

JECRCTM
UNIVERSITY
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Department of Chemistry
Course Structure and Syllabi
M. Sc. Course
(Chemistry)

Session 2015-16

JECRC University Jaipur

Department of Chemistry

M. Sc. Syllabus New Scheme

(Session 2015-2016)

SEMESTER WISE STRUCTURE OF THE M.Sc. (CHEMISTRY) PROGRAMME

SEMESTER – I

Code	Title of Course	Credits
MCE 001A	Compounds of Different Elements	4
MCE 002A	Reaction Mechanism : Structure and Reactivity	4
MCE 003A	Quantum, Surface and Electro Chemistry	4
MCE 004A	Mathematics and Computers for Chemists	4
MCE 005A	Qualitative and Quantitative Analysis (Practical)	12
		Total Credits = 28

SEMESTER – II

Code	Title of Course	Credits
MCE 007A	Chemistry of Transition Metals	4
MCE 008A	Reaction Mechanism : Addition, Elimination and Pericyclic Reactions	4
MCE 009A	Thermo Dynamics and Chemical Kinetics	4
MCE 010A	Applications of Spectroscopy	4
MCE 011A	Chromatographic Separations, Organic Synthesis and Potentiometric Analysis (Practical)	12
		Total Credits = 28

SEMESTER – III

Paper MCE 013A is compulsory to all. Moreover the students should select any one of the Elective group consisting three Theory Papers and One Practical in semester III.

Code	Title of Course	Credits
MCE 013A	Green Chemistry	4
MCE 014A	Inorganic Elective I: PHOTOINORGANIC CHEMISTRY AND X-RAY DIFFRACTION	4
MCE 015A	Inorganic Elective II: BIOINORGANIC CHEMISTRY	4
MCE 016A	Inorganic Elective III: ORGANOTRANSITION METAL CHEMISTRY-I	4
MCE 017A	Spectrophotometric Analysis (Practical)	12
MCE 018A	Organic Elective I: ORGANIC SYNTHESIS-I	4
MCE 019A	Organic Elective II: HETEROCYCLIC CHEMISTRY -I	4

MCE 020A	Organic Elective III: NATURAL PRODUCTS-I	4
MCE 021A	Multi-step Synthesis (Practical)	12
MCE 022A	Physical Elective I: ELECTROANALYTICAL TECHNIQUES	4
MCE 023A	Physical Elective II: ELECTROCHEMISTRY-I	4
MCE 024A	Physical Elective III: CHEMICAL KINETICS-I	4
MCE 025A	Thermodynamical Studies (Practical)	12
		Total Credits = 28

SEMESTER – IV

A set of three elective theory papers, one Practical and a Minor Project .

Code	Title of Course	Credits
MCE 027A	Inorganic Elective I: ORGANOTRANSITION METAL CHEMISTRY-II	4
MCE 028A	Inorganic Elective II: INORGANIC POLYMERS	4
MCE 029A	Inorganic Elective III: MINERAL BASED INDUSTRIAL CHEMISTRY	4
MCE 030A	Flame Photometric and Flame Photometric Determination (Practical)	12
MCE 031A	Organic Elective I: Disconnection Approach	4
MCE 032A	Organic Elective II: HETEROCYCLIC CHEMISTRY-II	4
MCE 033A	Organic Elective III: NATURAL PRODUCTS-II	4
MCE 034A	Chromatography and Spectroscopy (Practical)	12
MCE 035A	Physical Elective I: CHEMICAL ANALYSIS	4
MCE 036A	Physical Elective II: ELECTRO CHEMISTRY-II	4
MCE 037A	Physical Elective III: CHEMICAL KINETICS-II	4
MCE 038A	Polarography and Chemical Kinetics (Practical)	12
MCE 041A	Minor Project (Which will be done in vacations after Semester-III and will be evaluated in Semseter-IV)	4
		Total Credits = 28

SEMESTER – I

MCE 001A: Compounds of Different Elements

Unit-I

Stereochemistry and Bonding in main group compounds

VSEPR. Walsh diagram. Hybridization including energetic of hybridization. Bent's rule, $d\pi-p\pi$ bond. Some simple reactions of covalently bonded molecules (i) Atomic inversion (ii) Berry pseudo rotation (iii) Nucleophilic displacement (iv) Free radical mechanism

Unit-II

Hydrogen, alkali and alkaline earth metals

Classification of hydrides - e-deficient, e-precise & e-rich hydrides. Application of crown ethers in extraction of alkali and alkaline earth metals.

Noble gases

Isolation and properties. Preparation and structure of noble gas compounds

Unit-III

Boron compounds

Preparation, structure, bonding, reactions and applications of boranes, carboranes, metalboranes, metallocarboranes, borazines.

Compounds of carbon and silicon

Fullerenes and their compounds, Intercalation compounds of graphite, Synthesis, structure, properties, and applications. Carbides, fluorocarbons, silanes, silicates, zeolites and silicones.

Unit-IV

Compounds of oxygen group elements

Metal selenides and tellurides, oxyacids and oxoanions of S & N.

Compounds of nitrogen group elements

Nitrogen activation. Oxidation states of nitrogen and their interconversion. BN, PN and SN compounds - preparation, structure and bonding.

Unit-V

Compounds of halogen group elements

Synthesis, properties, bonding, and applications of interhalogens, pseudohalogens, polyhalides, oxyacids and oxoanions of halogens.

Solvents

Classification of solvents. Characteristic properties of an ionizing solvent. Reaction in liquid ammonia, liquid sulphur dioxide dimethyl formamide (DMF) and dimethyl sulphoxide (DMSO)

Suggested Books & References

1. Advanced Inorganic Chemistry, Cotton F.A. and Wilkinson G, John Wiley.
2. Inorganic Chemistry, Huhey J.E., Harper & Row.

3. Chemistry of the Elements, Greenwood N.N. and Earnshaw A., Pergamon
4. Inorganic Chemistry: A unified Approach, Porterfields W. W., Elsevier
5. Inorganic Chemistry, Sharpe Alan G., Pearson Education Ltd.
6. Inorganic Chemistry, Shriver D.F., Atkins, P.W. and Langford C.H., Oxford University Press, 1998
7. Inorganic Chemistry, Miessler G. L. and Tarr D. A., Pearson Publications
8. Inorganic Chemistry, Wulfsberg, G, University Science Books, Viva Books.

MCE 002A: Reaction Mechanism: Structure and Reactivity

Unit-I

Nature of Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, resonance hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzoid compounds, alternate and non-alternate hydrocarbons. Huckel's rule, energy. Level of p-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent-addition compounds, crown ether complexes and cryptands, inclusion compounds, catenanes and rotaxanes.

Unit-II

Stereochemistry

Conformational analysis of cycloalkanes, decalines, effect of conformation on reactivity, conformation of sugars, strain due to unavoidable crowding 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 spirane chirality due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

Unit-III

Reaction Mechanism : Structure and Reactivity

Type 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 mechanisms, isotope effects 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, Arrhenius equation.

Unit-IV

Aliphatic Nucleophilic Substitution

The SN2, SN1 mixed SN1 and SN2 and SET mechanism. The neighbouring group mechanism, neighbouring group participation by p and s bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl systems, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations.

Unit-V

Allylic Nucleophilic Substitution

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.

Suggested Books & References:

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 & Professionsl.
8. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
9. Pericyclic Reactions, S.M. Mukherji, Macmillan, India
10. Stereochemistry of Organic Compounds, D.Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.

MCE 003A: Quantum, Surface and Electro Chemistry

Unit-I

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, the hydrogen atom.

Approximate Methods

The variation theorem, linear variation principle. Perturbation theory (First order and nondegenerate). Applications of variation method and perturbation theory to the Helium atom.

Molecular Orbital Theory

Huckel theory of conjugated systems bond and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical cyclobutadiene etc.

Unit-II

Surface Chemistry

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).

Unit-III

Micelles

Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solubilization, micro emulsion, reverse micelles.

Unit-IV

Electrochemistry

Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions.. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Guoy-Chapman, Stern, Grahm Devanatham-Mottwatts, Tobin, Bockris, Devanathan model.

Unit-V

Overpotential

Introduction, types of overpotential, theories, exchange current density, introduction of Butler Volmer equation, Tafel plot. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, Effect of light at semiconductor solution interface. Polarography theory, Ilkovic equation; half wave potential and its significance.

Suggested Books & References:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata Mc Graw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R. Mc Ween y, ELBS.
5. Chemical Kinetics. K.J. Laidler, McGraw-Hill.
6. Kinetics and Mechanism of Chemical Transformation J.Rajaraman and J. Kuriacose, Mc Millan.
7. Micelles, Theoretical and Applied Aspects, V. MOrdoi, Plenum.
8. Modern Electrochemistry Vol. 1 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.

MCE 004A: Mathematics and Computers for Chemists

Unit-I

Matrix Algebra.

Addition and multiplication; inverse, adjoint and transpose of matrices, special matrices (Symmetric, skew-symmetric, Hermitian, Skew-Hermitian, unit, diagonal, unitary etc.) and their properties. Matrix equations: Homogeneous, non-homogeneous linear equations and conditions for the solution, linear dependence and independence. Introduction to vector spaces, matrix eigenvalues and eigenvectors, diagonalization, determinants (examples from Juckel theory).

Unit-II

Differential Calculus

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

Integral calculus, basic rules for integration, integration by parts, partial fractions and substitution. Reduction formulae, applications of integral calculus.

Functions of several variables, partial differentiation, co-ordinate transformations (e.g. cartesian to spherical polar).

Unit-III

Elementary Differential equations

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

Unit-IV

Introduction to computers

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

Unit-V

Computer Programming in C

History of "C" constants, variables and data types, operators and expression, input & output operation, decision making and branching looping, arrays, function, structures and unions,

Suggested Books & References:

1. The chemistry Mathematics Book, E.Steiner, Oxford University Press.
2. Mathematifs 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 Chemistery, J.R. Barante, Prenice Hall.
6. Basic Matchematics for Chemists, Tebbutt, Wiley
7. Fundamentals of Computer : V. Rajaraman (Prentice Hall)
8. Computers in Chemistry : K.V. Raman (Tata Mc Graw Hill)
9. Computer Programming in FORTRAN IV-V Rajaraman (Prentice Hall)

MCE 005A: Qualitative and Quantitative Analysis (Practical)

Inorganic Chemistry

1. To identify acidic radicals of dilute H₂SO₄ group.
2. To identify acidic radicals of concentrated H₂SO₄ group..
3. To identify acidic radicals not identify with dilute or concentrated H₂SO₄ group.
4. To analyze basic radicals of group I and II.

5. To analyze basic radicals of group III and IV.
6. To analyze basic radicals of group V, VI and VII.
7. To analyze Less common metal ions : Ti, MO, W, Ti, Zr, Th, V, U
8. Analysis of the mixture number 1 containing four acidic and four basic radicals.
9. Analysis of the mixture number 2 containing four acidic and four basic radicals.
10. Analysis of the mixture number 3 containing four acidic and four basic radicals.
11. Analysis of the mixture number 4 containing four acidic and four basic radicals.
12. Qualitative Analysis: Separation and determination of two metal ions Cu-Ni involving volumetric and gravimetric methods.
13. Qualitative Analysis: Separation and determination of two metal ions Ni-Zn involving volumetric and gravimetric methods.
14. Qualitative Analysis: Separation and determination of two metal ions Cu-Fe etc. involving volumetric and gravimetric methods.

Organic Chemistry

1. To separate and identify the organic mixture containing two solid components using water and prepare their suitable derivatives.
2. To separate and identify the organic mixture containing two solid components using hot water and prepare their suitable derivatives.
3. To separate and identify the organic mixture containing two solid components using NaOH and prepare their suitable derivatives.
4. To separate and identify the organic mixture containing two solid components using NaHCO₃ and prepare their suitable derivatives.
5. To separate and identify the organic mixture number 1 containing one solid and one liquid components and prepare their suitable derivatives.
6. To separate the mixture of Methyl Orange and Methylene Blue by using cyclohexane and ethyl acetate (8.5:1.5) as solvent system.
7. Preparation and separation of 2,4-dinitro Phenylhydrazone of acetone, 2-butanone using toluene and petroleum ether(40:60).
8. Preparation and separation of 2,4-dinitro Phenylhydrazone of hexane-2-one and hexane-3-one using toluene and petroleum ether(40:60).
9. To separate the mixture of phenylalanine and glycine. Alanine and aspartic acid. Leucine and glutamic acid. Spray reagent –Ninhydrin.
10. To separate the mixture of D,L-alanine, glycine and L-leucine using n-butanol : acetic acid : water(4:1:5). Spray reagent- Ninhydrin.
11. To separate monosaccharides –a mixture of D –galactose and D-fructose using n-butanol : acetone: water (4:1:5) .Spray reagent –aniline hydrogen phthalate.
12. Determination of DO, COD and BOD of water sample.

Physical Chemistry

1. Calibration of volumetric apparatus, burette, pipette and standard flask.
2. To investigate the adsorption of oxalic acid from aqueous solution by activated charcoal, and examine the validity of Freundlich and Langmuir adsorption isotherm.
3. To investigate the adsorption of acetic acid from aqueous solution by activated charcoal, and examine the validity of Freundlich and Langmuir adsorption isotherm.
4. Determination of congruent composition and temperature of a binary system (e.g. diphenylamine-benzophenone system).
5. Determination of glass transition temperature of given salt (e.g., CaCl_2) conductometrically.
6. To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water).
7. To construct the phase diagram for three component system (e.g. alcohol-benzene-water).
8. To determine CST of phenol and water in presence of 1.0% NaCl, 0.5% naphthalene, 1% succinic acid.
9. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
10. Determination of solubility and solubility product of sparingly soluble salts (e.g. PbSO_4 , BaSO_4) conductometrically.
11. Determination of the strength of strong and weak acid in a given mixture conductometrically.
12. to study of the effect of solvent on the conductance of AgNO_3 /acetic acid and to determine the degree of dissociation and equilibrium constant in different solvents and in their mixtures (DMSO, DMF, dioxane, acetone, water) and to test the validity of Debye-Huckel-Onsager theory.
13. Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye Huckel's limiting law.

Books Suggested

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.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.P. 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, Edward Arnold.
6. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Edward 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.

SEMESTER II

MCE 007A: Chemistry of Transition Metals

Unit-I

Metal-Ligand bonding

Valence Bond Theory (VBT), Crystal field theory (CFT) for octahedral, trigonal bipyramidal, square pyramidal, tetrahedral and square planar complexes. Crystal field stabilization energy (CFSE), Factor affecting the crystal field parameters, weak and strong field complexes, spectrochemical series, Jahn-Teller effect. Thermodynamic and related aspects of crystal fields - ionic radii, heats of ligation, lattice energy, site preference energy. Merits and limitations of CFT. Molecular orbital theory of octahedral, tetrahedral and square planar complexes. Pi bonding in bonding in octahedral complexes.

Unit-II

Metal ligand equilibria in solution

Stepwise and overall formation constants and their interaction, trends in stepwise constants. Factors affecting stability of metal complexes with reference to the nature of metal ion and ligand chelate effect and its thermodynamic origin. Determination of binary formation constant by pHmetry and spectrophotometry.

Unit-III

Electronic spectra of transition metal complexes

Types of electronic transition, selection rules for d-d transitions. Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes. Calculation of Racah parameters. Charge transfer spectra.

Unit-IV

Reaction mechanism of transition metal complexes

Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage.

Unit-V

Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

Suggested Books & References:

1. Advanced Inorganic Chemistry, Cotton F.A., Wilkinson G., Murollo C.A. Bochmann M., John Wiley
2. Inorganic Chemistry, Huheey J.E., Harper & Row.
3. Chemistry of the Elements. Greenwood N.N. and Earnshaw A., Pergamon.
4. Inorganic Electronic Spectroscopy, Lever A.B.P., Elsevier.

5. Magnetochemistry, Carlin R.I., Springer Verlag.
6. Inorganic Chemistry, Wilysberg G, University Science Books.

MCE 008A: Reaction mechanism: Addition, Elimination and Pericyclic Reactions

Unit – I

Aromatic Nucleophilic Substitution

The S_NAr SN1, benzyne and SN1 mechanism, Reactivity effect of substrate structure, leaving group and attacking nucleophile. The Von Richte. Sommelet-Hauser, and Smiles rearrangements.

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 - II

Aliphatic Electrophilic Substitution

Bimolecular mechanisms SE2 and SE1, The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving groups and the solvent polarity on the reactivity.

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, Vilsmeier reaction, Gatterman-Koch reaction

Unit – III

Addition to Carbon-Carbon Multiple Bonds :

Mechanistic and stereochemical 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 epoxidation.

Unit-IV

Addition to Carbon-Hetero Multiple bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

Elimination Reactions

The E2, E1 and E1cB 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.

Unit-V

Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions, $4n$ and $4n+2$ and allyl systems. Cycloadditions-antarafacial and suprafacial additions, $4n$ and $4n+2$ systems, $2+2$ addition of ketenes, 1,3 dipolar cycloadditions and cheletropic reactions. Sigmatropic rearrangements-suprafacial and antarafacial shifts of H, sigmatropic involving carbon moieties, 3,3- and 5,5 sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements. Fluxional tautomerism. Ene reaction.

Suggested Books & References:

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 & Professionals.
8. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
9. Pericyclic Reactions, S.M. Mukherji, Macmillan, India
10. Stereochemistry of Organic Compounds, D.Nasipuri, New Age International.
Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.

MCE 009A:Thermodynamics and Chemical Kinetics

Unit I

Classical Thermodynamics

Concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar free energy, partial molar volume and partial molar heat content and their significance. Determinations of these quantities. Concept of fugacity and determination of fugacity, activity, activity coefficient, determination of activity and activity coefficients.

Unit II

Statistical Thermodynamics and Non equilibrium thermodynamics

Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding, distribution laws (using Lagrange's method of undetermined multipliers). Thermodynamic criteria for non equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible process, transformation of generalized

fluxes and forces, non equilibrium stationary states, phenomenological equations, Onsager's reciprocity relations, electrokinetic phenomenon.

Unit III

Partition Functions

Partition functions-translation, rotational, vibrational and electronic partition functions, Fermi-Dirac Statistics, Maxwell distribution law and applications to metal Bose-Einstein statistics distribution Law and application to helium, Partition molar quantities in term of thermodynamic functions.

Unit IV

Chemical Dynamics-I

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, Dynamic chain reaction (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical reaction (hydrogen-bromine and hydrogen-chlorine reactions),

Unit V

Chemical Dynamics-II

kinetics of enzyme catalyzed reactions, general features for fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method, dynamics of unimolecular reactions (Lindemann Hinshelwood, Rice-Ramsperger and Kassel theories and Marcus (RRKM) theories for unimolecular reactions).

Suggested Books & References:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata Mc Graw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R. Mc Ween y, ELBS.
5. Chemical Kinetics. K.J. Laidler, McGraw-Hill.
6. Kinetics and Mechanism of Chemical Transformation J. Rajaraman and J. Kuriacose, Mc Millan.
7. Micelles, Theoretical and Applied Aspects, V. M. Oraoi, Plenum.
8. Modern Electrochemistry Vol. 1 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.

MCE 010A: Applications of Spectroscopy

Unit-I

Ultraviolet and Visible spectroscopy

Various electronic transitions (185-800 nm) Beer-Lambert law, 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.

Infrared Spectroscopy

Instrumentation and Sample handling. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ether's, 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 II*

Symmetry and Group theory in Chemistry

Symmetry elements and symmetry operation, definition of group, subgroup. Conjugacy relation and classes. Point symmetry group. Schonflies symbols, representations of groups by matrices (representation for the CN, CNV, etc, group to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use; spectroscopy. Derivation of character table for C_{2v} and C_{3v} point group Symmetry aspects of molecular vibrations of H₂O molecule.

Unit-III

Vibrational Spectroscopy

Symmetry and shapes of AB₂, AB₃, AB₄, AB₅ and AB₆, mode of bonding of ambidentate ligands, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy particularly for the study of active sites of metalloproteins.

Unit-IV

Nuclear Magnetic Resonance Spectroscopy

General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism of measurement, chemical shift values and correlation for protons bonded to carbon and other nuclei, chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra). Simplification of complex spectra nuclear magnetic double resonance. NMR shift reagents, solvent effects, Nuclear Overhauser effect (NOE), Carbon- 13 NMR spectroscopy, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon). Two dimension NMR spectroscopy.

Unit-V

Mass Spectroscopy

Introduction, ionization methods EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance, Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, meta stable peak. McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

***Note:** Unit-II will be included from Session 2015-16 only.

Suggested Books & References:

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.

MCE 011A: Chromatographic Separations, Organic Synthesis and Potentiometric Analysis (Practical)

INORGANIC CHEMISTRY

A. Chromatography Separation of cations and anions by

1. Paper Chromatography.
2. Chromatography : Ion exchange.

B. Chromatographic Separations

3. Cadmium and zinc
4. Zinc and magnesium.
5. Thin-layer chromatography-separation of nickel, manganese, cobalt and zinc. Determination of R_f values.
6. Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of R_f values.

C. Preparations(Any Six)

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

1. VO (acac)₂
2. TiO (C₉H₈NO)₂H₂O
3. cis-K[Cr(C₂O₄)₂(H₂O)₂]
4. Na[Cr(NH₃)₂(SCN)₄]
5. Ni(acac)₂
6. K₃[Fe(C₂O₄)₃]
7. Prussian Blue, Turnbull's Blue.
8. [Co(NH₃)₆] [Co(NO₂)₆]
9. cis-[Co(trien) (NO₂)₂] Cl.H₂O
10. Hg[Co(SCN)₄]
11. [Co(Pv)₂Cl₂]
12. [Ni(NH₃)₆]Cl₂
13. Ni(dmgl)₂
14. [Cu(NH₃)₄]SO₄H₂O

ORGANIC CHEMISTRY

Organic Synthesis

1. Acetylation : Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.
2. Oxidation : Adipic acid by chromic acid oxidation of cyclohexaneol
3. Grignard reaction :. Synthesis of triphenylmethanol from benzoic acid
4. Aldol condensation :.Dibenzal acetone from benzaldehyde.
5. Sandmeyer reaction : p-Chlorotoluene from p-toluidine.
6. Acetoacetic ester Condensation : Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation.
7. Cannizzaro reaction : 4-Chlorobenzaldehyde as substrate.
8. Friedel Crafts reaction : p-Benzoyl propionic acid from succinic anhydride and benzene.
9. Aromatic electrophilic substitutions : Synthesis of p-nitroaniline and p-bromoaniline.
10. Estimation of amines/phenols using bromate bromide solution/or acetylation method.
11. Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method
12. Determination of Iodine and Saponification values of an oil sample.

PHYSICAL CHEMISTRY

1. 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 hydrolysis of an ester/ionic reaction.
2. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.

3. Determination of the velocity constant for the oxidation of iodide ions by hydrogen peroxide study the kinetics as an iodine clock reactions.
4. Flowing clock reactions (Ref : Experiments in Physical Chemistry by Showmaker)
5. Determination of the primary salt effect on the kinetics of ionic reaction and testing of the Bronsted relationship (iodide ion is oxidised by persulphate ion).
6. To determine the relative strength of the acids by studying the hydrolysis of an ester.(at room and at any higher temperature)
7. Determine the energy of activation for the hydrolysis of an ester .
8. Determination of molecular weight of non-volatile and electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
9. Determination of the degree of dissociation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.
10. Determination of strengths of halides in a mixture potentiometrically.
11. Determination of the strength of strong and weak acids in a given mixture using a potentiometer/pH meter.
12. Determination of temperature dependence of EMF of a cell.
13. Determination of the formation constant of silver-ammonia complex and stoichiometry of the complex potentiometrically.
14. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.

Books Suggested

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.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.P. 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.

Semester III

MCE 013A: Green Chemistry

Unit-I

INTRODUCTION ,PRINCIPLE AND CONCEPTS OF GREEN CHEMISTRY:

What is green chemistry?Need for green chemistry;inception and evolution of green chemistry;twelve principles of green chemistry with their explanations and examples; designing a green synthesis using these principles ;green chemistry in day to day life.

Unit_II

Basic principles of Green Chemistry and their illustrations with examples.

(i) Prevention of waste/byproducts.

- (ii) Maximum Incorporation of the materials used in the process into the final product (Atom Economy): Green metrics
- (iii) Prevention/Minimization of hazardous/toxic products.
- (iv) Designing safer chemicals - different basic approaches
- (v) Selection of appropriate auxiliary substances (solvents, separation agents etc)
- (vi) Energy requirements for reactions—use of microwave, ultrasonic energy
- (vii) Selection of starting materials—use of renewable starting materials.
- (viii) Avoidance of unnecessary derivatization—careful use of blocking/protection groups.
- (ix) Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents.
- (x) Designing biodegradable products.
- (xi) Prevention of chemical accidents.
- (xii) Strengthening/development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. Development of accurate and reliable sensors and monitors for real time in process monitoring.

Unit-III

Application of non conventional energy sources : Microwave induced and ultrasound assisted green synthesis.

Introduction of microwave induced organic and inorganic synthesis; microwave activation – equipment ;time and energy benefits;limitations;

(a) Synthesis of nitrogen-oxygen /sulphur donor ligands and their coordination complexes ;synthetic organic transformations under microwaves

(b) Reactions in organic solvents –esterifications ;Fries rearrangement;Diels alder reaction and decarboxylation.

(c) Solvent free reactions(solid state reactions):deacetylation ;deprotection; saponification of ester;alkylation of reactive methylene compounds ;synthesis of nitriles from aldehydes; heterocyclic synthesis –B-lactams,pyrrole,quinoline.Ultrasound assisted green synthesis:introduction;instrumentation;physical aspects;oxidation;reduction;addition ,substitution reactions and synthesis of chromenes.

Unit-IV

Environmentally benign solutions to organic solvents (focus on water and ionic liquids).

(a) Ionic liquids as green solvents –introduction ;properties and types of ionic liquids; synthetic applications-Diels-Alder reaction ;epoxidation;Heck reaction;preparation of pharmaceutical compounds;enzyme catalysed synthesis.

(b) Aqueous phase reactions-introduction ;Pseudo organic solvent

(1) Application in oxidation of nitro;aromatic and carbonyl compounds ;reduction of carbon-carbon multiple bond,Benzoin condensation ;Michael reaction;Claisen rearrangement;knoevenagel reaction.

(2) Electrochemical synthesis- introduction,synthesis of sebacic acid,adiponitrile introduction on role of fluorine solvents and supercritical carbon dioxide in green chemistry .

Unit-V

Hazard assessment and mitigation in chemical industry

Future trends in Green Chemistry: Oxidation-reduction reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; Noncovalent derivatization. Biomass conversion, emission control. Biocatalysis

Suggested Books References:

1. Organic synthesis in water, Paul A. Grieco Blackie.
2. Green Chemistry, theory and practice, Paul T. Anastas and John C. Warner.
3. New Trends in Green Chemistry, V.K. Ahluwalia and M.Kidwai.
4. Green Chemistry For Sustainability, Sanjay K. Sharma and A.Mudhoo, CRC Taylor & Francis,. USA
5. Organic synthesis: Special techniques, V.K. Ahluwalia and Renu Aggarwal.
6. A Handbook of Applied Biopolymer Technology, Sanjay K. Sharma and A. Mudhoo, RSC Publishing, UK
7. Lancaster, M. Green chemistry; An Introductory Text; the Royal Society of Chemistry: Cambridge, UK, 2002.
8. Green Corrosion Chemistry & Engineering, Sanjay K. Sharma, Wiley Publications, UK
9. Chem, Rev. 2007, 107, 2167-2820 (special issue on green chemistry).

Specialization: Inorganic Chemistry

MCE 014A: Inorganic Elective I: PHOTOINORGANIC CHEMISTRY AND X-RAY DIFFRACTION

Unit-I

Basic of Photochemistry

Absorption, excitation, photochemical laws, quantum yield, electronically excited states-life times-measurements of the times. Flash photolysis, Energy dissipation by radiative and non-radiative processes, absorption spectra, Frank-Condon principle, photochemical stages-primary and secondary processes.

Unit-II

Properties of Excited States

Structure, dipole moment, acid-base strengths, reactivity. Photochemical kinetics-calculation of rates of radiative processes. Bimolecular deactivation-quenching.

Excited States of Metal Complexes

Excited states of metal complexes : Comparison with organic compounds, electronically excited states of metal complexes, charge transfer spectra.

Unit-III

Ligand Field Photochemistry

Photosubstitution, photooxidation and photoreduction, lability and selectivity, zero vibrational levels of ground state and excited state.

Unit-IV

Metal Complex Sensitizers

Metal complex sensitizer, electron relay, metal colloid systems, water photolysis, nitrogen fixation and carbon dioxide reduction.

Unit-V

X-RAY DIFFRACTION

Bragg condition, Miller indices, Laue Method, Bragg method, Debye Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern, Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules.

Suggested Books References:

1. Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.
2. Inorganic Photochemistry, J.Chem. Educ. vol. 60 No. 10, 1983.
3. Progress in Inorganic Chemistry, Vol. 30ed. S.J. Lippard. Wiley.
4. Coordination Chem. Revs. 1981, vol. 39, 121, 1231, 1975, 14, 321,; 1990 97, 313.
5. Photochemistry of Coordination Compounds, V. Balzari and V. Carassiti, Academic Press.
6. Elements in Inorganic Photochemistry, G.J. Ferraudi, Wiley.

MCE 015A: Inorganic Elective II: BIOINORGANIC CHEMISTRY

Unit-I

Metal Ions in Biological Systems

Bulk and trace metals with special reference to Na, K, Mg, Ca, Fe, Cu, Zn, Co, and K⁺/Na⁺ pump.

Metal Storage and Transport

Ferritin transferrin, and siderophores.

Unit-II

Bioenergetics and ATP Cycle.

DNA polymerisation, glucose storage, metal complexes in transmission of energy; chlorophyll's, photosystem I and photosystem II in cleavage of water.

Unit-III

DNA and RNA

Metal complexes of polynucleotide, nucleosides and nucleic acids (DNA and RNA)
Template temperature stability of DNA.

Unit-IV

Transport and Storage of Dioxygen

Haem proteins and oxygen uptake structure and function of haemoglobin's, myoglobin, haemocyanins and hemerythrin, model synthetic complexes of iron, cobalt and copper.

Unit-V

Metals in Medicine

Metal deficiency and disease,(Iron ,Zinc,Copper) toxic effects of metals. metals used for diagnosis and chemotherapy with particular reference the anticancer drugs.

Nitrogen fixation

Nitrogen in biosphere ,nitrogen cycle ,nitrification role microorganism ,nitrogen fixation in soils. Biological nitrogen fixation, and its mechanism, nitrogenase, Chemical nitrogen fixation.

Suggested Books References:

1. Principals of Bioinorganic Chemistry. S.J. Lppard and J.M. Berg University Science Books.
2. Bioinorganic Chemistry, I Bertini, H.B. Gray. S.J. Lippard and Jon Valentine, University Science Books.
3. Inorganic Biochemistry Vols I and II Ed.
4. Progress in Inorganic Chemistry Vols. 1i 18 Ed J.J. Lippard Wiley.
5. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
6. Bioinorganic Chemistry, 1. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
7. Inorganic biochemistry vol. I and II ed. G.L. Eichhorn, Elsever.
8. Progress in Inorganic Chemistry, Vol 18 and 38 ed J.J. Lippard, Wiley.

MCE016A : Inorganic Elective III: ORGANOTRANSITION METAL CHEMISTRY-I

Unit-I

Alkyls and Aryls of Transition Metals

Types, routes of synthesis, stability and decomposition pathways organocopper in organic synthesis.

Unit-II

Compounds of Transition Metal-Carbon Multiple Bonds alkylidenes, alkylidyne , synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis.

Unit-III

Compounds of low valent carbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis.

Unit-IV

Transition Metal π -Complexes

Transition metal π -Complexes with unsaturated organic molecules, alkenes, alkynes, allyl, complexes, preparation, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.

Unit-V

Transition metal π -Complexes with unsaturated organic molecules, diene, dienyl, arene and trienyl complexes, preparation, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis

Suggested Books References:

1. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree. John Wiley.
3. Metallo-organic Chemistry, A.J. Pearson, Wiley.
4. Organometallic Chemistry, R.C. Mehrotra and A. Singh New Age International

MCE 017A : Spectrophotometric Analysis (Practical)

Preparation (Any Six)

Preparation of selected inorganic compounds and their study by IR, electronic spectra, Mossbauer. ESR and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds involving vacuum lines. Selection can be made from the following :

1. Sodium amide.
2. Synthesis and thermal analysis of group II metal oxalate hydrate.
3. Atomic absorption analysis of Mg and Ca.
4. Preparation of Tin (IV) iodide, Tin (IV) chloride and Tin (II) iodide.
5. Preparation of ammonium hexachlorostannate $(\text{NH}_4)_2 \text{SnCl}_6$ ammonium hexachlorophlumbate $(\text{NH}_4)_2 \text{PbCl}_6$.
6. Hexa-bis (4,nitrophenoxy) cyclotriphosphazene.
7. Synthesis of trichlorodiphenylantimony (V) hydrate.
8. Sodium tetrathionate $\text{Na}_2\text{S}_4\text{O}_6$.
9. Synthesis of metal acetylacetonate .
10. Bromination of $\text{Cr}(\text{acac})_3$.
11. Magnetic moment of $\text{Cu}(\text{acac})_2 \cdot 2\text{H}_2\text{O}$.
12. Cis and Trns $[\text{Co}(\text{en})_2\text{Cl}_2]^+$.
13. Separation of optical isomer of cis- $[\text{Co}(\text{en})_2\text{Cl}_2]$.
14. Ion exchange separation of oxidation state of vanadium.
15. Preparation and use of Ferrocene.
16. Preparation of copper glycine complex-cis and trans bis (glycinato Copper (II))
17. Preparation of phosphine Ph_3P and its transition metal complexes.
18. Preparation of $[\text{Co}(\text{phenanthroline-5,6 quinone})]$.

Spectrophotometric Determinations

1. Manganese/Chromium/Vanadium in steel sample.
2. Nickel/molybdenum/tungston/vanadium/uranium by extractive spectrophotometric method.
3. Fluoride/nitrite/phosphate.
4. Zirconium-alizarin Red-S complex : Mole-ratio method.
5. Copper-Ethylene diamine complex : Slope-ratio method.
6. Iron-phenanthroline complex : Job's method of continuous variations.

Specialization: Organic Chemistry

MCE 018A: Organic Elective I: ORGANIC SYNTHESIS-I

Unit-I

Oxidation

Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated) Alcohols, diols, aldehyde's, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetroxide, iodobenzene diacetate and thallium. (III) Nitrate.

Unit-II

Reduction-I

Introduction, Different reductive processes. Alkanes, alkenes, alkynes, and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides.

Unit-III

Reduction-II

Introduction, Different reductive processes, Nitro, nitroso, azo and oxime groups. Expoxide, Nitro, Nitroso, azo and oxime groups. Hydrogenolysis.

Unit-IV

Rearrangements - I

General mechanistic considerations-nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements. Pinacol-pinacolone, Wagner-Meerwein.

Unit-V

Rearrangements - II

Demjanov, Benzil-Benzilic acid. Favorskii, Arndt-Eister synthesis, Neber, Beckmann, Hotmann Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction. Schmidt, Baeyer-Villiger. Shapiro reaction

Suggested Books References:

1. Modern Synthetic Reactions. H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, w. Carruthers, Cambridge Univ. Press.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March. John Wiley.
4. Principles of Organic synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Advanced Organic Chemistry Part B.F.A. Carey and R.J. Sundberg Plenum Press.
6. Rodd's Chemistry of Carbon Compounds. Ed. S. Coffey, Elsevier.

MCE 019A: Organic Elective II: HETEROCYCLIC

Unit-I

Nomenclature of Heterocycles

Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic fused and bridged heterocycles.

Unit-II

Aromatic Heterocycles

General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ^1H NMR-spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

Unit-III

Non-aromatic Heterocycles

Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction. Stereoelectronic effects anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic electrophilic interactions. Heterocyclic Synthesis Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions.

Unit-IV

Small Ring Heterocycles

Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiranes, azetidines, oxetanes and thietanes.

Unit-V

Benzo-Fused Five-Membered Heterocycles

Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes

Suggested Books References:

1. Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V.Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical.
5. Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introduction to the Heterocyclic Compounds, R.M. Acheson, John Wiley.
7. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, eds. Pergamon Press.

MEC 020A: Organic Elective III: NATURAL PRODUCTS-I

Unit - I

Terpenoids

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules : Citral, Gerniol a-Terpeneol, Mentohl.

Unit-II

Carotenoids

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules : Abietic acid and b-Carotene.

Unit-III

Alkaloids-I

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants.

Unit-IV

Alkaloids-II

Structure, stereochemistry, synthesis and biosynthesis of the following : Ephedrine , (+)-Coniine, Nicotine, Atropine, Quinine and Morphine.

Unit-V

Steroids

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

Suggested Books References:

1. Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
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, Ata-ur-Rahman and M.L. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers

MCE 021A: Multi-step Synthesis (Practical)

Qualitative Analysis

Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid or two solids and one liquid), using tlc for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.

Multi-step Synthesis of Organic Compounds

The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques.

1. Photochemical reaction Benzophenone \rightarrow Benzpinacol \rightarrow Benzpinacolone
2. Beckmann rearrangement : Benzanilide from benzene Benzene \rightarrow Benzophenone \rightarrow Benzophenone oxime \rightarrow Benzanilide
3. Benzilic acid rearrangement : Benzilic acid from benzoin Benzoin \rightarrow Benzil \rightarrow Benzilic acid Synthesis of heterocyclic compounds
4. Skraup synthesis : Preparation of quinoline from aniline
5. Fisher Indole synthesis : Preparation of 2-phenylindole from phenylhydrazine.
6. Enzymatic synthesis Enzymatic synthesis
7. Enzymatic reduction : reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ethyl-3-hydroxybutanoate and determine its optical purity.
8. Biosynthesis of ethanol from sucrose.
9. Synthesis using microwave Alkylation of diethyl malonate with benzyl chloride.
10. Synthesis using phase transfer catalyst. Alkylation of diethyl malonate or ethyl acetoacetate with an alkylhalide.

Paper Chromatography

Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of R_f values.

Spectroscopy

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

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

Books Suggested

1. Inorganic Experiments, J. Derek Woolings, VCH.
2. Microscale Inorganic Chemistry, Z. Szafran, R.M. Pike and M.M. Singh, Wiley.
3. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrand.
4. The systematic Identification of Organic Compounds, R.L. Shriner and D.Y. Curtin.

Specialization: Physical Chemistry

MCE 022A: PHYSICAL ELECTIVE I: ELECTROANALYTICAL TECHNIQUES

Unit I

Introduction

Role of analytical chemistry Classification of analytical methods classical and instrumental. Types of instrumental analysis. Selecting an analytical method. Neatness and cleanliness. laboratory operations and practices. Analytical balance. Techniques of weighing, errors. Volumetric glassware cleaning and calibration of glassware. Cleaning and Calibration of glassware. Sample preparation-dissolution and decompositions.

Unit II

Errors and Evaluation(Statistical Analysis)

Definition of terms in mean and median. Precision-standard deviation, relative standard deviation. Accuracy-absolute error, relative error. Types of error in experimental data determinate (systematic), indeterminate (or random) and gross. Sources of error and the effects upon the analytical results. Methods for reporting analytical data. Statistical evaluation of data-indeterminate errors. The uses of statistics.

Unit III

Conductometry

Important laws ,definitions,relations,effect of dilution on conductivity,measurement of conductivity,types of conductometric titrations, its applications and limitations.

Unit IV

Potentiometry

Principle instrumentation,types of potentiometric titrationsand its applications ,pH measurements,determination of pH,ion selective electrodes,instrumentation and its applications

Unit V

Coulometry

Introduction, principle,experimental details of coulometry at constant current and constant potential,titrational applications.

Suggested Books References:

1. Principles of Instrumental analysis D.A. Skoog and J.L. Loary, W.B. Saunders.
2. Principles of Instrumental Analysis D.A. Skoog W.B. Saunders.
3. Handbook of Instrumental Techniques for Analytical Chemistry, F. Settle, Prentice Hall

MCE 023A:PHYSICAL ELECTIVE II : ELECTROCHEMISTRY-I

Unit I

Electrochemical Energy Storage

Properties of Electrochemical energy storers : Measure of battery performance, Charging and discharging of a battery, Storage Density, Energy Density. Classical Batteries : (i) Lead Acid (ii) Nickel-Cadmium, (iii) Zinc manganese dioxide. Modern Batteries : (i) Zinc-Air (ii) Nickel-Metal

Hydride, (iii) Lithium Battery, Future Electricity storers : Storage in (i) Hydrogen, (ii) Alkali Metals, (iii) Non aqueous solutions.

Unit II

Bioelectrochemistry

Membrane Potentials, Simplistic theory, Modern theory, Electrical conductance in biological organism: Electronic, Protonic electrochemical mechanism of nervous systems, enzymes as electrodes.

Unit III

Corrosion and Stability of Metals :

Civilization and Surface mechanism of the corrosion of the metals; Thermodynamics and the stability of metals, Potential -pH (or Pourbaix) Diagrams; uses and abuses, Corrosion current and corrosion potential -Evans diagrams. Measurement of corrosion rate : (i) Weight Loss method, (ii) Electrochemical Method.

Unit IV

Inhibiting Corrosion

Cathodic and Anodic Protection. (i) Inhibition by addition of substrates to the electrolyte environment, (ii) by changing the corroding method from external source, anodic Protection, Organic inhibitors, The fuller Story Green inhibitors.

Passivation

Structure of Passivation films, Mechanism of Passivation, Spontaneous Passivation Nature's method for stabilizing surfaces.

Unit V

Kinetic of Electrode Process :

Essentials of Electrode reaction. Current Density, Overpotential, Tafel Equation, Butler Volmer equation. Standard rate constant (K_0) and Transfer coefficient (α), Exchange Current.

Irreversible Electrode processes

Criteria of irreversibility, information from irreversible wave. Methods of determining kinetic parameters for quasi-reversible and irreversible waves, Koutecky's methods, Meites Israel Method, Gellings method

Suggested Books References:

1. Modern Electrochemistry Vol. I, IIa, Vol. IIB J'OM Bockris and A.K.N. Reddy, Plenum Publication, New York.
2. Polarographic Techniques by L. Meites, Interscience.
3. "Fuel Cells : Their electrochemistry". McGraw Hill Book Company, New York.
4. Modern Polarographic Methods by A.M. Bond, Marcell Dekker.
5. Polarography and allied techniques by K. Zutshi, New age International publicatin. New Delhi.
6. "Electroanalytical Chemistry by Basil H. Vessor & Galen W. ; Wiley Interscience.
7. Electroanalytical Chemistry by Basil H. Vessor & alen w. ; Wiley Interscience.

8. Topics in pure and Applied Chemistry, Ed. S. K. Rangrajan, SAEST Publication, Karaikudi (India)

MCE 024A: PHYSICAL – ELECTIVE III :CHEMICAL KINETICS I

Unit I

Oscillatory Reactions

Autocatalysis and oscillatory reactions, Kinetics and mechanism of Belousov-Zhabotinski (B-Z) reactions.

Unit II

Enzymes and Inhibitions

Kinetics of one enzyme-Two substrate systems and their experimental characteristics, Kinetics of enzyme inhibited reactions, Enzyme inhibitors and their experimental characteristics.

Unit III

Dynamics of Gas-surface Reactions

Adsorption/desorption kinetics and transition state theory. Dissociative adsorption and precursor state. Mechanism of Langmuir's adsorption of the oxidation of carbon monoxide to carbon dioxide. True and apparent activation energies. Industrial importance of heterogeneous catalysis.

Unit IV

Transition State

A brief aspect of statistical mechanics and transition state theory. Application in calculation of the second order rate constant for reactions with collision for (1) atom + atom, (2) atom + molecule (linear), (3) atom + non linear molecule, (4) linear and linear molecule, (5) linear molecule + non linear molecule reactions. Solvent effects and thermodynamics formulations. Adiabatic electron transfer reactions, energy surfaces.

Unit V

Metal ion catalysis

Kinetics and mechanism of following reaction-

- (a) i. When reaction rate is independent of one of the reactants in presence of metal ion catalyst
ii. When reaction rate is retarded of one of the products in the presence of metal ion catalyst.
iii. When metal ion catalysis indicates an intermediate complex.
- (b) (i). Cyclodextrines and their mode of catalysis, a case study.

Suggested Books References:

1. Progress in Inorganic Chemistry, Vol. 30 1967.
2. R. Lumry and R.W. Raymond, Electron Transfer Reactions, Interscience.
3. N.L. Bender, Mechanism of Homogeneous Catalysis from protein to protein, Wiley.
4. A.G. Sykes, Kinetics of Inorganic reactions, Pergamon.
5. S.W. Benson, Mechanism of Inorganic Reactions, Academic Press.
6. Physical Chemistry Vol. 2, Ed. Prof Ya Grasimov, Mir publisher.
7. Basolo and Pearson, Inorganic Reaction Mechanisms, Wiley.
8. H. Taube, Electron Transfer Reactions, Oxford Press.

MCE 025A: Thermodynamical Studies (Practical)

1. Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.
2. Determination of the temperature dependence of the solubility of a compound in two solvents having similar intramolecular interactions (benzoic acid in water and in DMSO water mixture and calculate the partial molar heat of solution.
3. Determination of Pka of an indicator (e.g. methyl red) in (a) aqueous and (b) micellar media.
4. Determination of stoichiometry and stability constant of Ferricisothiocyanate complex ion in solution.
5. Determination of rate constant of alkaline bleaching of Malachite green and effect of ionic strength on the rate of reaction.
6. Verify Beer's law for solution of KMnO_4 and determine concentration of given aqueous solution of unknown concentration of this salt.
7. Determine the solubility and solubility product of a sparingly soluble salt conductometrically.
8. Determine the dissociation constant of a weak acid conductometrically and verify Ostwald's dilution law.
9. Study the hydrolysis of methyl acetate catalysed by HCl solution and equinormal solution of urea hydrochloride and determine the degree of hydrolysis of the salt.
10. Study saponification of ethyl acetate conductometrically.
11. Oscillatory reaction (demonstration) and note down the time for damping of oscillation.
12. Study the reaction rate of decomposition of H_2O_2 Kinetically in presence of iodide in acid solution.

Books Suggested

- i. Inorganic Experiments, J. Derek Woolings, VCH.
- ii. Microscale Inorganic Chemistry, Z. Szafran, R.M. Pike and M.M. Singh, Wiley.
- iii. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrand.
- iv. The systematic Identification of Organic Compounds, R.L. Shriner and D.Y. Curtin.

Semester IV

Specialization: Inorganic Chemistry

MCE 027A: Inorganic Elective I: ORGANOTRANSITION METAL CHEMISTRY-II

Unit-I

Transition metal compounds with bonds to hydrogen

Transition metal compounds with bonds to hydrogen.

Unit-II

Homogeneous Catalysis

Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins,

Unit-III

Reactions of CO

Catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxoreaction), explanation reactions,

Unit-IV

Activation of C-H bond

Reactions involving activation of C-H bond

Unit-V

Flexional Organometallic Compounds

Flexionality and dynamic equilibrium in compounds such as η^2 olefine, η^3 -allyl and dienyl complexes.

Suggested Books References:

1. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree. John Wiley.
3. Metallo-organic Chemistry, A.J. Pearson, Wiley.
4. Organometallic Chemistry, R.C. Mehrotra and A. Singh New Age International.

MCE 028A: Inorganic Elective II: INORGANIC POLYMERS

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 reactins. Polymerization in homogeneous and heterogeneous systems.

Unit-II

Polymer Characterization

Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity an molecular weight distribution.

Unit-III

Polymers of Boron

Structure, Properties and Applications of Polymers based on boron-borazines, boranes and carboranes.

Unit-IV

Polymes of silicon

Structure, Properties and Applications of Polymers based on Silicon, silicone's polymetalloxanes and polymetallosiloxanes, silazanes.

Unit-V

Polymers of Phosphorous and sulphur

Structure, Properties and Application of-

- i. Polymers based on Phosphorous-Phosphazenes, Polyphosphates
- ii. Polymers based on Sulphur -Tetrasulphur tetranitride and related compounds.

Suggested Books References:

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.
7. Contemporary Polymer Chemistry, H.R. Al cock and F.W. Lambe, Prentice Hall

MCE 029A : Inorganic Elective III: MINERAL BASED INDUSTRIAL CHEMISTRY

Unit-I

INDUSTRIAL CHEMISTRY

Ferrous and non-ferrous industries-quality ,control methods, general principles applied in studying an industry –manufacture of iron ,steels metallurgy of gold and silver.

Unit-II

CEMENT

Classification of cement, manufacture of Portland cement –setting and hardening of cement, chemical constitution of Portland cement and their characteristics – special cement and their characteristics –special cements and their uses.

Cermics

Unit-III

Ceramics

Classification of ceramics,basic raw materials-application of colours to pottery porcelain and china ware-manufacture,glass-raw materials,manufacture of special glass-optical,borosilicate,flint and coloured glass.

Unit-IV

Solid Poisons

Industrial poisons and their classification solid poisons –their identification-physiological activity and control;solids:Pb,As,Hg,asbestos,textile fibres.

Unit-V

Liquid and Gases Poisons

Industrial poisons and their classification liquid and gaseous poisons –their identification-physiological activity and control : liquids:organic solvents,gases oxides of S ,N and H₂S,cyanides,aldehydes,ketones and hydrocarbons.

Suggested Books References:

1. Chemical Process Industries; N.D. Shreeve.
2. Applied Chemistry for Engineer; Diamont.
3. Industrial Poisons and solvents; Jacobs.
4. Chemistry of engineering materials; Jain & Jain
5. Engineering chemistry; B.K. Sharma.

MCE 030A: Flame Photometric and Flame Photometric Determination (Practical)

Flame Photometric Determinations

1. Sodium.
2. Potassium
3. Sodium and potassium when present together
4. Lithium
5. Calcium
6. Barium
7. strontium.
8. Cadmium
9. Magnesium in tap water.

Quantitative determinations of a two component mixture

One Volumetrically and one gravimetrically

1. Cu^{+2} , Ni^{+2}

Quantitative determinations of a three component mixture :

One Volumetrically and two gravimetrically

1. Cu^{+2} , Ni^{+2} , Zn^{+2}
2. Cu^{+2} , Ni^{+2} , Ng^{+2}

Specialization: Organic Chemistry

MCE 031A: Organic Elective I: Disconnection Approach

Unit-I

Disconnection Approach

An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reaction, amine synthesis.

Unit-II

Protecting Groups

Principle of protection of alcohol, amine, carbonyl and carboxyl groups.

One Group C-C Disconnections

Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic Nitro compounds in organic synthesis.

Unit-III

Two Group C-C Disconnections

Diels-Alder Reaction, 1,3-difunctionalised compounds, a-b- unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation.

Unit-IV

Ring Synthesis-I

Saturated heterocycles, synthesis of 3,4,5 and 6 membered rings. aromatic heterocycles in organic synthesis. General strategy and stereoselectivity, Cyclisation and insertion reaction, rearrangement in synthesis,

Unit-V

Ring Synthesis-II

Photocycloaddition and use of ketenes, Pericyclic rearrangement and special methods, carbonyl condensation, Diels –Alder reaction and reduction of aromatic compounds.

Suggested Books References:

1. Designing Organic Synthesis, S. Warren. Wiley.
2. Organic Synthesis-Concept, Methods and Starting Materials, J. Fuhrhop.
3. Some Modern Methods of Organic Synthesis. W. Carruthers, Cambridge Univ. Press.
4. Modern Synthetic Reactions H.O. House, W.A Benjamin.
5. Advanced Organic Chemistry : Reactions, Mechanisms and Structure, J. March. Wiley.
6. Principles, of Organic Chemistry Part B. F.a. Carey and R.J. Sundberg, Plenum Press.

MCE 032A: Organic Elective II: HETEROCYCLIC CHEMISTRY-II

Unit-I

Meso-ionic Heterocycles

General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications.

Six-Membered Heterocycles with one Heteroatom

Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and phridones. Synthesis and reactions of quionlizinium and benzopyrylium salts, coumarins and chromones.

Unit-II

Six Membered Heterocycles with Two or More Heteroatoms Synthesis and reactions of diazoles, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles Synthesis and reactions of azepines, oxepines, thiepinines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines.

Unit-III

Heterocyclic Systems Containing P

Heterocyclic rings containing phosphorus : Introduction, nomenclature, synthesis and characteristics of 5- and 6-membered ring systems phosphorinaes, phosphorines, phospholanes and phospholes.

Unit-IV

Heterocyclic Systems Containing B

Heterocyclic rings containing B : Introduction, synthesis reactivity and spectral characteristics of 3- 5- and 6- membered ring system.

Unit-V

Heterocyclic Systems Containing As and Sb

Heterocyclic rings containing As and Sb : Introduction, synthesis and characteristics of 5- and 6-membered ring system

Suggested Books References:

1. Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V.Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scietific Techinal.
5. Contemporary Hetrocyclic Chemistry, G.,R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introductiion to the Heterocyclic Compounds, R.M. Acheson, Johnwiely.
7. Comprehensive Heterocyclic Chemistry, A.R. Katrizky and C.W. Rees, eds. Pergamon Press

MCE 033A: Organic Elective III: NATURAL PRODUCTS-II

Unit-I

Plant Pigments-I

Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin Quercetin, Myrcetin, Quercetin 3-glucoside, Vitexin, Diadzein,

Unit-II

Plant Pigments-II

Buttein, Aureusin, Cyanidin-7arabinoside, Cyanidin, Hirsutidin, Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

Unit-III

Prophyrins

Structure and synthesis of Haemoglobin and Chlorophyll.

Unit-IV

Prostaglandis

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

Unit-V

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).

Suggested Books References:

1. Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthorpe and J.B. Harborne, Longman, Essex.
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, Ata-ur-Rahman and M.L. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.

MCE 034A: Chromatography and Spectroscopy (Practical)

Thin Layer Chromatography

1. To separate the mixture of Methyl Orange and Methylene Blue by using cyclohexane and ethyl acetate(8.5:1.5) as solvent system.
2. To Prepare and separate 2,4-dinitro Phenylhydrazone of acetone, 2-butanone, hexane-2-one and hexane-3-one using toluene and petroleum ether(40:60).
Paper Chromatography
3. To separate the mixture of phenylalanine and glycine. Alanine and aspartic acid. Leucine and glutamic acid. Spray reagent –Ninhydrin.
4. To separate the mixture of D,L-alanine, glycine and L-leucine using n-butanol : acetic acid : water(4:1:5). Spray reagent- Ninhydrin.
5. To separate monosaccharides –a mixture of D –galactose and D-fructose using n-butanol : acetone: water (4:1:5) . Spray reagent –aniline hydrogen phthalate.
6. To Separate and identify sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of R_f values.

Spectroscopy

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

- i. Amino acids
- ii. Proteins
- iii. Carbohydrates
- iv. Cholesterol
- v. Ascorbic acid
- vi. Aspirin
- vii. Caffeine

Specialization: Physical Chemistry

MCE 035A: PHYSICAL ELECTIVE I: CHEMICAL ANALYSIS

Unit I

Food analysis

Moisture, ash, crude protein, fat crude fibre, carbohydrates, calcium, potassium, sodium and phosphate. Food adulteration-common adulterants in food, contamination of food stuffs. Microscopic examination of foods for adulterants. Pesticide analysis in food products. Extraction and purification of sample. HPLC. Gas chromatography for organophosphates. Thin-layer chromatography for identification of chlorinated pesticides in food products.

Unit II

Analysis of soil

Analysis of Soil, moisture pH total nitrogen, phosphorus, silica, lime, manganese, sulphur and alkali salts.

Unit III

Analysis of Fuel

Fuel analysis : liquid and gas. Ultimate and proximate analysis-heating values-grading of coal. Liquid fuels-flash point, aniline point, octane number and carbon residue. Gaseous fuels-produced gas and water gas-calorific value

Unit IV

Analysis of Water

Objectives of analysis-parameter for analysis-colour, turbidity, total solids, conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different forms of nitrogen, Heavy metal pollution-public health significance of cadmium, chromium, copper, lead, zinc, manganese, mercury and arsenic.

Unit V

Clinical Chemistry

Composition of blood-collection and preservation of samples. Clinical analysis. Serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulins, barbiturates, acid and alkaline phosphates. Immuno assay : principles of radio immunoassay (RIA) and applications. The blood gas analysis trace elements in the body.

Drug analysis

Narcotics and dangerous drug. Classification of drugs. Screening by gas and thin-layer chromatography and spectrophotometric measurements.

Suggested Books References:

1. Analytical Chemistry, G.D. Christian, J.Wiley.
2. Fundamentals of analytical Chemistry. D.A. Skoog. D.M. West and F.J. Holler, W.B. Saunders.

- Analytical Chemistry-Principles. J.H. Kennedy. W.B. Saunders.
- Analytical Chemistry-Principles and Techniques. LG. Hargis. Prentice Hall.
- Principles of Instrumental analysis D.A. Skoog and J.L. Loary, W.B. Saunders.
- Principles of Instrumental Analysis D.A. Skoog W.B. Saunders.
- Quantitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
- Environmental Solution, S.M. Khopkar, Wiley Eastern.
- Basic Concepts of Analysis Chemistry, S.M. Khopkar, Wiley Eastern.
- Handbook of Instrumental Techniques for Analytical Chemistry,., Settle, Prentice Hall.

MCE 036A : PHYSICAL ELECTIVE II: ELECTRO CHEMISTRY-II

Unit I

Fuel cell

Electrochemical Generators (Fuel Cells) : Hydrogen oxygen cells, Hydrogen Air cell, Hydrocarbon air cell, Alkaine fuel cell, Phosphoric and fuel cell, direct NaOH fuel cells, applications of fuel cells.

Unit II

Electrocatalysis

Chemical catalysts and Electrochemical catalysts with special reference to purostates, porphyrin oxides of rare earths. Electrocatalysis in simple redox reactions, in reaction involving adsorbed species. Influence of various parameters.

Unit III

Voltammetry

General principle and applications, linear sweep voltammetry (LSV),cyclic voltammetry (CV)square wave voltammetry ,stripping voltammetry ,cathodic and anodic adsorptive stripping voltammetry (CAAdSV and AAdSV).

Unit IV

Electro-organic synthesis

Types of electroorganic reaction , constant current and constant potential electrolysis ,cell design, effect of variable , nature of mediun , nature of electrode materials, over voltage, effect of redox couple, application of sewage waste water treatment.

Unit V

Controlled Current Techniques

Introduction, general theory, Sand equation, programmed current chronopotentiometry, Quasireversible waves, reversal techniques, galvanostatic double pulse method.

Suggested Books & References:

- Electrochemical methods by Allen J. Bard and Larry R. Fanlkner, Johnwiley. Pub.
- Electrochemistry by Carl H. Hamann, Andrew Hanmett and wolf vielstich.
- Modern Polarographic Methods by H. Vessor & Galen W.Wiley Interscience.
- Topis inpure and applied chemistry Ed. S.K. Rangrajan SAEST Pub., Karaikudi, (India).

5. Techniques of eletro-organic synthesis Part I, II & III by N.L. Weinberg John Wiley Pub.

MCE 037A: PHYSICAL ELECTIVE III :CHEMICAL KINETICS-II

Unit I

Micelles catalysis and inhibition

Kinetics and mechanism of micelle catalyzed reactions (Ist order and second order) Various type of micelle catazed reactions. Micelle inhibited reactions.

Kinetics and Mechanism of Substitution Reaction

Classification of ligand substitution mechanism. Anation and base catalyzed kinetics of anation reactions. Aquation and acid catalyzed kinetics of aquation reactions (octahedral complexes).

Unit II

Radiation Chemistry

Radiation chemistry and photochemistry. Radiation chemistry of water and aqueous solutions. Hydrogen atom and hydroxyl radical-oxidizing and reducing conditions. Kinetics and mechanism of photochemical and photosensitized reactions (One example in each case). Stern-Volmer equation and its application. Hole-concept in the presence of semiconductor type photocatalysts. Kinetics and mechanism of electron transfer reaction in the presence of visible light. Kinetics of exchange reactions (Mathematical analysis)

Unit III

Induced Phenomenon

Induced reactions concept and their characteristics, Induction factor, Mechanism of (i) Fe (II) induced oxidation of iodine by Cr(VI) in weak acid medium, (ii) As (III) induced oxidation of Mn(II) by chromate in acid solutions. Kinetics and mechanism of induced reactions in metal complexes (octahedral complexes of Cobalt (III) only)-basic concepts.

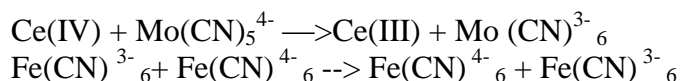
Unit IV

Electron Transfer Reaction in Metal Complexes

Kinetics and mechanism of 1:1, 1:2, 1:3 metal substrate complexes as intermediate, Henry Taubes classical reaction ,its kinetics and mechanism, Inner-sphere and outer sphere, electron transfer reactinos and mechanism. Variaous types of inner sphere bridges, adjacent and remote attack. Linkage isomerism. Chemical and resonace mechanism.

Unit V

Marcus-Cross relation in outtersphere reactions (no mathematical derivation). Its application in reactions :



Bridged outer-sphere electron transfer mechanism, Nucleophilic and electrophilic catalyst and their mode of action.

Suggested Books References:

1. Progress in Inorganic Chemistry, Vol. 30 1967.
2. R. Lumry and R.W. Raymond, Electron Transfer Reactions, Interscience.
3. N.L. Bender, Mechanism of Homogeneous Catalysis from protein to protein, Wiley.
4. A.G. Sykes, Kinetics of Inorganic reactions, Pergamon.
5. S.W. Benson, Mechanism of Inorganic Reactions, Academic Press.
6. Physical Chemistry Vol. 2, Ed. Prof Ya Grasimov, Mir publisher.
7. Basolo and Pearson, Inorganic Reaction Mechanisms, Wiley.
8. H. Taube, Electron Transfer Reactions, Oxford Press

MCE 038A : Polarography and Chemical Kinetics (Practical)

1. Identification and estimation of metal ions such as Cd^{+2} , Pb^{+2} , Zn^{+2} , polarographically.
2. Study of a metal ligand complex polarographically (using Lingane's Method).
3. Determination of rate constant and formation constant of an intermediate complex in the reaction of Ce(IV) and Hypophosphorous acid at ambient temperature.
4. Determination of energy and enthalpy of activation in the reaction of KMnO_4 and benzyl alcohol in acid medium.
5. Determination of energy of activation and entropy of activation from a single kinetic run.
6. Kinetics of an enzyme catalyzed reaction
7. To determine the hardness of Water by complexometric method and by HCl method.
8. To determine the amount of free chlorine in given water sample.
9. Determination of Total residual Chlorine and amount of Fluoride ion in given water samples.
10. Determination of Viscosity of a given lubricant by Redwood Viscometer No.1.
11. Determination of Flash and Fire Points of a given lubricant by Pensky Martin Apparatus.
12. Determination of Cloud and Pour Points of a given lubricant.
13. To determine moisture, volatile and ash content in a given coal sample by proximate analysis.
14. To determine the calorific value of Solid Fuel by Bomb's Calorimeter.

Books Suggested

1. Inorganic Experiments, J. Derek Woolings, VCH.
2. Microscale Inorganic Chemistry, Z. Szafran, R.M. Pike and M.M. Singh, Wiley.
3. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrand.
4. The systematic Identification of Organic Compounds, R.L. Shriner and D.Y. Curtin.

MCE 041A : Minor Project : (Which will be done in vacations after Semester-III and will be evaluated in Semester-IV)