chemistry Semester-III

Polymer Chemistry

Unit - 1

Basics: Importance of polymers. Basic concepts : Monomers, repeat units, degree of polymerization Linear, branched and network polymers. Classification of polymers. Polymerization : condensation, addition/radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

Unit - 2

Polymer Characterization: Polydispersion-average molecular weight concept. Number, weight and viscosity averagemolecular weights. Polydispersity an molecular weight distribution. The practical significance of molecular weight. Measurement of molecular-weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods.

Unit - 3

Analysis and testing of polymers Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study.Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tearresistance, Hardness and abrasion resistance.

Unit - 4

Inorganic Polymers: A general survey and scope of Inorganic Polymers special characteristics, classification, homo and hetero atomic polymers. Structure, Properties and Applications of

a. Polymers based on boron-borazines, boranes and carboranes.
b. Polymers based on Silicon, silicone's polymetalloxanes and polymetallosiloxanes, silazanes.

Unit - 5

Structure, Properties and Application of

a. Polymers based on Phosphorous-Phosphazenes, Polyphosphates
b. Polymers based on Sulphure-Tetrasulphur tetranitride and related compounds.

Co-ordination and metal chelate polymers.

Reference Book:

1. Inorganic Chemistry, J.E. Huheey, Harper Row.

2. Developments in Inorganic polymer Chemistry, M.F. Lappert and G.J. Leigh.
3. Inorganic polymers- N.H. Ray.
4. Inorganic polymers, Graham and Stone.
5. Inorganic Rings and Cages : D.A. Armitage.
6. Textbook of Polymers Science, F.W. Billmeyer Jr. Wiley.

INORGANIC-III LAB

Synthesis of selected inorganic compounds and their studies by measurements of decomposition temperatures and molar conductance, magnetic and IR electronic spectra.

1. Preparation of Schiff base 3d metal complexes.

2. Preparation of N,N-bis(salicylaldehyde)ethylenediamine [salenH2], Co(salen) 3.Preparation of N,N-bis(salicylaldehyde)ethylenediamine [salenH2], Ni(salen)

4.Preparation of N,N-bis(salicylaldehyde)ethylenediamine [salenH2], Cu(salen)

5.Preparation of N,N-bis(salicylaldehyde)ethylenediamine [salenH2], V(salen)

6.Aquabis(acetylacetonato)nitrosylchromium(I), [Cr(NO)(acac)2(H2O)]

7. cis-Bis(glycinato)copper(II) and trans-Bis(glycinato)copper(II)

8. Preparation of Zn, Cd and Hg thiocyanates from their respective chlorides

9. Bis(benzoylacetonato)copper(II)

10. Bis (acetylacetonato)oxovanadium(IV), [VO(acac)2]

11. [MoO2(acac)2]

Interpretation of ESR and mass spectra of some known coordination compounds.

ORGANIC-III LAB

Qualitative Analysis

Separation, purification and systematic identification of the components of a mixture of three organic compounds (solids and liquids). Preparation of one derivative of

each compound. Use of TLC for ascertainment of purity of compounds.

Multi-step Synthesis

This exercise should illustrate the use of organic reactions/ diverse conditions and principles for organic synthesis. Purification of compounds by chromatographic

techniques.

Photochemical reaction

Benzophenone-> benzpinacol-> benzpinacolone

Rearrangement

Benzaldehyde-> benzoin-> benzil -> benzilic acid

Phthalic anhydride -> phthalimide -> anthranilic acid -> 2-chlorobenzoic acid

Benzophenone -> benzophenone oxime-> benzanilide

Spectral Analysis

Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, CMR & MS) Spectrophotometric (UV/VIS) Estimations of the following (any one compound)

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

PHYSICAL- III LAB

Spectroscopy (Physical Chemistry)

i. Determination of PKa of an indicator (e.g. methyl red) in (a) aqueous and (b) micellar media.

ii. Determination of stoichiometry and stability constant of Ferricisothicoyanation complex ion in solution.

iii. Determination of rate constant of alkaline bleaching of Malachite green and effect of ionic strength on the rate of reaction.

Chemical Kinetics

i. Determination of rate constant and formation constant of an intermediate complex in the reaction of Ce(IV) and Hypophosphorous acid at ambient temperature.

ii. Determination of energy and enthalpy of activation in the reaction of KMnO4 and benzyl alcohol in acid medium.

iii. Determination of energy of activation of and entropy of activation from a single kinetic run.

iv. Kinetics of an enzyme catalyzed reaction.

Thermodynamics

ii. Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture. Determination of the temperature dependence of the solubility of a compound in two solvents having similar intromolecular in tetractions (benzoic acid in water and in DMSO water mixture and calculate the partial molar heat of solution.

Polarography

i. Identification and estimation of metal ions such as Cd+2, Pb+2, Zn+2, and i+2 etc. polarographically.

ii. Study of a metal ligand complex polarographically (using Lingane's Method).

Spectrophotometric Determinations

a. Determinations of Manganese/Chromium in steel sample by spectrophotometric

b. Nickel by extractive spectrophotometric method.

c. Fluoride/nitrite/phosphate.

d. Copper-Ethylene diamine complex : Slope-ratio method.

Flame Photometric

a. Determinations of sodium and potassium when present together by flam photometric

b. Determinations of lithium/calcium/barium/strontium.

c. Determinations of cadmium and magnesium in tap water.

Reference Book:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS.
2. Analytical Chemistry, S.M. Khopkar, New Age International Ltd., New Delhi.
3. Synthesis and Characterization of Inorganic Compounds, W. L. Jolly, Prentice Hall
4. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall
5. Macroscale and Microscale Organic Experiments, K. L. Williamson, D. C. Heath.
6. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
7. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clarke, Adward Arnold.
8. Vogel's Textbook of Practical Organic Chemistry, ELBS.
9. F.G. Mann and B.C. Saunders, Practical Organic Chemistry, Orient Longman.
10. Findley's Practical Physical Chemistry, B. P. Levitt, Longman
11. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

M.Sc. Semester IV

ENVIRONMENTALCHEMISTRY

Unit-1

Environment: Introduction, Chemical composition of atmosphere- particles, ions and radicals and their formation, Chemical and photochemical reactions in atmosphere, smog formation, oxides of N,C,S and their effect, vertical temperature, heat budget of earth atmospheric system, the Biogeochemical cycle of C,N,P, and O.

Unit - 2

Soils: Composition, micro and macro nutrients, Pollution- fertilizers, pesticides, plastics and metals. Waste treatment. Pollution by chemicals, petroleum, chlorofluorohydrocarbons. Green house effect, acid rain, air pollution controls. Analytical methods for measuring air pollutants.

Unit - 3

Hydrosphere : Chemical composition of water bodies-lakes, streams, rivers and wet lands etc. Hydrological cycle.Aquatic pollution- inorganic, organic, agricultural, industrial and sewage, detergents, oil spills and oil pollutants, Water quality parameters – dissolved oxygen, biochemical oxygen demand, solids, content of chloride, sulphate, nitrate and nitrite, Water quality standards. Analytical methods for measuring metals (As, Cd, Cr, F, Pb, Hg, Se,) Purification and treatment of water

Unit - 4

Environmental Toxicology:Toxic heavy metals : Mercury, lead, arsenic and cadmium. Causes of toxicity. Bioaccumulation, sources of heavy metals. Chemical speciation of Hg, Pb, As, and Cd. Biochemical and damaging effects.Toxic Organic Compound : Pesticides, classification, properties and uses of organochlorine and ionospheres pesticides detection and damaging effects. Polychlorinated biphenyls : Properties, use and environmental continuation and effects. Polynuclear Aromatic Hydrocarbons : Source, structures and as pollutants.

Unit - 5

Aquatic Chemistry and Water Pollution: Redox chemistry in natural waters. Dissolved oxygen, biological oxygen demand, chemical oxygen demand, determination of DO, BOD and COD. Aerobic and anaerobic reactions of organic sulphure and nitrogen compounds in water acid-base chemistry of fresh water and sea water. Aluminum, nitrate and fluoride in water. Petrification. Sources of water pollution. Treatment of waste and sewage. Purification of drinking water, techniques of purification and disinfection.

Reference Book:

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, 1. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
3. Progress in Inorganic Chemistry, Vol 18 and 38 ed J.J. Lippard, Wiley.
4. Bioorganic Chemistry : A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
5. Understanding Enzymes, Trevor Palmer, Prentice Hall.
6. Environmental Chemistry, Colin Baird, W.H. Freeman Co. New York, 1998.
7. Chemistry of Atmospheres, R.P. Wayne, Oxford.
8. Environment Chemistry, A.K. De, Wiley Eastern, 2004.
9. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
10. Introduction to atmospheric Chemistry, P.V. Hobbs, Cambridge.

M.Sc. Semester IV

Medicinal Chemistry

Unit - 1

Structure and activity : Relationship between chemical structure and biological activity (SAR). Receptor Site Theory. Approaches to drug design. Introduction to combinatorial synthesis in drug discovery. Factors affecting bioactivity. QSAR-Free-Wilson analysis, Hansch analysis, relationship between Free-Wilson analysis and Hansch analysis.

Unit - 2

Pharmacodynamics: Introduction, elementary treatment of enzymes stimulation, enzyme inhibition, sulfonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry.

Unit - 3

Antibiotics and antibacterials Introduction, Antibiotic β-Lactam type - Penicillins, Cephalosporins, Antitubercular – Streptomycin, Broad spectrum antibiotics – Tetracyclines, Anticancer - Dactinomycin (Actinomycin D)

Unit - 4

Antifungal –polyenes, Antibacterial – Ciprofloxacin, Norfloxacin, Antiviral – Acyclovir Antimalarials : Chemotherapy of malaria. SAR. Chloroquine, Chloroguanide and Mefloquine

Unit - 5

Non-steroidal Anti-inflammatory Drugs :Diclofenac Sodium, Ibuprofen and Netopam Antihistaminic and antiasthmatic agents: Terfenadine, Cinnarizine, Salbutamol and Beclomethasone dipropionate.

Reference Book:

1. 1.Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope adn J.B. Harbome, Longman, Esses.
2. 2-Organic Chemistry : Vol. 2 1L. Finar, ELBS
3. 3-Stereoselective Synthesis : A Practical Approach, M. Norgradi, VCH.
4. 4-Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. 5-Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston. harwood Academic Publishers.
6. 6-Introduction to Flavonoids, B.A. Bohm. Harwood Academic Publishers.
7. 7-New Trends in Natural Product chemistry, Ataaur Rahman and M.L. Choudhary, Harwood Academic Publishers.
8. 8-Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.

M.Sc. Semester IV

Subject: Industrial chemistry

Unit I

Raw Materials and Energy for Chemical Industry: Raw materials – Characteristics of raw materials and their resources – methods of raw material concentrations – integral utilization of raw materials. Energy for chemical industry – Fuels – classification of fuels – coal – fuel gases and liquid fuels – petroleum – cracking – Octane number – cetane number – composition and uses of coal gas, water gas, producer gas, oil gas and gobar gas.

Unit II

Cement, Ceramics, Glass and Fertilizers Cement: Manufacture – Wet Process and Dry process. Types, Analysis of major constituents, setting of cement, reinforced concrete. Cement industries in India. Ceramics: Important clays and feldspar, glazing and verification.

Glass: Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbing glass. Fertilizers: Fertilizer industries in India, Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts.

Unit III

Small Scale Chemical IndustriesElectrothermal and electrochemical industries: electroplating – surface coating industries – oils, fats and waxes – soaps and detergents – cosmetics. Match industries and fire works: manufacture of some industrially important chemicals like potassium chlorate, and red phosphorus – metal powders.

Unit IV

Sugar and Agro Chemical Sugar: Cane sugar manufacture, recovery of sugar from molasses, sugar estimation, sugar industries in India. Agrochemical industries: Important categories of insecticides, fungicides, herbicides. Mode of action and synthesis of common pesticides like Gammexane, DDT, alathrin, Parathion, Malathion, Baygon, DDVP, Warfarin.

Unit V

Industrial Pollution & Chemical Toxicology Introduction – causes of industrial pollution – thermal power plants – nuclear power reactors– fertilizers and chemical industry – pulp and paper industries – agro based industries – cement industry. Toxic Chemicals in the environment – biochemical effects of arsenic, cadmium, lead, mercury and cyanide.

Reference Books

1. I.Mukhlyonov(ed.),Chemical Technology,Vol.1,Mir publication, Moscow, III edn., 1979.
2. A.K.De., Environmental Chemistry, Wiley Eastern Ltd.,11 edn., Meerut 1989.Chs 5-7
3. B.K Sharma – Industrial chemistry – Goel publishing house.
4. R.Norris Shreve and J.A.Brink, Jr. Chemical Process Industries. IV edn., McGraw Hill, Tokyo, 1977.
5. B.N.Chakrabarty,Industrial Chemistry,Oxford&IBH Publishing Co.,New Delhi, 1981.
6. P.P.Singh, T.M.Joseph, R.G.Dhavale, College Industrial Chemistry, Himalaya Publishing House, Bombay, 4th edn., 1983.
7. B.K.Sharma and H.Kaur,Environmental Chemistry, Krishna Prakashan,Meerut, 1997.
8. A.K. De, Envionment Chemistry, Wiley Eastern Ltd., Meerut 1994,
   A.K. Mukherjee, Environmental Pollution and Health Hazards – Causes and Control Galgotia Press, New Delhi 1986.

M.Sc. Semester IV

Chemistry of Materials

UNIT I

Ceramics, Composites and Nanomaterials. Ceramic structures, mechanical properties, clay products. Refractories, characterization, properties and
applications. Microscopic composites, dispersion-strengthened and particle-reinforced composites, macroscopic composites. Nanocrystalline phase,
preparation procedures, properties and applications.

UNIT II

Liquid Crystals. Thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases. Molecular arrangement in
smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of
ordering in liquid crystals.

UNIT III

Ionic Conductors. Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic
conductors, phase transtions and mechanism of conduction in superionic conductors. Examples and applications of ionic conductors.

UNIT IV

High Tc Materials. High Tc superconductivity. Preparation and characterization of 1-2-3 and 2-1-4 materials. Normal state properties, anisotropy,
temperature dependence of electrical resistance, and optical phonon modes. Superconducting state; heat capacity; coherence length, elastic constants,
microwave absorption-pairing and multigap structure in high Tc materials. Applications of high Tc materials.

UNIT V

Organic Solids, Fullerenes, Molecular Devices. Conducting organics, organic superconductors, magnetism in organic materials. Fullerenes, doped,
fullerenes as superconductors. Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches, sensors.
Non-linear optical materials, non-linear optical effects. Molecular hyperpolarisability.

1. **Reference Books**
2. Material Science and Engineering-An Introduction, W.D. Callister, Wiley.

3. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Saunders College.
4. Principles of the Solid State, H.V. Keer, Wiley Eastern.
5. Materials Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings, ELBS.
6. Thermotropic Liquid Crystals, G.W. Gray, editor, John Wiley.
7. Handbook of Liquid Crystals, Kelker and Hatz, Chemie Verlag.