MAHARSHI DAYANAND SARASWATI UNIVERSITY, AJMER

पाठ्यक्रम

SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

M.Sc. CHEMISTRY

M.Sc. Chemistry (Prev) & (Final)

2009–10 से प्रभावी(w.e.f.)

सत्र 2013–14

महर्षि दयानन्द सरस्वती विश्वविद्यालय, अजमेर

M.SC. CHEMISTRY

SCHEME OF EXAMINATION

1. The number of papers and the maximum marks for each paper practical shall be shown in the syllabus for the subject concerned. It will be necessary for a candidate to pass in the theory part as well as in the practical part (wherever prescribed) of a Subject/Paper separately.
2. A candidate for a pass at each of the Previous and the Final Examination shall be required to obtain (i) at least 36% marks in the aggregate of all the papers prescribed for the examination and (ii) at least 36% marks in practical (s) wherever prescribed in the examination, provided that if a candidate fails to secure at least 25% marks in each individual paper work, wherever prescribed, he shall be deemed to have failed at the examination not with standing his having obtained the minimum percentage of marks required in the aggregate for that examination. No division will be awarded at the Pervious Examination. Division shall be awarded at the end of the Final Examination on the combined marks obtained at the Previous and the Final Examination taken together, as noted below:

First Division	60%	of the aggregate marks taken together
Second Division	48%	of the Previous and Final Examination

All the rest will be declared to have passed the examinations.

3. If a candidate clears any paper(s) Practical(s) / Dissertation Prescribed at the Previous and or/ final Examination after a continuous period of three years, then for the purpose of working out his division the minimum pass marks only viz 25% (36% in the case of practical) shall be taken into account in respect of such paper(s) Practical(s) Dissertation are cleared after the expiry of the aforesaid period of three year, provided that in case where a candidate require more than 25% marks in order to reach the minimum aggregate as many marks out of those actually secured by him will be taken into account as would enable him to make the deficiency in the requisite minimum aggregate.

M.SC. PREVIOUS CHEMISTRY

	Papers	Max. Marks
I.	Inorganic Chemistry	100
II.	Organic Chemistry	100
III.	Physical Chemistry	100
IV.	Group Theory, spectroscopy, Diffraction Methods and Computer	100
	Practicals (including 25 marks for seminars)	200
	TOTAL	600

M.Sc. Final Chemistry

V	Spectroscopy, Photochemistry and Solid State Chemistry	100
VI.	Environment and Chemistry of Life	100
Elective Pool		
	(Candidate is required to select any one of the following groups)	
Group - A		
VII-a	Advanced Inorganic Chemistry	100
VIII-a	Metal Complexes and Polymers	100
	Practicals (including 25 marks for seminars)	200
Group-B		
VII-b	Organic Synthesis	100
VIII-b	Heterocyclic & Natural Products	100
	Practicals (including 25 marks for seminars)	200
Group-C		
VII-c	Chemistry Dynamics	100
VIII-c	Electro- Chemistry	100
	Practicals (including 25 marks for seminars)	200
Group-D		
VII-d	Forensic Chemistry and Toxicology	100
VIII-d	Methods of instrumental analysis	100
	Practicals (including 25 marks for seminars)	200
	TOTAL	1200

Note: Each theory paper is divided into three independent units. The question paper is divided into three parts Part -A, Part -B and Part –C. Part A (20 marks) is compulsory and contains 10 questions (20 words each) and at least three questions from each unit, each question is of two marks. Part –B (20 marks) is compulsory and contains four questions at least one from each unit. Candidate is required to attempt all four questions. Each question is of five marks (50 words). Part –C (60 marks) contains six questions two from each unit. Candidate is required to attempt three questions one from each Unit. Each question is of twenty marks (400 words).

NOTICE

1. Change in Statutes/Ordinances/Rules/Regulations/Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change. **The decision taken by the Academic Council shall be final.**

M.SC. PREVIOUS

PAPER I- INORGANIC CHEMISTRY

Time:3 Hours **Max. Marks:100**

Unit I

(a) Stereochemistry and Bonding in Main Group Compounds

VSEPR, Walsh diagrams (tri-and penta–atomic molecules), dπ-pπ bonds, Bent rule and energetics of hybridization, some simple reaction of covalently bonded molecules.

(b) 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.

(c)Metal-Ligand Bonding

Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory.

(d)Metal Clusters

Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

Unit II

Reaction Mechanism of Transition Metal Complexes

Energy profile of reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, 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. 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.

Unit III

(a)Electronic Spectra and Magnetic Properties of Transition Metal Complexes

Spectroscopic ground state, correlation, orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of Dq. B and β parameters, charge transfer spectra, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

(b)Metal π-Complexes

Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reaction of metal carbonyls; preparation, bonding structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.

Books Suggested

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements,N.N. Greenwood and A. Earnshow, Pegamon.
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. Reaction mechanism, Basalo Pearson, Academic Press

PAPER II- ORGANIC CHEMISTRY

Time:3 Hours **Max. Marks:100**

Unit I

(a) Nature of Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes, tautomerism.

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

Bonds weaker than covalent - addition compounds. Crown ether complexes and cryptands, inclusion compounds.

(b) Reaction Mechanism: Structure and Reactivity

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, hammond's postulate, curtin-Hammett principle. Potential energy diagrams.

Generation, structure, stability and reactivity of carbocations, carbonanions, 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.

c) Aliphatic Nucleophilic Substitution

The S_N2, S_N1, mixed S_N1 and S_N2 and SET mechanism

d) Aromatic Nucleophilic Substitution

The $ArSN^1ArSN^2$, benzyne and $S_{RN}1$ mechanism. Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser, and smiles rearrangements.

Unit-II

a) Aliphatic Electrophilic Substitution

Biomolecular mechanism-S_E2 and S_Ei. The SE^1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

b) Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para raio, ipso attack, orientation in other ring system. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vismeir reaction, Gattermann-koch reaction.

(c) 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 solvent 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.

(d) Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding.

UNIT-III

(a)Addition to Carbon-Hetero multiple Bonds

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

Mechanism of condensation reactions involving enolates- Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

Hydrolysis of esters and amides, ammonolysis of esters.

(b) Addition to Carbon-Carbon Multiple Bonds

Mechanism 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.

(c) Stereochemistry

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

Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

(d) Optical Rotatory dispersion (ORD) and Circular Dichroism (CD)

Definition, deduction of absolute configuration ,octant rule for ketones

(e) 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, 4n+2 an allyl systems. Cycloadditions- antarafacial and suprafacial additions, 4n, 4n+ systems,2+2 addition of ketenes, 1,3, dipolar cycloaddition and cheleotropi reactions.

Sigmatropic rearrangements-suprafacial and antarafacial shifts of

sigmatropic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements. Fluxional tautomerism. Ene reaction.

Books Suggested

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. A guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K.Ingold Cornell University Press.
5. Organic Chemistry, T.R. Morrison and R.N. Boyd, Prentice- Hall
6. Modern Organic Reactions,H.O. Housee, 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. Stereochemistry of Organic Compounds, P.S. New Age International.
12. Quantum chemistry by Zimmerman Academic Press.

PAPER III- PHYSICAL CHEMISTRY

Time:3 Hours **Max. Marks:100**

Unit I

(a) Quantum Chemistry

Schrodinger equation to some model systems viz., harmonic oscillator, the rigid rotor, the hydrogen atom. Applications of variation method and perturbation theory to the Helium atom.

(b) Molecular Orbital Theory

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

(c)Electrochemistry

Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations., methods of determination. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface.

Over potentials, exchange current density, derivation of Butler-Volmer equation, Tafel plot.

Biochemistry- threshold membrane phenomena, Nernst-Planck equation, electrocardiography.

Polarography theory, Ilkovic equation; half wave potential and its significance.

Introduction to corrosion - forms of corrosion

Unit II

Thermodynamics

(a) Thermodynamics Concept of fugacity and determination of fugacity. Non-ideal systems: Excess functions for non-ideal solutions: Activity, activity coefficient, Debye-Huckel theory for activity coefficient for electrolytic solution; determination of activity and activity coefficient; ionic strength.

Application of phase rule to three component system – acetic acid + chloroform + water

(b) Statistical Thermodynamics

Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulate of ensemble and averaging. Canonical, grand canonical and micro canonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers.)

Partition functions-translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Applications of partition functions.

Chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac statistics, heat capacity behaviour of solids distribution law and applications to metal in brief.

Bose-Einstein statistics-distribution law and application to helium in brief.

Unit III

A. Chemical Dynamics

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, methods of determining mechanism, isotope effects.

Dynamic chain (hydrogen-bromine reactions, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine reaction), acid base catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, flash photolysis, dynamics of unimolecular reactions (Lindermann-Hinshelwood and Rice-Ramsperger-Kassel-Marcus[RRKM] theories of unimolecular reactions).

B. Surface Chemistry

(a) Adsorption

Pressure difference across curved surface (Laplace equation), vapour pressure of droplets (kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation without derivation), catalytic activity at surfaces.

(b) 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.

(c) Macromolecules

Electrically conducting, fire resistant, liquid crystal polymers, general mechanism and kinetics of polymerization.

Books Suggested

1. Physical Chemistry, P.W. Atkins, ELBS
2. Introduction to Quantaum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N.Levine, Prentice Hall.
4. Coulson's Valance, R. McWeeny, ELBS
5. Chemical Kinetics, K.J. Laidler, Macgraw-Hill.
6. Kinetics and Mechanism of Chemical transformations, J. Rajaraman and J Kuriacoose,McMillan.
7. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum
8. Modern Electrochemistry Vol.I andVol. 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. Phase Rule by Bowden.
11. Phase Rule by Y.K. Gupta.

PAPER IV- GROUP THEORY, SPECTROSCOPY DIFFRACTION METHODS AND COMPUTER

Time:3 Hours **Max. Marks:100**

Unit I

(a) Symmetry and Group Theory in Chemistry

Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroup Conjugacy relation and classes. Point symmetry group.

(b) Raman Spectroscopy

Classical and quantum theories of Raman effect. Pure rotational ,vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle. Resonance Raman spectroscopy, coherent anti Stokes Raman spectroscopy (CARS).

(c) X-ray Diffraction

Bragg condition, Miller indices, Laue methods, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystal, 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, Ramchandran diagram.

Unit II

(a) Molecular spectroscopy: energy levels, molecular obitals, vibrational transitions, vibration progression and geometry of the excited states, Franck-Condon Principle, electronic spectra of polyatomic molecules, Emission spectra, radiative and non-radiative decay, internal conversion, spectra of transition metal complexes, charge- transfer spectra.

(b) Photoelectron Spectroscopy

Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules. ESCA, chemical information

from ESCA.

Auger electron spectroscopy-basic idea.

Photoacoustic Spectroscopy :,Basic principle of photoacoustic spectroscopy (PAS), PAS-gases and condensed systems, chemical and surface applications.

(c) Electron Spin Resonance Spectroscopy

Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron) including biological systems and to inorganic free radicals such as PH_4, F_2 and $[BH_3]$.

(d) Electron Diffraction

Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules, Low energy electron diffraction and structure of surfaces.

(e) Neutron diffraction

Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

Unit-III

(a)Introduction to Computers and Computing

Basic structure and functioning of computers with a PC as an illustrative example. Memory, I/O devices. Secondary storage. Computer language. Operating systems with DOS as an example. Introduction to UNIX and WINDOWS. Data Processing, principles of programming. Algorithms and flow-charts.

(b)Computer Programming in C

Overview of C, Constants, Variables, and Data Types, Operators and Expression, Managing Input and Output Operators, Decision Making and Branching, IF statement, IF....ELSE statement, GO TO statement, Decision Making and Looping, WHILE statement, DO statement and FOR statement, Jumps in loop.

(c)Programming in Chemistry

Development of small computer codes involving simple formulae in chemistry, such as van der WAALS EQUATION, titration, kinetics, radioactive decay. Evaluation of lattice energy and ionic radii from experimental data. Linear simultaneous equations to solve secular equations within the Huckel theory. Elementary structural features such as bond lengths.

Books Suggested

1. Modern Spectroscopy, J.M. John Wiley.
2. Applied Electron Spectroscopy for chemical Analysis Ed. H. Windawi and F.L. Ho, Wiley Interscience.
3. NMR, NQR,EPR and Mossbaur Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry, R.S. Drago, Saunders College.
5. Chemical Applications of Group Theory, F.A. Cotton

6. Introduction to Molecular Spectroscopy, R. Chang, McGraw Hill.
7. Basic Principles of Spectroscopy, R.Chang, McGraw Hill.
8. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH-Oxford.
9. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
10. Introduction to Magnetic Resonance. ,A Carrington and A.D. Carrington and A.D. Maclachalan, Harper & Row.
11. Programming in Ansi C- E. Balagursamy

PRACTICALS

Time: 12 Hours **Max. Marks-200**

(Distributed over two days)

Inorganic

A. Separation and determination of two metal ions Cu-Ni, Ni-Mg, Cu-Fe etc. involving volumetric and gravimetric methods.

B. Preparations (Any five of the following preparation)

(1) $TIO(C_9H_8NO)_2.2H_2O$
(2) cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
(3) $Na[Cr(NH_3)_2(SCN)_4]$
(4) $Mn(acac)_3$
(5) $K_3[Fe(C_2O_4)_3]$
(6) Purssian Blue, Tunbull's Blue.
(7) $Co(NH_3)_6[Co(NO_2)_6]$
(8) cis-$[Co(trien)(NO_2)_2]Cl.H_2O$
(9) $[Co(Py)_2Cl_2]$
(10) $[Ni(NH_3)_6]Cl_2$
(11) $Ni(DMG)_2$
(12) $[Cu(NH_3)_4]SO_4.H_2O$

Organic

C Qualitative Analysis
Separation, purification identification of compounds of binary mixture(two solids)

Organic Synthesis (Any five)

(i) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.
(ii) Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.
(iii) Aldol condensation: Dibenzal acetone from benzaldehyde.
(iv) Sandmeyer reaction:p- chlorotoluene from p-toluidine
(v) Cannizzaro reaction:4-Chlorobenzaldehyde as substrate.
(vi) Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.
(vii) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline.

OR

E Quantitative Analysis (Any Five)

(i) Estimation of amines/phenols using bromide solution/or acetylation method

(ii) Determination of Iodine values of an oil sample.
(iii) Determination of Acid values of an oil sample.
(iv) Determination of saponification values of an oil sample
(v) Determination of DO for a water sample.
(vi) Determination of COD for a water sample.
(vii) Determination of BOD for a water sample.

F Physical Chemistry

(Students are required to perform at least 15 experiments from the following experiments.)

1. Determination of congruent composition and temperature of a binary system (e.g. diphynylamine-benzophenone system).
2. To construct the phase diagram for three component system(e.g., chloroform-acetic acid-water).
3. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
4. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
5. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.
6. Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship(iodine ion is oxidised by persulphate ion)
7. Oscillatory reaction.
8. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
9. Determination of solubility and solubility product of sparingly soluble salts (e.g., $PbSO_4$, $BaSO_4$) conductometrically.
10. Determination of the strength of strong and weak acids in a given mixture conductometrically.
11. To study 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 mixture(DMSO,DMF, dioxane, acetone, water) and to test the validity fo Debye-Huckel-Onsager theory.
12. Determination of strengths of halides in a mixture potentiometrically.
13. Determination of the strengths of strong and weak acids in a given mixture using a potentiometer/pH meter.
14. Determination of the formation constant of silver-ammonia complex and stoichiometry of the complex potentiometrically.
15. Acid-base titration in a non-aqueous media using a pH meter
16. Determination of activity and activity coefficient of electrolytes.
17. Determination of the dissociation constant of acetic acid in DMSO,DMF, acetone and dioxane by titrating it with KOH.
18. Determination of the dissociation constant of monobasic/dibasic acid.
19. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.

20. Enzyme kinetics-inversion of sucrose.

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.Pastp, C. Johnson and M. Miller, Prentice Hall.
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D. C. Health.
5. Systematic Qualitative Organic Analysis, H. Mideleton, 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. Experiments Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

INSTRUCTIONS FOR PRACTICALS

Max. Marks: 200 **Time:12 Hours**
(Distributed over two days)

1. A board of three examinations will be constituted by appointment of two external examiners and one internal examiner.
2. Marking Scheme:

Inorganic	
(A) Qualitative Analysis	-40
(B) Preparations	-20
Organic	
(C) Qualitative Analysis	-30
(D) Organic Synthesis/Quantitative Analysis	-30
Physical	
1. One experiment is to be performed	-50
Viva	-15
Record	-15
Grand Total	-200

M.SC. FINAL

PAPER V SPECTROSCOPY, PHOTOCHEMISTRY AND SOLID STATE CHEMISTRY

Time:3 Hours **Max. Marks:100**

Unit I

(a) Application of spectroscopy

UV-Visible, IR, ^1H NMR, ^{13}C NMR, MASS-interpretation of common organic compounds.

UNIT-II

(a) Mossbauer 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^{+4} compounds- nature of M-L bond, coordination number, structure and (3) detection of oxidation state and inequivalent MB atoms.

(b) Mass Spectrometry

Introduction, ion production- EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

(c) Electronic Properties and Band Theory

Metals. insulators and semiconductors, electronic structure of solids-band theory, band structure of metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors.

Optical properties- Optical reflectance, photoconduction-photoelectric effects.

Magnetic Properties- Classification of materials: quantum theory of paramagnetic cooperative phenomena-magnetic domains, hysteresius.

UNIT-III

a. Photochemical Reactions

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

b. 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.

c. Photochemistry of Alkenes

Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions. rearrangement of 1,4- nad 1.5- dienes.

d. Photochemistry of Carbonyl Compounds

Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β,γ-unsaturated and α, β-unsaturated compounds. Cyclohexadienones. Intermolecular cycloaddition reactions-dimerisations and oxetane formation.

e. Photochemistry of aromatic Compounds

Isomerisations, additions and substitutions.

f. Miscellaneous Photochemical Reactions

Photo- Fries reactions of anilides. Photo-Fries rearrangement.

Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photo degradation of polymers. Photochemistry of vision.

Books Suggested

1. Physical Methods for Chemistry, R.S. Drago, Saunders Company.
2. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS
3. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, iley.
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, R.V. Parish, Ellis Horwood.
8. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.
9. Spectrometric identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and 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. Fundamentals of Photochemistry, K.K. Rohtagi-Mukherji, Wiley-Eastern
14. Essentials of Molecular Photochemistry, A. Gilbert and J.Baggott, Blackwell Scientific Publication.
15. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
16. Introductory Photochemistry, A.Cox and T.Camp, Mc-Graw Hill.
17. Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.
18. Organic Photochmistry, J.Coxon and B. Halton, Cambridge University Press.
19. Solid State Chemistry and its Applications, A.R. West, Plenum.
20. Principles of the Solid State, H.V. keer, Wiley Eastern.
21. Solid State Chemistry, N.B. Hannay.
22. Solid State Chemistry, D.K. Chakrabarty, Nesw Age International.

PAPER VI ENVIRONMENT AND CHEMISTRY OF LIFE

Time:3 Hours **Max. Marks:100**

Unit I

a. Air

Chemical composition of atmosphere ions and radicals and their formation chemical and photochemical reactions in atmosphere. Green house effect, acid rain, ozone hole phenomenon, thermal inversion.

Source and toxic effects of Pb, Cd, Hg, As, Cr, Ni and Mn.

b. Air Pollution

Classification of air pollutants- sources, effects and control of CO, SO_2,

NO , HC as gaseous pollutants, suspended particulate matter aerosols, photochemical air pollution.

c. Water

Water quality parameters and their analysis. purification and treatment of waste water.

d. Water Pollution

Sources of water pollution- solid waste, industrial, agricultural, oil, radioactive waste, thermal pollution classification of water pollutants- basis, effects and controls. sampling of water pollutants.

e. Soil and Soil Pollution

Brief introduction of pedagogy of soils. definition, components of soil, fertility management of soils, soil sediment analysis-physical and chemical parameters.

Soil pollution- sources, detrimental effects and control.

Unit II

(a) Metal Ions in Biological Systems

Definition and classification of metals

(b) Na^+/K^+ Pump

Role of bulk and trace metals ions in biological processes.

(c) Bioenergetics

Standards free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

(d) Cell Membrane and Transport of Ions

Ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport. Nerve conduction.

Unit III

(a) Enzymes

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis Menten kinetics and Michaelis constant, Lineweaver-Burk plots, reversible and irreversible inhibition.

(b) Mechanism of Enzyme Action

Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Example of some typical enzyme mechanisms for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A.

(c) Co-Enzyme Chemistry

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD^+, $NADP^+$,FMN, FAD, lipoic acid, vitamin B_{12}. Mechanisms of reactions catalyzed by the above cofactors.

(d) Biotechnical Application of Enzymes

Use of enzymes in food and drink industry-brewing and cheese making, syrups from corn starch, enzymes as targets for drug design, recombinant DNA technology.

Books Suggested

1. Environmental Chemistry, S.E. Mannahan, Lewis Publishers.
2. Environmental Chemistry, Sharma & Kaur, Krishna Publishers.
3. Environmental Chemistry, A.K. De, Wiley Eastern.
4. Environmental Pollution Analysis, S.M. Khopkar, Wiley Eastern.
5. Standard Method of Chemical Analysis, F.J. Welcher Vol.III Van Nostrand Reinhold Co.
6. Element Annalysis of Airborne Particles, Ed. S. Landsbergeer and M Creatchman, Gordon and Breach Science Publication.
7. Environmental Chemistry, C. Baird, W.H. Freeman.
8. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
9. Bioinorganic Chemistry, I Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
10. Inorganic Biochemistry vols I and II G.L. Eichhorn, Elsevier.
11. Progress in Inorganic Chemistry, Vols 18 and 38 ed. J.J. Luippard, Wiley.
12. Bioorganic Chemistry: A chemical Approach to Enzyme Action. Heceermann Dugas and C. Penny, Springerverlag.
13. Understanding Enzymes, Trevor Palmer, Prentice Hall.
14. Enzyme Chemistry: Impact and Applications, Ed. Collin J Suckling. Chapman and Hall.
15. Fundamental of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
16. Immbilized Enzymes: An introduction and Application in Biotechnology, Michael D. Trevan, John Wiley.
17. Enzymatic Reaction Mechanisms, C. Walsh, W.H. Freeman.
18. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.
19. Biochemistry: The Chemical reactions of Living Cells, D.E. Metzler, Academic Press.
20. Enzyme Mechanisms Ed. M.I. Page and A. Williams, Royal Society of Chemistry.
21. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
22. Biochemistry, L. Stryer, W.H. Freeman
23. Biochemistry, J. David Rawn, Neil Patterson.
24. Biochemistry, Voet and Voet, John Wiley.
25. Outline of Biochemistry, E.E. Conn and P.K. Stumpf, John Wiley.
26. Bioorganic Chemistry: A chemical Approach to Enzyme Action, H. Dugas and C. Penny, Springer-Verlag.
27. Macromolecules: Structure and Function, F. Wold, Prentice Hall.

ELECTIVE PAPERS

Time:3 Hours **Max. Marks:100**

GROUP–A

PAPER: VII-A ADVANCED INORGANIC CHEMISTRY

Unit I

(a) Alkyls and Aryls of Transition Metals

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

(b) Compounds of Transition Metal-Carbon Multiple Bonds

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

(c) Transition Metal π-Complexes

Transition Metal π-complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparations, properties, nature of bonding and structural features, Important reactions related to nucleophilic and electrophilic attack on ligands and applications in organic synthesis.

Unit II

(a) Fluxional Organometallic Compounds

Fluxionality and dynamic equilibria in compounds such as η^2- olefin, η^3-allyl and dienyl complexes

(b) Supra molecular Chemistry (Concepts and language)

(A) Molecular recognition: Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of co-receptor molecules and multiple recognition.

(B) Supra molecular reactivity and catalysis

(C) Transport processes and carrier design.

(D) Supra molecular devices- electronic, ionic and switching, supra molecular photochemistry.

Some examples of self-assembly in supra molecular chemistry.

(c) Metals In Medicine

Metals deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs.

Unit III

(a) Homogenous Catalysis

Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeigler- Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reactions), oxopalladation reactions, activation of C-H bond.

(b) Metalloenzymes and their role in biological systems

Zinc enzymes- carboxypeptidase and carbonic anhydrase. Iron enzyme-catalyses, peroxidase and cytochrome P-450. Copper enzyme- superoxide dismutase. Molybdenum oxatransferase enzyme- xanthine oxidase. Coenzyme vitamin B_{12}

(c) Metal Storage Transport and Biomineralization with reference to Ferritin, transferrin, and siderophores.

Books Suggested

1. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegdus, 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 Agee International.
5. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
6. Bioinorganic Biochemistry, I.Berttini, H.B. Gray, S.J. Valentine, University Science Books.
7. Inorganic Biochemistry vols I and II.ed. G.L. Eichhorn Elsevier.
8. Progress in Inorganic Chemistry, Vols 18 and 38 ed. J.J. Lippard, wiley
9. Supramolecular Chemistry, J.M. Lehn, VCH.

GROUP –A

Time:3 Hours **Max. Marks:100**

PAPER: VIII-A METAL COMPLEXES AND POLYMERS

Unit I

(a) Excited States of Metal Complexes

Excited states of metal complexes: comparison with organic compounds, electronically excited states of metal complexes, charge-transfer spectra, charge transfer excitations, methods for obtaining charge-transfer spectra.

(b)Redox Reactions by Excited Metal Complexes

Energy transfer under conditions of weak interaction and strong interaction-exiplex formation; conditions of the excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates (2,2'-bipyridine and 1,10 phenonthroline complexes), illustration of reducing and oxidising character of Ru(II) (bipyridal complex, comparison with Fe $(bipy)_3$; role of spin-orbit coupling-life time of these complexes. Application of redox processes of electronically excited states for catalytic purposes, transformation of low energy reactants into high energy products. chemical energy into light.

(c) Metal Complex Sensitizers

Metal complex sensitizer, electron relay, metal colloid system, semiconductor supported metal or oxide system, water photolysis, nitrogen fixation and carbon dioxide reduction.

Unit II

(a) Basics of Polymers

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 co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

(b) Polymer Characterization

Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Poly dispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscosity, light scattering, osmotic and ultra-centrifugation methods. 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. Tear resistance. Hardness and abrasion resistance.

Unit III

(a) Structure and Properties

Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structure of polymers. Morphology of crystalline polymers, strain induced morphology, crystallization and melting. Polymer structure and physical properties- crystalline melting point Tm- melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Tg-Relationship between Tm and Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

(b) Polymer Processing

Plastics, elastomers and fibers. Compounding. Processing techniques: calendaring, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fiber spinning.

(c) Properties of Commercial Polymers

Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers- Fire retarding polymers and electrically conducting polymers. Biomedical polymers- contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

Books Suggested

1. Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauder, Wiley.
2. Inorganic Photochemistry, J. Chem. Educ., vol. 60,no, 10,1983.
3. Progress in Inorganic Chemistry, vol30, ed. S.J. Lippard, Wiley.
4. Coordination Chem. Revs., 1981,vol. 39,121,131;1975,15,321;1990,97,313.
5. Photochemistry of Coordination Compounds, V. Balzari and V. Carassiti, Academic Press.
6. Elements of Inorganic Photochemistry, G.J.Ferraudi, Wiley.
7. Textbook of Polymer Science, F.W. Billmeyer Jr, Wiley.
8. Polymer Science, V.R. Gowarikar,N.V. Vuswanathan and J. Sreedhar, Wiley-Eastern.
9. Functional Monomers and Polymers, K. Takemoto, Y. Inaki and RM. Ottanbrite.
10. Contemporary Polymer Chemistry, H.R. Alcock and F.W. Lambe, Prentice Hall.

11. Physics and Chemistry of Polymers, J.M.G. Cowie, Blackie Academic and Professional.

GROUP –B

Time:3 Hours **Max. Marks:100**

PAPER: VII-B ORGANIC SYNTHESIS

Unit I

(a) Oxidation

Introduction, Different oxidative processes.

Hydrocarbons- alkenes, aromatic rings, saturated C-H groups (activated and inactivated).

Alcohols, diols, aldehydes, ketones, ketals and carboxalic acids.

Amines, hydrazines and sulphides.

(b) Reduction

Introduction. Different reductive processes.

Hydrocarbons- alkanes, alkenes, alkynes and aromatic rings.

Carbonyls compounds- aldehydes, ketones, acids and their derivatives. Epoxides.

Nitro, nitroso, azo and oxime groups.

Hydrogenolysis.

(c) Rearrangements

General mechanistic considerations- nature of migration migratory aptitude, memory effects.

A detailed study of the following rearrangements

Pinacol-pinacolone, Wagner-Meenarwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Beckmann, Hofmann, Curtius, Schemidt, Baeyer-Village, Shapiro reaction.

Unit II

(a) Organometallic Reagents

Principles, preparations, properties and applications of the following in organic synthesis with mechanistic details.

(b) Group I and II metal organic compounds

Li, Mg, Hg, Cd, Zn Compounds.

(c) Transition Metals

Cu, Pd, Ni, Fe, Co, Rh, Cr, and Ti Compounds.

(d) Synthesis of Some Complex Molecules

Application of the above in the synthesis of following compounds: Camphor, Longifoline, Cortisone, Reserpine, Vitamine D, Juvabione, Aphidicolin and Fredericamycin A.

Unit III

(a) Protecting Groups

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

(b) One Group C-C Disconnections

Alcohols and carbonyl compounds, regioselectivity. Alkene synthesis, use of

acetylenes and aliphatic nitro compounds in organic synthesis.

(c) Two Group C-C Disconnections

Diels-Alder reaction, 1,3-difunctionalised compounds. α, β-unsaturated carbonyl compounds, control in carbonyl condensations, 1,5- difunctionalised compounds. Micheal addition and Robinson annelation.

(d). Ring Synthesis

Saturated heterocycles, synthesis of 3-, 4-, 5- and 6-membered rings, aromatic heterocycles in organic synthesis.

Book Suggested

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, Pleanum Press.
6. Rodd's Chemistry of carbon Compounds, Ed.S. Coffey, Elsevier.
7. Designing Organic Synthesis, S.Warren, Wiley.
8. Organic Synthesis – Concept, methods and staring Materialos, J. Fuhrhop and G. Penzillin, Verlage VCH.
9. Some Modern Methods of Organic Synthesis. WE. Carruthers, Cambridge Univ. Press.
10. Modern Synthesis Reactions, H.O. House, W.AA. Benjamin,
11. Advanced organic Chemistry: Reactions, Mechanisms and Structure, J. March, Wiley
12. Principles of Organic Synthesis, R. Norman and J.M. Coxon, Blackie Academic & Professional.
13. Advanced Organic Chemistry Part B, F.A. Carey and R.J. Sundberg, Plenum Press.

GROUP –B

Time:3 Hours **Max. Marks:100**

PAPER: VIII-B HETEROCYCLIC AND NATURAL PRODUCTS

Unit I

(a) Nomenclature of Heterocycles

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

(b) 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, diagmagnetic susceptibility exaltations.)

Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

(c) 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.

Stereo-electronic effects- anomeric and related effects. Attractive interactions-hydrogen bonding and intermolecular nucleophilic-electrophilic interactions.

(d) Heterocyclic Synthesis

Principles of heterocyclic synthesis involving cyclization reaction and cycloaddition reactions.

(e) Small Ring Heterocycles

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

(f) Heterocyclic Systems Containing P, As, Sb and B

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

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

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

(g) Six-Membered Heterocycles with one Heteroatom

Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones.

Unit II

(a) Benzo-Fused Five-membered Hetrocycles

Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes. Meso-Ionic heterocycles

(b)Seven-and Large-membered Heterocycles

Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, diazocines, dioxocines .

(c) Six-Membered Heterocycles with Two or More heteroatoms

Synthesis and reactions of tetrazines and thiazines.

(d)Terpenoids and Carotenoids

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule.

Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol,α-Terpeneol, Menthol, Farnesol, , Santonin, Phytol, Abietic acid and β-Caritene.

(a)Alkaloids

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on

nit ɔgen heterocyclic ring, role of alkaloids in plants.

Structure, Stereochemistry, synthesis and biosynthesis of the following: ɛ,hedrine, Nicotine, Atropine, Quinine and Morphine.

Unit III

(b) Prostaglandins

Occurrence, Nomenclature, Classification, biogenesis and physiological effects. Synthesis of PGE_2 and $PGF_{2\alpha}$.

(c) 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.)

(b) Steroids

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry.

Isolation, structure determination and synthesis of Cholesterol, Bile acids, androsterone, estosterone, Estrone, Progestrone, Aldosterone.

Biosynthesis of Steroids.

(c) Plant Pigment

Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Quercetin, Myrcetin, Diadzein, Butein, Cycanidin, Hirsutidin.

Biosynthesis of flavonoids; Acetate pathway and Shikimic acid pathway.

(d) Porphyrins

Structure and synthesis of Haemoglobin and Chlorophyll.

Books Suggested

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 Heterocyclicc 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. Karitzky and C.W. Reeds,eds. Pergamon Press.
8. Natural Products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
9. Organic Chemistry,Vol 2, I.L. Finar, ELBS.
10. Stereoselective Synthesis: A practical Approach, M. nogradi, VCH.
11. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
12. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A.Marston, Harwood Academic Publishers.
13. Introduction to Flavonoids, B.A. Bohm, Harwood Academic Publishers.

14. New Trends in Natural Products Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
15. Insecticides of Natural Origin, Sukhdev, Harwood Academic Publishers.

GROUP –C

Time:3 Hours **Max. Marks:100**

PAPER: VII-C CHEMICAL DYNAMICS

Unit-I

(a) Substitutional Reactions.

Substitutional reactions. Classification of ligand substitution mechanism. Anation and base catalyzed kinetics of anation reactions. Aquation acid catalyzed kinetics of aquation reaction (octahedral complexes). Inner-sphere electron transfer reaction and mechanism. Various type of inner sphere bridges , adjustment and remote attack, linkage isomers Chemical and resonance mechanisms. Marcu's Cross relation outersphere reactions(no mathematical derivation).Its application reactions-

$Ce(IV) + Mo(CN)^{4-}_5 \rightarrow Ce(III) + Mo(CN)_6^{3-}$

$Fe(CN)_6^{3-} + Fe(CN)_6^{4-} \rightarrow Fe(CN)_6^{4-} + Fe(CN)_6^{3-}$

Bridged outer-sphere electron transfer mechanism.

Kinetics of reactions in the presence of cyclodextrines. Considering one full case study. Nucleophilic and electrophilic catalyst and their mode of action.

(b) Metal ion catalysis and induced phenomena

Metal ion catalyzed reactions, their kinetics and reaction mechanism in solutions. Induced reactions, their characteristics. Mechanism of (i) Fe(II) induced oxidation of iodine by Cr(VI).

(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. Kinetics of hydroformylation reaction.

Unit-II

(a) Atmospheric Reactions

Physical structure of the atmosphere, chemical composition of the atmosphere, Kinetics and mechanism of NOx, ClOx cycles and H_2+O_2 reaction. Mechanism of general methane oxidation. Kinetics and mechanism of low temperature oxidation of methane. Concept of global warming.

(b) Dynamics of Gas surface reaction

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

(c)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 :

application. Hole concept in the presence of semi conductor type photo catalysts. Kinetic and mechanism of electron transfer reaction in the presence of visible light. Kinetics of exchange reactions (mathematical analysis).

Unit-III

(a) Oscillatory Reactions

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

(b) Enzymes and Inhibitions

Kinetic of one enzymes- Two substrate systems and their experimental characteristics.

Enzyme inhibitors and their experimental characteristic.

Kinetics of enzyme inhibited reactions.

(c) Micelles catalysis and inhibition

Kinetics and mechanism of micelle catalyzed reactions. (I^{st} order and second order) Various type of micelle catalyzed reactions. Micelle inhibited reactions

(d)Transition State

A brief aspect of statistical mechanics and transition state their application in calculation of the second order rate constant for reaction with collision for (I) atom+(2)atom+molecule(3)+molecule reaction. Static solvent effects and thermodynamics formulations. Advanced electron transfer reactions, energy surfaces.

Recommended Books

1. progress in Inorganic Chemistry, Vol30, 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 ChemistryVol.2 Ed. Prof. Ya Grasimov, Mir Publisher.
7. Basolo and pearson, Inorganic Reaction Mechanism, Wiley.
8. H. Taube, Electron Transfer Reaction, Oxford Press.

GROUP –C

Time:3 Hours **Max. Marks:100**

PAPER: VIII-C ELECTROCHEMISTRY

Unit I

(a)Conversion and storage of Electrochemical Energy :

Present status of energy consumption: Pollution problem. History of fuel cells. Direct energy conversion by electrochemical means. Maximum intrinsic efficiency of an electrochemical converter. Physical interpretation of the Carnot efficiency factor in electrochemical energy convertors. Power outputs.

Electrochemical Generators (Fuel Cells)Hydrogen oxygen cells, hydrogen Air cell, Hydrocarbon air cell, alkaline fuel cell, phosphoric and fuel cell,

direct NaOH fuel cells. applications of fuel cells.

(b)Electrochemical Energy Storage:

Properties of Electrochemical energy stores: 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 Hydride, (iii) Lithium Battery.

Future electricity stores: storage in (i) Hydrogen, (ii)alkali Metals,(iii) Non aqueous solutions.

Unit II

(a)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) Diaphragms, uses and abuses, Corrosion current and corrosion potential-Evans diagrams.

Measurement of corrosion rate : (i) Weight Loss Method (ii) Electrochemical Method

Inhibiting Corrosion: Cathodic and Anodic protection (i) Inhibition by addition of substrates to the electrolyte environment (ii) by charging the corroding method from external source, anodic protection, organic inhibitors, The fuller'story green inhibitors.

(b)Passivation:

Structure of passivation films. Mechanism of Passivation, Spontaneous Passivation: nature's method for stabilizing surfaces.

(c)Kinetics of Electrode Process

Essential of electrode reaction. Current Density Overpotential . Butler Volumer equation. Standard rate constant . Transfer coefficient (α), exchange Current.

(d)Irreversible Electrode Processes: Criteria of irreversible information from irreversible wave.

Methods of determining kinetic parameters for quasi-reversible and irreversible waves: Koutecky's method, Meits Israel methods, Gelling's method.

Unit -III

(a) Bioelectrochemistry: Bioelectrodies, membrane, potentials , simplistic theory, modern theory. Electrical conductance in biological organism. Electronic, protonic electrochemical mechanism of nervous systems, enzymes as electrodes.

(b)Electro catalysis:

Chemical catalysis and Electrochemical catalysis with special reference to purostates (porphyrin oxides of rare earths. Electro catalysis in simple redox reactions, in reaction involved adsorbed species, Influence of various parameters.

(c)Potential Sweep Method:

Linear sweep Voltammetry, Cyclic Voltammetry, theory and applications, Diagnostic criteria of cyclic voltammetry. Controlled current microelectrode

technique. comparison with controlled potential methods. Chronopotentiometry: theory and applications.

(d)Bulk Electrolysis Methods

Controlled potential coulometry, Controlled Coulometry. Electro organic synthesis and its importance application, stripping analysis. anodic and cathodic modes, pre electrolysis and stripping steps, applications of stripping analysis.

Reference:

1. Modern Electrochemistry vol. I, IIA Vol. IIB, J'OM Bockris and A.K.N. Peddy, Plenum Publication, NewYork
2. Polarographic Techniques by L. Meites, Interscience.
3. 'Fuel Cells; Their electrochemistry' McGraw Hiss Book Company New York.
4. Modern Polarographic Methods by A.M. Bond, Marcell Dekker.
5. Polarographyand allied technique by K. Zutshi., New Age Publication, New Delhi.
6. "Electrianalytical Chemistry" by Basil H. Vessor & Galen W. Wiley Interscience.
7. Electroanalytical Chemistry by Basil H. Vessor & Galen W. Wiley Interscience.
8. Topic in Pure and Applied Chemistry. Ed. S.K. Rangrajan, SAEST publication, Karaikudi (India)

GROUP-D

VII d : Forensic chemistry and toxicology:
VIII d : Methods of instrumental analysis
VII d: Forensic chemistry and toxicology: Max.. Marks :100 Time:3 Hrs.

Unit I

Important components of forensic lab

Proteins –Definition, classification, General Properties - molecular weight, denaturation, isoelectric point, coagulation of proteins, salting in and salting out of proteins & Reactions.

Nucleic acids – chemistry of purines, pyrimidine and uric acid – synthesis and uses of uracil, cytosine, thymine, adenine, guanine- isolation of caffeine from its natural source- constitution of RNA and DNA, DNA profiling, DNA finger printing.

Vitamins - Definition, occurrence, Properties and Types with special reference to Vitamins A and B.

Hormones – Definition, types, biological Activities of Pituitary, Thyroid and Sex Hormones.

Blood – General Composition and Antigenic Properties, Blood Coagulation. Preliminary idea of Antigen, Antibody and Immunological Principle. Structure of Antibodies. Forensic identification and grouping of Blood Stains

Unit II

Identification & estimation of following narcotics – Opium, Morphine, Heroine, barbiturates, cocaine, diazepam

Introduction to body as a whole: the various body systems and organs

Injuries from burn, scald, lightning, electricity; Ante mortem and post mortem burn; Injuries on road, air crash, explosion; Wound- definition, types and classification, medicological importance. Ante and post mortem wounds, Self inflicted wounds.

Alcohol & alcoholic beverages – manufacture of ethanol and liquors-Chemical Properties and identification of alcohol, constituents of liquors- estimation of alcohol content in liquors-denaturation, denaturants, industrial alcohol and power alcohol, breath alcohol analysis, Analysis of Alcohol in Blood and Urine Samples.

Drug action and effect – Isolation, synthesis and estimation of alkaloids, drug dose relationship, mechanism of drug action. Absorption, distribution and elimination.

Unit III

Elementary knowledge of human skeleton. Importance of Anthropometry in Forensic Science. Determination of Height from Bones. Determination of sex from bones. Age determination from cranium and other body bones. Identification of deceased by super imposition of skull. Identification of species by small bone fragments. Forensic odontology. Forensic Examination of semen stains. Teeth- identification, type, functions, determination of species origin and race from teeth, individualization from teeth and bite marks.

Definition and general introduction to toxicology, poisons- types, mode of action, extraction of poisons in toxicological analysis. Absorption, distribution, metabolism, chemistry of poisons, excretion of poisons. Detection and estimation of CO, Cyanide, formaldehyde, methanol, chloral, chloroform,, phenols, cresols, phosphorus, As, Hg. Pb, and Cd, organophosphorus, organochlorine and carbamate pesticides and pyrethrenoids, corrosive poisons. Elementary knowledge of Food poisoning.

VIII D: METHODS OF INSTRUMENTAL ANALYSIS

Max.. Marks :100 **Time:3 Hrs.**

Unit I

(a) Electron microscopy- principle, instrumental components, transmission electron microscopy, preparation of sample with special reference to biological tissue, applications.

Scanning electron microscopy- principle, electron specimen interactions, instrumental components, preparation of samples, applications.

Inductively coupled plasma atomic emission spectroscopy (ICPAES) – Principles and instrumentation

(b) Principle, instrumentation and applications of:

Gas Chromatography

High performance liquid chromatography

Ion exchange chromatography

Thin layer chromatography and its applications to organochlorine compounds

Electrophoresis- paper electrophoresis, low voltage electrophoresis, thin

layer electrophoresis, gel electrophoresis and immuno electrophoresis.

Unit II

(a) Principal, instrumentation. applications of:
Atomic absorption spectrophotometry (AAS)
X-ray fluorescence spectrometry (XRF)
Radio Immuno Assay (RIA)
Neutron Activation analysis (NAA)

(b) Thermal methods- principle, instrumentation and applications of Thermogravimetry (TGA), differential thermal analysis (DTA) and differential scanning calorimetry (DSC).

Optical methods- principle, instrumentation and applications of refractometry, polarimetry, nephelometry and turbidimetry colorimetry.

Unit III

Determination of blood group, HDA system and red cell isoenzymes and serum protein in paternity determination, ABO blood group system and MNS group system. Laboratory examination of semen stain, saliva stain, urine stain, flower stains for pollen grains, stains of fruits and vegetables.

Physical analysis of the following:

Food analysis and food adulteration- Analysis of major and minor components of food, common adulterants in food, microscopic examination of foods for adulteration, pesticide analysis in food products.

Elements of statistics- mean, mode, median, correlation and regression analysis, null hypothesis, variance, t-test, chi- square test.

PRACTICALS

Max.Marks:200 **Time:12 Hours**
(Including 25 marks for seminar) **(Distributed over two days)**
For elective group A, B and C
Inorganic Chemistry

A. Preparation (Any Seven)

1. Sodium amide. Inorg.Synth., 1946,2,128.
2. Synthesis and thermal analysis of Group II metal oxalate hydrate. J. Chem. Ed., 1988,65,1024.
3. Atomic absorption analysis of Mg and Ca.
4. Trialkoxyboranes-Preparation, IR and NMR spectra.
5. $PhBCl_2$ dichlorophenylborane-Synthesis in vaccum line.
6. Preparation of Tin(IV) Iodine, Tin (IV) chloride and Tin (II) iodide. Inorg. Synth.,1953,4,119.
7. Relative stability of Tin(IV) and Pb(IV). Preparation of ammonium hexachlorostannate $(NH_4)SnCl_6$.ammonium hexachloroplumbate $(NH_4)PbCl_6$
8. Hexa-bis (4-Nitrophenoxy) cyclotriphosphazene.
9. Synthesis of trichlorodiophenylantimony(V) hydrate. Inorg. Synth.,1985,23,194.
10. Sodium tetrathionate $Na_2S_4O_6$.
11. Metal complexes of dimethyl sulfoxide(IR): $CuCl_2.2DMSO$ $PbCl_2.2DMSO$.

$RuCl_2.4DMSO$.J.Chem. Educ., 1982,59,57.

12. Synthesis of acetylacetonate: Magnetic moment, IR, NMR. Inorg. Synth, 1957,5,130; 1963,1.183.
13. Bromination of $Cr(acac)_2$. J.Chem. Edu..1986, 63, 90.
14. Magnetic moment of $Cu(acac)_2H_2O$.
15. Cis and Trans $[Co(en)_2Cl_2]^+$.
16. Separation of optical isomer of cis-$[Co(en)_2Cl_2]Cl$. J. Chem. Soc., 1960,4369.
17. Ion exchange separation of oxidation state of vanadium. J. Chem. Educ., 1980,57,316;1975,55,55.
18. Determination of Cr(III) complexes. $[Cr(H_2O)_6NO_3.3H_2O$, $[Cr(H_2O)_4Cl_2]Cl.2H_2O$, $[Cr(en)_3]Cl_3$, $C_r(acac)_3$. Inorg. Synth.,1972,13,184.
19. Preparation of N, N bis(salicyldehyde) ethylenediamine, salen H_2, Co(salen) J. Chem. Educ., 1977, 54, 443; 1973, 50, 670.

Determination of O_2absorption by Co(salen) Acct. Chem. Res., 1975, 8, 384. Reaction of oxygen adduct with $CHCl_3$(deoxygenation).

20. Preparation of Fe(II), chloride (use it as Friedel-Craft chlorination source. J. Org. Chem. 1978,43,2423;J.Chem. Edu.,1984,61,645;1986,63,361.
21. Reaction of Cr (III) with a multidentate ligand: a kinetics experiments (visible spectra Cr-EDTA complex) J.A.C.S., 1953,75,5670.
22. Preparation of [Co(phenonthroline-5,6-quinone.]
23. Preparation and use of Ferrocene.
J.Chem.Edu,1966,43.73;1976,53,730
24. Preparation of copper glycine complex-cis and trans bis (glycinato Copper (II). J. Chem .Soc. dalton,1979,1901. J.Chem Edu. 1982,59,1052.
25. Preparation of Phosphine Ph_3P and its transition metal complexes.
26. Conversion of p-xylene to terephthalic acid catalyzed by $CoBr_2$(homogeneous catalysis)

B. Spectrophotometric Determination (Any Three)

a. Manganese/Chromium/ Vanadium in steel sample
b. Nickel/molybdenium/tungston/ vanadium/uranium by extractive spectrophotometric method.
c. Fluoride/ nitrite/ phosphate
d. Iron-phenanthroline complex: Job's Method of continuous variations.
e. Zirconium-Alizarin Red-S complex: Mole-ratio method.
f. Copper-Ethylene diamine complex: Slope-ratio method.

OR

C. Flame Photometric Determinations(Any Three)

a. Sodium and potassium when present together
b. Lithium/ calcium/barium/ strontium
c. Cadmium and magnesium in tap water
d. Sulphate
e. Phosphate
f. Silver

OR

D. Chromatographic Separations (Any Three)

a. Cadmium and Zinc

b. Zinc and Magnesium
c. Thin-layer chromatography-separation of nickel. manganese. cobalt and zinc. Determination of R_f values.
d. 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.

Organic Chemistry

Qualitative Analysis

E Separation, purification and identification of the components of mixture of three organic compounds (three solids or two liquids and one solid, two solids and one liquid) using TLC for checking the purity of the separated compounds, chemical analysis.

F Multi-Step Synthesis of Organic Compounds (any four)

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

(i) Photochemical reaction
Bebzophenone → benzpinacol → benzpinacolone
(ii) Beckmann rearrangement: benzanilide from benzene
Benzene → Benzophenone → Benzophenone oxime → Benzanilide
(iii) Benzilic acid rearrangement : Benxilic acid from benzoin
Benzoin → Benzil → Benzilic acid
(iv) Synthesis of heterocyclic compounds
Skraup synthesis: preparation of quinoline from aniline Fisher-Indole synthesis : Preparation of 2- phynylindole from phenylhydrzine.
(v) Enzymatic synthesis
enzymatic reduction: Reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S(+) ethyl-3-hydroxybutanoate and determine is optical purity.
(vi) Biosynthesis of ethanol from sucrose
(vii) Synthesis using microwaves
Alkylation of diethyl malonate with benzyl chloride.
(viii) Synthesis using phase transfer catalyst
(ix) Alkylation of diethyl malonate or ethyl acetoacetate with an alkyl halide

OR

G Extraction of Organic Compounds from Natural Source (Any Five)

1. Isolation of caffeine from tea leaves.
2. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins)
3. Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported.)
4. Isolation of nicotine dipicrate from tobacco.
5. Isolation of cinchonine from cinchona bark.
6. Isolation of piperine from black pepper.
7. Isolation of lycopene from tomatoes.
8. Isolation of β-carotene from carrots.
9. Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid.
10. Isolation of eugenol from cloves.
11. Isolation of (+) limonine from citrus rinds.

H. Spectroscopy

Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR)

OR

I Spectrophotometric (UV/VIS) Estimations (Any Three)

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

Physical Chemistry/ Electronics

J. Number of hours for each experiment: 3-4 hours. Students are required to perform at least ten experiments.

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 intermolecular 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) aquesous and (b) micellar media
4. Determination of stoichiometry and stability constant of inorganic (e.g. feric-salicyclic acid) and organic (e.g. amine-iodine) complexes.
5. Characterization of the complexes by electronic and IR spectral data.
6. Estimation of Pb^{+2} and Cd^{2+}/Zn^{2+} and Ni^{2+} by polarography.
7. Determination of dissolved oxygen in aquesous solution of organic solvents.
8. Measurements of resistance with multimeter.
9. To measure the resistance of the given ameter.
10. Voltage measurement with CRO.
11. Familiarizing with CRO
12. Use of a Wheatstone Bridge for accurate measurement of resistance
13. Capacitor as a charge storage device.
14. To study the behaviour of parallel charged capacitors in series charged capacitors placed in parallel.
15. The use of LCR Bridge.
16. Response characteristics of RC network.
17. Response characteristics of LR network.
18. Response characteristics of LCR network.
19. Verification of Kirchoff's law.
20. To study the Lissajou's figures

21. Measurement of e.m.f. with thermocouple.
22. To plot the characteristic curve of a diode.
23. Half-wave and full-wave rectifier.
24. Clipping and clamping circuits.
25. Capacitor filter for full-wave rectifier.
26. Voltage doubler, Zener stablized bipolar power supply.
27. Transistor characteristics
28. Differential amplifier.
29. Transistor amplifier.
30. Introduction of an operational amplifier as voltage follower.
31. Op-Amp as non-inverting and inverting amplifier.
32. Simple integration differentiation with Op-Amp 741.
33. Op-Amp as comparator.
34. Designing and fabrication of printed circuit board.
35. Setting up of a thermostat: Constant temperature bath.
36. Four-probe method for resistivity measurement.

Books suggested

1. Inorganic Experiments, J. Derek Woollins, VCH.
2. Microscale Inorganic Chemistry, Z. Sqafran, R.M. Pike and M.M. Singh, Wiley.
3. Practical Inorganic Chemistry, GMarr and B.W. Rockelt, Van Nostrand.
4. The Systematic Identification of Organic Compounds, R.L. Shriner and D.Y. Cutin.
5. Semimicro Qualitative Organic Analysis, N.D. Cheronis, J.B. Entrikin and E.M. Hodnett.
6. Experimental Organic Chemistry, M.P. Doyle and W.S. Mungall
7. Small scale Organic Preparations, P. J. Hill.
8. Organometallic Synthesis, J.J. Fisch and R.B. king, Academic.
9. Experimental Physical Chemistry, D.P. Shoemaker, C.W. Garland and J.W. Niber, McGraw Hill Interscience.
10. Findlay's Practical Physical Chemistry, revised B.P. Levitt, longman
11. Experiments in Physical Chemistry, J. C. Ghosh, Bharti Bhavan.

Instructions for Laboratory Course

1. A board of examiners will be constituted by appointment of two external examiners and one internal examiner.
2. The time for examinations will be 12 hours distributed over tow days.
3. Distribution of Marks:

Inorganic:

(a) preparation (one)-20
(b) Photometric determination/flame photometric determination/ chromatography (any One)-30

Organic

(a) Qualitative Analysis-25
(b) Multi step synthesis/ extraction of organic compounds (any one)-15
(c) Spectroscopy/photometric estimation (one)-15

Physical / Electronics

Maximum two exercise may be assigned keeping in view the time i.e. 3-4 **hours** for completion of experiments.-40

Viva	-20
Record	-10
Seminars	-25
Grand Total	-200

Note: Head of the Department will award the Seminar marks and will handover it to the board of examiners.

PRACTICALS (FOR ELECTIVE GROUP D)

A. Microscopic and forensic examination (Any five)

1. Microscopical examination of hair: - measurement of medullary index, hair index, scale count, etc.
2. Microscopical and chemical examination of some fibers.
2. Microscopical examination of the cell and diatoms.
3. Microscopical examination of wood, pollen grains.
4. Drawing and identification of the skull and other body bones.
5. Determination of height of an individual by the measurements of long bones.
6. Determination of the sex of a person by the examination of bones.
7. Determination of age of the person by the bones.
8. Some anthropological measurements of head length and width, cephalic index, measurement of height, measurements of arm span, measurements of upper limbs and lower limbs.
9. Examination of blood sample: preliminary colour test, crystal test and species determination.
10. Determination of ABC blood group.
11. Electrophoretic of some polymorphic blood enzymes PGM, EAP, AK, Esterase D and Haetoglobin (Hb).
12. Laboratory examination of semen stain: preliminary test, crystal sperm identification and its staining, acid phosphate test.
13. Laboratory examination of urine stain.
14. Laboratory examination of saliva stain.
15. Forensic examination of hair: - measurement of medullary index hair index, scale count.
16. Forensic examination of some fibers: - microscopical & chemical tests.
17. Comparison of tool marks by comparison microscope.
18. Spottings of forensic specimens.

B. Qualitative Analysis (Any five)

1. Identification of some ink by paper chromatography and TLC.
2. Identification of some alkaloids by infra red spectrophotometer.
3. Identification of some plastic packaging films by infra red spectrophotometer
4. Identification of some alkaloids by TLC.
5. Identification of some insecticides and pesticides by TLC.
6. Identification of some barbiturates by TLC

7. Identification of amino acids, sugars. drugs by paper chromatography and TLC.
8. Identification of pesticides, vegetable poisons from biospecimen by Spot test.
9. Identification of pesticides, opium and morphine.
10. Identification of ganja.
11 TLC of dyes pigments and inks.
11. Identification of trace elements in paint samples- spectrographic method.
12. Colour reactions of amino acids – qualitative analysis of amino acid.
13. Preparation of Lactose from milk.
14. Preparation of Casein from milk.
15. Preparation of caffeine from tea leaves.
16. Preparation of cystine from human hair.
17. Preparation of D (+) glucose from cane sugar.
18. Preparation of Hippuric acid from urine.
19. Qualitative Analysis of compounds containing purine group.
20. Qualitative Analysis of Alkaloids.

C. Quantitative Analysis (Any five)

1. Determination of concentration of liquid by colorimeter.
2. Determination of pH of given acid/base/buffer.
3. Estimation of morphine by colorimetry.
4. Estimation of methyl alcohol by colorimetry.
5. Examination of plastic pieces and glass pieces for physical fit.
6. Spectrographic analysis of Cu, Fe, Zn and Al.
7. Determination of Cu and Ni- electro gravimetric method.
8. Wavelength calibration of UV- VIS spectrophotometer.
9. Spectrophotometric determin ition of cobalt- UV-VIS spectrophotometer/ spectronic 20.
10. Estimation of total reducing sugars in molasses.
11. Qualitative analysis of opium and the estimation of morphine content.
12. Quantitative estimation of carbohydrates, proteins, non-protein nitrogen, lipids, etc.
13. Estimation of lead in blood and urine by dithiozone methods.
14. Estimation of copper in viscera.
15. Estimation of As, Hg (macro and micro methods).
16. Determination of blood alcohol by various methods.
17. Determination of methyl alcohol in biological tissue.
18. Assay of chloral hydrate.
19. Estimation of cyanide.
20. Use of pH meter- preparation of buffer of forensic biochemical relevance.
21. Colorimetric estimation of glucose, urea, creatinine and cholesterol.
22. Estimation of protein by Folin-Ciocalteau and biuret methods.
23. UV-VIS spectrophotometry of ink examination.
24. Estimation of glucose.
25. Estimation of glycine.
26. Determination of Iodine value of fat.

Determination of Iodine value of oil.
Determination of Acid value of fat.
Determination of Acid value of oil.
Determination of Rancidity of oil sample.
Separation and Identification (Any five)

1. **Separation and identification of volatile organic solvent from the mixture of liquids by distillation method.**
2. **Separation and identification of none volatile organic solvents from urine sample.**
   Solvents: methyl alcohol, ethyl alcohol, chloroform, diethyl ether, carbon tetra chloride, acetone, benzene, etc.
3. **Separation and identification of acidic and neutral volatile poisons from urine sample by steam distillation. Volatile poisons: chloral hydrate, phenol.**
4. **Separation and identification of some basic volatile poisons from urine sample by steam distillation method. E.g. amphotamine, nicotine, ephedrine etc.**
5. **Identification of some metallic poisons by colour/ spot/crystal/tests: - As,Sb, Cu, Ag, Pb, Hg, Fe, Co, Ni, Cr, Cd, etc.**
6. **Identification of some anions by colour/chemical tests: - sulphate, sulphide, nitrate, nitrite, carbonate, chloride, bromide, iodide, etc.**
7. **Identification of soil by density gradient tube method.**
8. **Separation and estimation of a mixture containing ethanol, methanol and isopropanol using gas chromatography.**
9. **Qualitative analysis of opium and the estimation of morphine content.**
10. **Qualitative and quantitative analysis of ganja.**
11. **Separation, purification and identification of compounds of ternary mixtures (three solids) using chemical tests.**

BOOKS SUGGESTED FOR ELECTIVE GROUP 'D'

1.	V K Sharma	Instrumental methods of Chemical Analysis
2.	Skoog	Principles of Instrumental Analysis
3.	Ewing	Instrumental methods of Chemical Analysis
4.	H E Thomas	Hand Book of Pharmaceutical and Clinical Measurements and Analysis
5.	G H Morrison	Trace Analysis-Physical Methods
6.	Krishnan	An Introduction to Modern Criminal Investigation
7.	Willard, merrit & Astin	Instrumental methods of Analysis
8.	B K Sharma	Instrumental methods of Chemical Analysis
9.	S N Tiwari	Monograph on Toxicology
10.	Shram J D	Vidhi Vigyan and Vish Vigyan
11.	Remington	Text Book of pharmaceutical Science
12.	Clark	Toxicology
13.	Welcher	Standard Methods of Chemical Analysis
14.	Gliaster	Medical Jurisprudence and Toxicology

15. Curry — Forensic Science Vol. 4
16. Keith Simpson & Bernard — Forensic Medicine
17. Alan Curry — Poison detection in Human Organ
18. O P Agrwal — Chemistry of Organic Natural Products Vol. I and II
19. Hawk — Physiological Chemistry
20. Morrison and Boyd — Organic Chemistry
21. S N Tiwari — Manual on Toxicological Analysis
22. Culliford — Manual on Examination of Blood Stains
23. Stryer — Bio-Chemistry
24. Taylor — Medical Jurisprudence
25. Parikh — Chikitsa Nyaya Shastra Aur Vish Vigyan (Hindi)
26. C C Chaterji — Human Physiology
27. Ross & Wilson — Foundations of Anatomy and Physiology
28. Krognaman — The Human Skeleton in Forensic Medicine
29. Surandernath — An Introduction to Forensic Anthropology
30. Tedeschi, etc. — Forensic Medicine Vol. I, II, III
31. Nandi — Forensic Medicine
32. E J Gardner, M J Simmons — Principles of Genetics (John Wiley, New York) and D P Snustad
33. Thaddeus Mann — The Biochemistry of Semen and of the Male Reproductive Tract (Methuen & Co. Ltd: London)
34. P L Williams and — Gray's anatomy (Churchill Livingstone. London) R Warwick
35. Metropolitan Police — Forensic Science Laboratory, London: Biology Methods Manual
36. N G Dey & T K Dey — Medical bacteriology (Allied Agency, Calcutta)
37. Brain Lane — The Encyclopedia of forensic science (Headline; London)
38. Richard Saferstein — Criminalistics: An introduction to forensic science (5th Edn. Prentice Hall, Englewood Cliffs, New Jersey)
39. C E O'Hara and G L O'Hara — Fundamentals of criminal investigation (6th Edn. Charles C Thomas. Springfield, Illinois)
40. B S Nabar — Forensic Science (SVP National Police Academy, Hyderabad)
41. R Safferstein — Forensic Science Hand book Vol. I, II, III (Prentice Hall, Englewood Cliffs, New Jersey)
42. A S Curry — Methods of forensic science Vol III (Interscience Publisher, London)
43. C G G Aitken and D A Stoney — The use of statistics in forensic science(Ellis Horwood Ltd, New York)
44. B R Sharma — Forensic science in criminal investigation and trials (Central Law Agency, Allahabad)

45. L Zechmeister and L Cholnoky — Principles and practices of chromatography (Chapman & Hall, London)
46. R E Dodd — Chemical Spectroscopy (Elsevier, Amsterdam)
47. Willard, H Hobart et al — Instrumental methods of Analysis (CBS Pblishers, Delhi)
48. Wischnitzer, Saul — Introduction to Electron Microscopy (Pergamon Press, New York)
49. G H Jeffery, et al — Vogel's Textbook of Quantitative Chemical Analysis (5th Edn. Wesley Longman, Singapore)
50. Christian, D Gray and Feldman — Atomic Absorption Spectroscopy (Wiley Interscience, New York)
51. A B Littlewood — Gas Chromatography: Principles, Techniques and Applications (Academic Press, New York)
52. Welcher, J Frank — Standard methods of chemical analysis (6th Edn, Vol 3, Part A, Robert E Krieger Publishing Co. New York)
53. G Chatwal & S Anand — Instrumental methods of Chemical Analysis (Himalaya Publishing House, Bombay)
54. Lawes, Grahame — Microscopy and X-Ray Micro-analysis (John wiley, Chichester)
55. Ewing, Glalenwood — Analytical Instrumentation Hand Book, 2nd rev. ed. (Marcel dekker, New York)
56. Ganel, L Barbra — Biological Electron Microscopy (Van Nostrand Reinhold Co., New York)
57. Reimer and Ludwig — Scanning Electron Microscopy: Physics of image formation and microanalysis (Springer-Veriag. Berlin)
58. Frank M Biffen and William Seaman — Modern Instruments in Chemical Analysis (Mc Graw Hill, New York)
59. Gerald W King — Spectroscopy and Molecular Structure (Holt Rine Hart and Wiinston, New York)
60. K Kackschalger — Errors, Measurements & Result in Chemical Analysis (Van Nostrand Reinhold, London)
61. J Bassett, et al — Vogel's Text Book of Quantitative Inorganic Analysis (4th Edn. Longmans Essex)
62. Iras Lurie and John D Wittor Jr — High Performance Liquid Chromatography in Forensic Chemistry
63. G L Gooberman — Ultrasonics- Theory and applications (English University Press, London)
64. David M, Mercules — Fluorescence and Phosphorescence Analysis-Principle and Applications (Interscience Publishers, New York)
65. H Ward Smith — Methods of determining alcohol in methods of forensic science Vol. IV (Interscience Publishers. New York)

66.	I C Garret	The quantitative analysis of drugs (Chapman and Hall)
67.	F D Smell & F D Biffen	Commercial methods of analysis 2nd Edn. (Chemical Pub. Co. Inc)
68.	John Steward Remington	The Paint-Laboratory Note book (Leonard Hill Ltd.)
69.	R S Drago	Physical methods of inorganic chemistry (Reinhold Pub.)
70.	D G Peters et al	Chemical Separation and Measurements (Sauders Co.)
71.	G W Himus	Fuel Testing (Leonard Hill)
72.	F Fiegl and V Anger	Spot Tests in Organic Analysis (Elsevier, Amsterdam)
73.	F Fiegl and V Anger	Spot Tests in Inorganic Analysis (Elsevier, Amsterdam)
74.	Snell & Snell	Colorimetric Method of Analysis (Van Nortland)
75.	N D Cheronis et al	Identification of organic compounds using semi micro techniques (Wiley)
76.	Erich Leschle	Clinical Toxicology (J A Churchill, London)
77.	C J Polson and R Tattesall	Clinical Toxicology (English University Press, London)
78.	A Looms	Essentials of Toxicology (Less & Febiger, Philadelphia)
79.	William H Warren	Laboratory manual for the detection of poisons and powerful drugs (P Blakiston's Son & Co., Philadelphia)
80.	C P Stewart and Stolman	Toxicology-Mechanisms and Analytical Methods Vol. I & II (Academic Press, New York)
81.	Franck Bamford	Poisons-Their Isolation and Identification (J A Churchill, London)
82.	Irving Sunshine et al	Guideline for Analytical Toxicology Programs Vol. I (CRC Press)
83.	Alan Curry	Poison Detection in Human Organs (Charles C Thomas)
84.	F Lundgist et al	Methods in Forensic Science (Vol I to IV, Interscience Publishers, New York)
85.	A Stolman	Progress in Chemical Toxicology Vol. I, II (Academic Press, New York)
86.	M J Pelczar, E C S Reid	Microbiology V Edn (Tata McGraw Hill Publishing & Chan Co., New Delhi)
87.	Stites D P et al	Basic & Clinical Immunology 5th Edn (Lange Medical Publications, Losatios)