POST GRADUATE PROGRAMME

1. At each of the Previous and Final Year Examination in a subject, a candidate must obtain for a pass (i) at least 36 % marks of the aggregate marks in all the papers prescribed at the examination, and (ii) atleast 36% marks in practical, wherever prescribed, at the examination; provided that if a candidate fails to secure 25% marks in each individual paper of theory at any of the examination and also in the Dissertation; wherever prescribed, he/she shall be deemed to have failed at the examination, notwithstanding his/her having obtained the minimum percentage of marks required in the aggregate for the examination. Division will be awarded at the end of the Final Examination of the combined marks obtained at the Previous and the Final Examinations taken together as noted below. No Division will be awarded at the Previous Examination.

First Division	: 60 Percent	of the total aggregate
Second Division	: 48 Percent	marks of Previous and
Third Division	: 36 Percent	Final year taken together

Note : The candidate is required to pass separately in theory and practicals.

2. Dissertation may be offered by regular students only in lieu of one paper of Final Year Examination as prescribed in the syllabus of the subject concerned. Only such candidates will be permitted to offer dissertation who have secured atleast 50% marks in the aggregate at the previous examination.

Note: Dissertation shall be type-written and shall be submitted in triplicate, so as to reach the Controller of Examinations atleast two weeks before the commencement of Examination.

3. There shall be atleast eight theory in Post-Graduate Examination, 4 in Previous and 4 in Final year examinations of 100 marks each unless and otherwise prescribed. The non-credit papers wherever prescribed will remain as such. The marks of these non-credit papers will not be counted for division but passing in the same is compulsory.

4. Each theory paper will be of three hours duration.

5. Wherever practicals are prescribed the scheme will be included in the syllabus.

6. A candidate who has completed a regular course of study for one academic year and Passed M.A. / M.Sc./ M.Com. Previous Examination of the university shall be admitted to the Final Year

Examination for the degree of Master of Arts / Master Of Science / Master of Commerce provided that he / she has passed in atleast 50% of the papers at the previous examination by obtaining atleast 36% marks in each such paper.

(a) For reckoning 50% of the papers at the previous examination, practical will be included and one practical will be counted as one paper.

(b) Where the number of papers prescribed at the previous examination is an odd number it shall be increased by one for the purpose of reckoning 50% of the paper.

(c) Where a candidate fails for want of securing minimum aggregate marks but secured 36% marks in atleast 50% of the papers, he/she will be exempted from re-appearing in those papers in which he/she has secured 36% marks.

(d) Where the candidate secures requisite minimum percentage in the aggregate of all the papers but fails for want of the requisite minimum percentage of marks prescribed for each individuals paper he/she shall be exempted from re-appearing in such paper (s) in which he / she has secured atleast 25% marks.

7. A candidate who has declared fail at the Final Year Examination for the degree of Master of Science / Arts, Commerce shall be exempted

from re-appearing in a subsequent year in the following papers :

(a) Where a candidate fails for want of securing the minimum percentage in the aggregate marks, he/she shall be exempted from re-appearing in such paper (s) Practical (s). Dissertation in which he/she has secured atleast 36% marks; provided he/she is passing in atleast 55% of the papers. (Here passing in each paper requires 36% marks).

(b) Where a candidate secures the minimum requisite including dissertation wherever prescribed but fails for want of minimum percentage of marks prescribed for in each individual paper / dissertation, he / she shall be exempted from reappearing in such paper (s) dissertation in which he/she has secured atleast 25% marks provided he/she is passing in atleast 50% of the paper (here passing in each paper requires 25% marks)

M.Sc. (PREVIOUS) CHEMISTRY, 2004-2005

The examination shall consist of four theory papers and one practical.

Paper & Course		Hrs/week	M. Marks
Paper-I	Inorganic Chemistry	4	100
Paper-II	Organic Chemistry	4	100
Paper-III	Physical chemistry	4	100
Paper-IV	Recent Trends in Chemistry	4	100
Practicals (Three groups) 18 (per group)			**200**

PAPER-I
INORGANIC CHEMISTRY

Time : 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

Metal ligand bonding - Limitations of CFT, Ligand field theory, MOT-octahedral, tetrahedral and square planar complexes, MO theory & π-bonding, correlation (Walsh diagrams) dπ - pπ bonding.

Electronic spectra of transition metal complexes- Spectroscopic ground states, Orgel and Tanabe - Sugano diagram (d^1 to d^9 states), calculation of Dq, B and b parameters, charge transfer spectra

UNIT-II

Metal π- complexes - I – Carbonyls, structure and bonding, use of vibrational spectra of metal carbonyls for bonding and structure elucidation, types of carbonyls, their preparations and important reactions.

UNIT-III

Metal π- complexes - II - Preparation, bonding, structure and important reactions of transition metal nitrosyls, dinitrogen and dioxygen complexes.

UNIT-IV

Boranes - Preparation and important reactions, electron deficient characters of boranes, structure and bonding in boranes, concept of multicentric bonding and M.O description, Lipscomb concept of bonding elements, semitopological description of s, t, y and x nomenclature.

Silicones - Preparation, properties and structure of silicones , their industrial and technical importance.

UNIT-V

Sulphur-Nitrogen compounds - Preparation, properties of tetrasulphur tetranitride, disulphur dinitride, polythiozyl and other sulphonitrides, sulphur imides.

Phosphorus- Nitrogen compounds - Linear and cyclic polymers, their synthesis and reactions, structure and bonding, Allock's skeletal π—bonding concept.

Books Recommended :

1. Advanced Inorganic Chemistry, F.A.Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E Huhey, Harpes & Row
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon
4. Inorganic Electronic Spectroscopy, ABP Lever, Elsevier
5. Magnetochemistry, R.L. Carlin, Springer Verlag
6. Comprehensive Coordination Chemistry (Eds.) G. Wilkinson, R.D Gillars and J.A McCleverty, Pergamon.

PAPER-II
ORGANIC CHEMISTRY

Time : 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

Nature of bonding in organic molecules - Delocalized chemical bonding-conjugation, cross conjugation,, bonding in fullerenes, aromaticity in benzenoid and non-benzenoid compounds, annulenes, ferrocenes and helicenes, alternant and non-alternant hydrocarbons, Huckel's rule, energy level of π-molecular orbitals, anti-aromaticity, ψ-aromaticity, homo-aromaticity, PMO approach.

Stereochemistry - Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain., 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.

UNIT-II

Reaction mechanism, structure and reactivity - Kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, iostope effects, effect of structure on reactivity-resonance and field effects, steric effect, steric inhibition to resonance, substituent and reaction constants, Taft equation.

Aliphatic nucleophilic substitution - The S_N2, S_N1, mixed S_N1 & S_N2, S_Ni and SET mechanisms, neighbouring group participation.

Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation, rearrangements, nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon, reactivity-effects of substrate structure, attacking nucleophile, leaving group and reaction medium, ambient nucleophile, regioselectivity.

Aliphatic electrophilic substitution - S_E2 and S_E1 mechanisms, electrophilic substitution accompanied by double bond shifts, effect of substrates, leaving group and the solvent polarity on the reactivity.

UNIT-III

Aromatic electrophilic substitution - The arenium ion mechanism, orientation and reactivity, energy profile diagrams, the ortho/para ratio, ipso attack, orientation in other ring systems, diazonium coupling, Vilsmeir - Haak reaction, Bischler-Napieralske reaction, Pechmann reaction.

Aromatic nucleophilic substitution - The S_NAr, S_N1, benzyne and $S_{RN}1$ mechanisms, reactivity - effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommetet-Hauser and Smiles rearrangements.

Free radical reaction - Types of free radical reactions, free radical substitution mechanism, neighboring group asistance, reactivity for aliphatic and aromatic substrate at a bridgehead, reactivity in the attacking radicals, the effect of solvents on reactivity, allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, autooxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction, free radical rearrangement, Husdiecker reaction.

UNIT-IV

Addition to carbon-carbon multiple bonds - Mechanistic and stereochemical aspects of addition

reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity, addition to cyclopropane ring, hydrogenation of double bond, triple bonds and aromatic rings, hydroboration, cyanoethylation.

Addition to carbon-hetero multiple bonds - Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds, Wittig reaction, mechansim of condensation reaction involving enolates, Mannich, Benzoin, Perkin and Stobbe reactions, hydrolysis of esters and amides ammonolysis of esters.

Elimination reaction - The E2, E1, ElcB and E2c mechanisms and their spectrum, orientation of the double bond, reactivity-effect of substrate structures, attacking base, the leaving group and the medium, stereochemistry, elimination v/s substitutions, pyrolytic eliminations.

UNIT-V

Reagents in organic synthesis - Use of the following reagents in organic synthesis and functional group transformation, Gilman's reagent, lithium dimethyl cuprate LDA, dicyclohexylcarbodiimide, trimethyl silyl iodide, tributyltin hydride, DDQ, Baker yeast, Petersons synthesis, Merrifield resins, 1,3 - dithiane, selenium oxide, osmium tetroxide.

Books Recommended :

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 of Mechanism in Organic Chemistry, Peter Sykes, Longman
4. Structure and Mechanism in Organic Chemistry, Peter Sykes, Longman
5. Modern Organic Reactions, H.O. House, Benjamin
6. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional
7. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh Macmillan.
8. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
9. Stereochemistry of Organic Compounds, P.S Kalsi, New age International.
10. Organic Reaction and Their Mechanisms, P.S. Kalsi, New Age International.
11. Organic Reaction Mechanism, V.K. Ahluwalia and R.K. Parshar, New Age International.
12. Stereochemistry of Organic Compounds, E.L. Eliel.

PAPER-III
PHYSICAL CHEMISTRY

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

Quantum chemistry - The Schrodinger equation and the postulates of quantum mechanics, solutions of the Schrodinger equation to some model system viz.. particle in a box, the harmonic oscillator.

Approximate methods - The variation theorem and its applications, hydrogen atom.

Angular momentum - Ordinary angular momentum, generalized angular momentum, eigen functions and eigen values of angular momentum, operators, algebra of operators, ladder operators, addition of angular momenta, spin, antisymmetry and Pauli's exclusion principle.

Electronic structure of atoms - Electronic configuration, Russell-Saunder's terms and coupling schemes, molecular orbital theory, Huckel theory of conjugated systems, bond order and charge density calculations, application to ethylene and butadiene.

UNIT-II

Classical thermodynamics - Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies, partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significance, determinations of these quantities.

Non-ideal systems - excess function for non-ideal solutions, activity, activity coefficient.

Debye-Huckel theory for activity coefficient of electrolyte solutions, determination of activity and activity coefficients, ionic strength.

Statistical 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)

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

Chemical equilibrium and equilibrium constant in terms of partition functions, Fermi-Dirac statistics, Bose-Einstein statistics, distribution law.

Non-equilibrium thermodynamics - Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g. heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non – equilibrium stationary states. phenomenological equations, microscopic reversibility and Onsager's reciprocity relations.

UNIT-III

Chemical dynamics - Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, chain reactions, photochemical reactions (Hydrogen-bromine and hydrogen-chlorine reactions) oscillatory reactions,

(Belousov-Zhabotinsky reaction), homogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions.

UNIT-IV

Surface adsorption chemistry - Surface tension, Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electrokinetic phenomenon), catalytic activity at surfaces.

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, solubilization, micro-emulsion, reverse micelles.

Macromolecules - Definition, types of polymers, electrically conducting, fire resistant and liquid crystal polymers, kinetics of polymerization, mechanism of polymerization, molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimentation.

UNIT-V

Electrochemistry - Debye-Huckel-Onsager treatment and its extension, ion-solvent interactions, Debye-Huckel-Jerum mode, derivation of electro-capillarity, Lippmann equations (surface excess), methods of determination, structure of electrified interfaces,

Guoy-Chapman, Stern, Graham-Devanathan-Mottwatts, Tobin, Bockris, Devanathan models, over potentials, exchange current density, derivation of Butler-Volmer equation, Tafel plot, semiconductor interfaces, theory of double layer at semiconductor, electrolyte - solution interfaces, structure of soluble layer interfaces, effect of light at semiconductor solution interface, electrocatalysis, electrocardiography, bioelectrochemistry.

Book Recommended :

1. Physical Chemistry, P.W Atkins, ELBS
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill
3. Quantum Chemistry, I. N. Levine, Prentice Hall
4. Coulson's Valence, R. McWeeny, ELBS
5. Chemical Kinetics, K.J. Laidler, Mcgraw-Hill
6. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
7. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum
8. Modem Electrochemistry Vol. I and Vol.II, J.O.M. Bockris and A.K.N. Reddy, Plenum
9. Introduction to Polymer Science, R.Gowarikar, N.V. Vishwanaman and J. Sridhar, Wiley Eastern.

PAPER-IV
RECENT TREND IN CHEMISTRY

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

Environmental chemistry – Atmosphere-chemical and photochemical reactions in the atmosphere, oxygen and ozone chemistry, green house gases and effect, hydrosphere - physical chemistry of sea water, eutrophication, sewage treatment, lithosphere and chemistry involved, smog formation, acid rains, Bhopal gas tragedy, Chernobyl, minamata disasters,

industrial pollution due to cement, sugar distillery, drug, paper and pulp, thermal and nuclear power plants, metallurgical and polymer industries, a brief idea of toxicological effects of arsenic , lead, cadmium, mercury, ozone, PAN, cyanide, pesticides, oxides of nitrogen, sulphur and carbon, carcinogens

UNIT-II

Analysis of pollution – Sampling and monitoring of air and water, determination of total dissolved solids, conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, phosphate and different forms of nitrogen, phenols, pesticides, surfactants, DO, BOD and COD, microorganisms-the catalysts of aquatic chemical reactions, water pollution laws and standards.

UNIT-III

Microwave spectroscopy - Theory, selection rules, diatomic molecule as non-rigid rotator, symmetric top molecules, P-Q-R-bands, instrumentation, limitations and application.

Raman spectroscopy – Theory, Stokes and anti-Stokes lines, Raman depolarization ratio, instrumentation, intensity of Raman peaks, applications.

Mossbauer spectroscopy – Theory, Mossbauer nuclides, instrumentation and applications

Photoelectron spectroscopy – Franck - Condon principle, types of electron spectroscopy, ESCA-theory,

instrumentation and applications, Auger emission spectroscopy–theory, instrumentation and applications.

Atomic absorption spectroscopy – Principle, instrumentation and applications

UNIT-IV

Green chemistry – Green reagent-dimethyl carbonate and other polymer supported reagents, green catalysts-acid catalyst, basic catalysts, oxidation catalysts, polymer supported catalysts, photocatalyst, green synthesis-phase transfer catalyst. microwave induction, ultrasound assisted, green solvents-reactions in acidic and neutral ionic liquids, green synthesis of polycarbonates, paracetamol, ibuprofen , citral, urethane, adipic acid and styrene.

UNIT-V

Introduction to computers and Computing (only overview required) – Basic structure and functioning of computers with a PC an an illustrative example, memory, I/O devices, secondary storage, specification of a typical PC, operating systems with DOS as an example, introduction to UNIX and WINDOWS, data processing, principles of programming, algorithms and flow-charts, brief idea of packages such as MATLAB, MS-OFFICE and FOXPRO

Computer programming in FORTRAN/C/BASIC - (The language features are listed here with reference

to FORTRAN. The instructor may choose another language such as BASIC or C and the features may be replaced appropriately). Elements of the computer language, constants and variables, operations and symbols, expressions, arithmetic assignment statement, input and output, format statement, termination statements, branching statements such as IF or GO TO statement, LOGICAL variables, double precision variables, subscripted variables and DIMENSION, DO statement, FUNCTION and SUB-ROUTINE, COMMON and DATA statements.

Programming in chemistry – Determination of (i) activity coefficient using Debye-Huckel limiting law (ii) root mean square, average and most probable velocities (iii) critical constants of a gas (iv) dissociation constant of a weak acid from equivalence conductance (v) electronegativity of an atom using Pauling's relation (vi) normality, molarity and molality of solution (vii) solubility of sparingly soluble salts (viii) concentration of complex using Beer-Lambert's Law (ix) half life and average life of radioactive nucleus (x) lattice energy of a crystal using Born-Lande equation.

Books Recommended :

1. Modern Spectroscopy, J.M. Hollas, John Wiley

2. Applied Electron Spectroscopy for Chemical Analysis, Ed.H. Eindawi and F.L.H. Wiley Interscience.

3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.

4. Physical Methods in Chemistry, R.S. Drago, Saunders.

5. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.

6. Computers and Common Sense, R. Hunt and J. Shelley, Prentice Hall.

7. Computational Chemistry, A.C. Norris.

8. Microcomputer Quantum Mechanics, J.P. Killng-back, Adam Hilger.

9. Computer Programming in FORTRAN IV.V Rajaraman, Prentice Hall.

10. An Introduction to Digital Computer Design, V. Rajaraman and T. Radhakrishnan, Prentice Hall

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

12. Green Chemistry, P.Anastas, RSC.

13. Environmental Chemistry, S.E. Manahan, Lewis Pub.

14. Environmental Chemistry, Sharma and Kaur, Krishna Pub.

15. Environmental Chemistry, A.K. De, Wiley Eastern

16. Environmental Chemistry, C. Baird, W.H. Freem

M.Sc. (PREV.) CHEMISTRY, 2004-2005

Duration 16 Hrs **M.M. 200**

(i) Inorganic Practicals	60 Marks
(ii) Organic Practicals	60 Marks
(iii) Physical Practicals	60 Marks
(iv) Seminar	20 Marks
Total	**200 Marks**

INORGANIC PRACTICALS

Duration 6 Hrs. (one day) **M.M. : 60**

Distribution of Marks:

1. Qualitative analysis (3 marks for each radicals)	18 Marks
2. Quantitative analysis Volumetric	12 marks
3. Preparation/ Chromatrography	10 Marks
4. Viva-Voce	10 Marks
5. Sessional/Record	10 Marks
Total	**60 Marks**

List of Experiments -

1. Qualitative analysis - Qualitative analysis of inorganic mixture containing SIX radicals from the following list: (at least two from Group B)

Ten mixtures are compulsory to be done during the session.

Group A - Carbonate, Sulphite, Sulphate, Sulphide, Nitrite, Acetate, Oxalate, Nitrate, Chloride, Iodide, Phosphate, Fluoride, Borate, Silver, Lead Mercury, Bismuth, Copper, Cadmium, Tin, Arsenic, Antimony, Aluminium, Chromium, Iron, Nickel, Cobalt, Zinc, Manganese, Calcium, Barium, Strontium, Magnesium, Ammonium.

Group B - Thiosulphate, Cyanate, Thiocyanate, Hypochlorite, Chlorate, Percholrate, Iodate, Persulphate, Silicate, Chromate, Arsenate, Benzoate, Thalium, Tungsten, Molybdenum, Vanadium, Beryllium, Uranium, Thorium, Titanium, Zirconium, Cerium.

2. Quantitative analysis -

Volumetric determination of two components (binary) mixture containing any two of the following; Copper, Zinc, Silver, Nickel, Calcium, Magnesium, etc. (three exercises to be performed in practice).

3. Preparation of any ten complexes

(i) $TiO(C_9H_8NO)_2 . H_2O$

(ii) $Cis\text{-}K[Cr(C_2O_4)_2(H_2O)_2]$

(i) $Na[Cr(NH_3)_2(SCN)_4]$

(ii) $Mn(acac)_3$

(iii) $K_3[Fe(C_2O_4)_3]$

(iv) Prussian Blue, Turnbull's Blue.

(v) $Co[(NH_3)_6][NO_2]_6$

(vi) $Cis\text{-}[Co(trien)(NO_2)_2]Cl.H_2O$

(vii) $Hg[Co(SCN)_4]$

(viii) $[Co(Py)_2Cl_2]$

(ix) $[Ni(NH_3)_6]Cl_2$

(x) $Ni\ (dmg)_2$

(xi) $[Cu(NH_3)_4]SO_4.H_2O$

(xii) $VO(acac)_2$

OR

Separation of cations and anions by paper chromatography/column chromatography/ ion exchange.

ORGANIC PRACTICALS

Duration 6 Hrs. (one day) **M.M. 60**

Distribution of Marks

Exercises

1.	Qualitative analysis	20 Marks
2.	Quantitative analysis	10 Marks
3.	Organic Synthesis	10 Marks
4.	Viva-voce	10 Marks
5.	Record	10 Marks
	Total	**60 Marks**

List of Experiments

1. Qualitative Analysis - (Organic mixture)

Separation, purification and identification of compounds in a binary mixture (solid-solid or solid-liquid). One mixture to be given in the examination, suitable derivatives to be prepared, wherever possible.

2. Quantitative Analysis (one experiment to be performed in the examination)

(i) Determination of equivalent weight of an acid by silver salt method

(ii) Estimation of phenol/aniline using bromate-bromide solution or acetylation method.

(iii) Estimation of glucose by titration using Felhing's solution/Benedict solution

(iv) Estimation of carbonyl group by using 2,4-dinitrophenylhydrazine

(v) Determination of iodine and saponification value of an oil sample

3. Organic synthesis (One experiment to be performed from the following in the examination)

Acetylation - Acetylation of salicyclic acid using acetyl chloride

Benzoylation - Benzoylation of phenol/aniline/glycine

Oxidation - Phenathquinone from phenanthrene

Sandmeyer reaction - p-Chlorotoluene from p-toluidine

Acetoacetic ester condensation - Synthesis of ethyl-n-butylacetoacetate

Cannizaro reaction – Any p- substituted benzaldehyde as substrate

Backmann rearrangment – Acetanilide from acetopheone

Claisen-Schmidt condensation – Benzalaceto-phenone/ benzalacetone/dibenzalacetone from benzaldehyde

Books Recommended :

1. Advanced Practical Organic Chemistry, N.K. Vishnoi
2. A Hand Book of Organic Analysis, H.T Clarke
3. Systematic Quantitative Organic Analysis, H. Middleton, Edward Arnold Lts.
4. Text Book of Practical Organic Chemistry, Arthur I Vogel, ELBS.

M.Sc. (PREVIOUS) CHEMISTRY, 2004-2005

PHYSICAL PRACTICALS

Duration 6 Hrs. (one day) **M.M. 60**

Distribution of Marks

Exercises

1.	Experiment-I	20 Marks
2.	Experiment-II	20 Marks
3.	Viva-voce	10 Marks
5.	Record/sessional	10 Marks
	Total	**60 Marks**

Exercises -

1. Adsorption

To study surface tension-concentration relationship for solutions (Gibb's equation)

2. Phase equilibria

(i) Determination of congruent composition and temperature of a binary system (e.g. diphenylamine-benzophenone system).

(ii) Determination of glass transition temperature of a given salt (e.g $CaCl_2$) conductometrically.

3. Chemical kinetics

(i) Determination of the effect of (a) change of temperature (b) change of concentration of reactants and catalysts and (c) ionic strength of media on the velocity constant of hydrolysis of an ester or ionic reactions.

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

(xiii) Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion-persulphate ion)

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

(xv) Flowing clock reactions

(xvi) Oscillatory reaction.

4. Conductometry

(i) Determination of velocity constant and order of the reaction for saponification of ethyl acetate by sodium hydroxide conductometrically.

(ii) To study the effect of solvent on the $AgNO_3$/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 of Debye - Huckel-Onsager theory.

(iii) Determination of the activity coefficient of zinc ions in the solution of 0.002 zinc sulphate using Debye-Huckel's limiting law.

(iv) Verify Ostwald dilution law and calculate dissociation constant of weak acid

(v) Verify Kohlrausch's law

(vi) Determine basicity of weak organic acid

(vii) Determine the solubility of sparingly soluble salts and its solubility product.

5. Potentiometry/pH metry

(i) Determination of strength of halides in a mixture potentiometrically

(ii) Determination of the valency of mercurous ions potentiometrically

(iii) Determine the strength of strong and weak acids in a given mixture using a potentiometer/pH meter

(iv) Determination of the formation constant of copper - ammonia complex and stoichiometry of the complex potentiometrically

(v) Determination of activity and activity coefficient of electrolytes

(vi Determination of the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.

(vi) Determination of the dissociation constant of monobasic or dibasic acid.

6. Polarimetry

(i) Determination of rate constant for hydrolysis/ inversion of sugar using a polarimeter

(ii) Enzyme kinetics-inversion of sucrose

7. Chromatography

Separation of inorganic ions or organic compounds by paper chromatography or thin layer chromatography

8. Distribution law

(i) Complex formation between copper sulphate and ammonia

(ii) Equilibrium constant of the reaction between iodine and potassium iodide.

9. Photochemistry

(i) Photochromism in Aberchrome 540 or malachite green or potassium ferrocyanide-phenolphthalein system

(ii) Determination of quantum yield

(iii) Photooxidation of leucomethyl crystal violet.

Books Recommended :

1. Practical Physical Chemistry, Alexander and Findlay.

2. Experimental Physical Chemistry, Berman and Tipper
3. Practical Physical Chemistry, Arthur M. James
4. Advanced Physical Chemistry Experiment, J. Rose
5. Experiments in Physical Chemistry, Wilson, New Cowrbe, Denaro, Rickert and Wincent
6. Practical Physical Chemistry, J.B. Yadav
7. Experiments in Physical Chemistry, J.C. Ghosh
8. Findlay's Practical Physical Chemistry revised by B.P. Levitt.
9. Experimental Physical Chemistry, D.P. Shoemaker, C.W Garland and J.W Niber.

M.Sc. (FINAL) CHEMISTRY, 2005-2006

The examination shall consist of four theory papers and one practical. The candidate will select two papers from any group- Group A, B, C or D.

Paper & Course		Hrs/week	M. Marks
Paper-I	Group theory and Spectroscopy	4	100
Paper-II	Photochemistry and Supramolecular Chemistry	4	100
Elective Papers			
Paper-III-A	Coordination and Organo-metallic Chemistry	4	100
Paper-IV-A	Modern Interfaces of Inorganic Chemistry	4	100
Paper-III-B	Modern Aspects of Organic Chemistry	4	100
Paper-IV-B	Chemistry of Heterocyclic and Natural Products	4	100
Paper-III-C	Chemical Kinetics	4	100
Paper-IV-C	Quantum Mechanics and Photochemistry	4	100
Paper-III-D	Electroanalytical and Separation Methods	4	100
Paper-IV-D	Analytical Chemistry and Spectral Metods	4	100
Practicals	Group A	18	200
	Group B	18	200
	Group C	18	200
	Group D	18	200

PAPER–I
GROUP THEORY AND SPECTROSCOPY

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

Symmetry and group theory in chemistry – Symmetry elements and symmetry operations, definitions of group, subgroups, relation between orders of a finite group and its subgroup, similarity transformation and classes, point groups, Schonflies symbols, representation of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, $D_{nh,}$ etc. groups to

be worked out explicitly), character of a representation, the great orthogonality theorem (without proof) and its importance, character tables and their use.

UNIT-II

Applications of group theory – The reduction formula, hybridisation in BF_3, CH_4 or $[PtCl_4]^{2-}$, vibrational modes in H_2O, BF_3, crystal field splitting of orbitals in octahedral complexes, delocalisation energy of butadiene.

UNIT-III

Ultra-violet and visible spectroscopy – Electronic transitions, instrumentation, shift of bands with solvents, the isolated double bond, conjugated dienes, effects of geometrical isomerism (steric effect, effect of alkyl substitution and ring residues), exocyclic double bonds, Woodward-Feiser rule, effect of strain around the diene chromophore, polyenes, UV spectra of carbonyl compounds, unsaturated aldehydes and ketones, UV spectra of benzene and its derivatives, other applications of UV spectroscopy.

Infra-red spectroscopy – Molecular vibrations, calculation of vibrational frequencies, instrumentation, finger print region, i.r of alkanes and effect of some functional groups, effect of hydrogen bonding, Fermi resonance, overtones, shifting of bands due to inductive and mesomeric effects, aromatic and heteroaromatic compounds, effect of ring strain, applications of IR spectroscopy, brief idea of FT-IR.

Nuclear magnetic resonance spectroscopy – Theory, instrumentation, chemical shift, spin-spin coupling, coupling constants, factors affecting chemical shift, vincinal coupling and stereostructure, proton exchange reactions, geminal non-equivalence (rotation around single bonds), ring inversion, shifts reagents, spin decoupling, deuterium labelling and exchange, nuclear overhauser effect, C^{13} n.m.r., applications of ^1H and ^{13}C n.m.r spectroscopy, brief idea of COSY, NOESY, DEPT, INEPT, APT, 2D nmr and INADEQUATE techniques.

UNIT-IV

Mass spectrometry - Ionisation of a molecule on electron impact-EI, CI, FD, FAB, instrumentation, molecular ion, the base peak, the metastable peak, the nitrogen rule, the effect of isotopes, mass spectra of different classes of compounds, McLafferty rearrangement, Retro Diels-Alder reaction.

Optical rotatory dispersion – Principle, Cotton effect curve, octant rule, applications.

Electron spin resonance spectroscopy - Principles, instrumentation, applications, Combined applications of UV-visible, I.R., NMR and Mass spectroscopy for elucidation of structure of some simple molecules

UNIT-V

Vibrational spectroscopy – Symmetry and shapes of AB_2, AB_3, AB_4, AB_5 and AB_6 molecules, mode of bonding of ambidentate ligands, ethylene diamine and diketonato complexes.

NMR of paramagnetic substances – The contact and pseudo contact shifts, factors affecting nuclear relaxation, applications to inorganic systems including biochemical systems.

Nuclear quadrupole spectroscopy – Quadrupole, nuclear quadrupole moments, electric field gradient, coupling constant splitting and applications.

Books Recommended -

1. Group Theory and its Application to Chemistry, K.V. Raman, Tata McGraw Hill, New Delhi
2. Symmetry and Group Theory, Ramashanker and S.C. Ameta, Himanshu Publications.
3. Group Theory, F.A Cotton.
4. Spectroscopy of Organic Compounds, P.S Kalsi, Wiley Eastern.
5. Application of Absorption Spectroscopy of Organic Compounds, J.R. Dyer, Prentice-Hall
6. Carbon-13 NMR Spectroscopy, J.B Stothers, Academic Press.
7. Mass Spectroscopy-R Davis, M. Frearson, Wiley Eastern.
8. Spectrophotometric Identification of Organic Compounds, Silverstein and Basseler, Wiley
9. Spectroscopy, Y.R Sharma, S. Chand and Co, New Delhi

PAPER–II
PHOTOCHEMISTRY AND SUPRAMOLECULAR CHEMISTRY

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks.
Total 50 marks

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks.
Total 40 marks

UNIT-I

Photochemistry

Photochemical reactions – Interaction of electro-magnetic radiations with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

Determination of reaction mechanism – Classification, rate constants and life times of reactive energy

states - 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.

Photochemistry of alkenes – Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4 – and 1,5-dienes.

UNIT-II

Photochemistry of carbonyl compounds – Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β, γ-unsaturated and α, β-unsaturated compounds, cyclohexadienones, inter-molecular cycloaddition reactions-dimerisations and oxetane formation.

Photochemistry of aromatic compounds - Isomerisations, additions and substitutions

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.

UNIT-III

Pericyclic reactions – Electrocyclic reactions, cycloaddition reactions and sigmatropic reactions, frontier molecular orbital and perturbation molecular orbital methods, correlation diagram and selection rules.

UNIT-IV

Supramolecular chemistry–I - Introduction, nature of supramolecular interactions, cation binding hosts, crown ethers, lariat ethers, podands, cryptands, spherands, macrocyclic and template effects, calixarenes, siderophores, binding of anions- two dimensional and cyclophane hosts, guanidinium based, organometallic and neutral receptors, anti-crowns, hydride sponge and other Lewis acid chelates, binding of neutral molecules, solid states clathrates, fullerene as guest, host and superconducting inter-calation compounds.

UNIT-V

Supramolecular chemistry–II - Templates and self-assembly-tennis balls and soft balls, catenanes and rotaxanes, helicates, molecular knots, supramolecular photochemistry, semiochemistry, molecular electronic devices-swithes, wires and rectifiers, dendrimers

Books Recommended :

1. Photochemistry, J.G Cavert and J.N. Pitts, Wiley
2. Molecular Photochemistry, N.J. Turro, Benjamin
3. Fundamentals of Photochemistry, K.K. Rohatgi Mukherji, New Age
4. Photochemistry, R.P. Wayne, Butterworth
5. Analytical Chemsitry of Macrocyclic and Supramolecular compounds, S.M. Khopkar
6. Supramolecular Chemistry, J.M. Lehn, VCH
7. Supramolecular Chemistry, J.W Stead and J.L. Atwood, John Wiley.

ELECTIVE PAPERS

PAPER–III (A)
COORDINATION AND ORGANOMETALLIC CHEMISTRY

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

Complexion equilibria – complex ion equilibrium in solution, stability constants (step wise and overall stability constants), factors affecting stability constants, methods of determining stability constants

UNIT-II

Coordination compounds - I.R spectra of transition metal complexes, theoretical principles and interpretation of experimental observations, isomerism of coordination compounds, magnetic properties of coordination compounds, paramagnetism, ferro-and anti – ferromagnetism, measurement of magnetic susceptibility and temperature effect.

Optical activity of coordination compounds, symmetry requirements for optical activity, study of ORD, circular dichroism, cotton effect with special reference to complexes of Cr, Co, Ni and Pt .

UNIT-III

Reaction mechanism of transition metal complexes - Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetics, 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 reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus Hush theory, inner sphere type reaction.

UNIT-IV

Metal storage transport and biomineralization, ferritin, transferrin and siderophores

Calcium in biology - Calcium in biology in living cells, transport and regulation, molecular aspects of inter-molecular processes, extracellular binding proteins

Metalloenzymes - Zinc enzymes-carboxypeptidase and carbonic anhydrase, iron enzymes-catalase, peroxidase and cytochrome P-450, copper enzymes-superoxide dismutase, molybdenum oxatransferase enzymes-xanthine oxidase, coenzyme vitamin B_{12}.

Metal - nucleic acid interactions – Metal ions and metal complex interactions, metal complexes-nucleic acids.

UNIT-V

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 to organic synthesis, Transition metal compounds with bonds to hydrogen

Fluxional organometallic compounds – Fluxionality and dynamic equllibria in compounds such as η^2 – olefin, η^2 -allyl and dienyl complexes.

Books Recommended :

1. Principle and Applications of Organotransition Metal Chemsitry, J.P. Coliman, 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. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books
5. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lipparad and J.S Valentine, University, Science Books
6. Inorganic Biochemistry Vols I and II. Ed G.L. Eichhorn, Elsevier
7. Progress in Inorganic Chemistry, Vols 18 and 38 Ed. J.J. Lipparad, Wiley

PAPER IV-A
MODERN INTERFACES OF INORGANIC CHEMISTRY

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

Inorganic photochemistry - Ligand field excited state, charge transfer excited state, ligand to metal, metal to ligand, charge transfer to solvent, tenteraligand stage, metal to metal stage, Thexi stage and OSENCO state.

Photochemical reactions - Photosubstitution reaction, photo - rearrangement reaction, redox

reactions, promt and delayed photochemical reactions, d-d- and charge transfer reactions.

Photochemical reactions of coordination compounds - Chromium (III) complex, cobalt (III) complexes, radium (III) complex, complexes of transition elements, complexes of lanthanides and actinides.

Applications of photochemical reactions of coordination compounds – Synthesis, catalyst, chemical actinometry, photochromism and photocalorimetry

UNIT–II

Inorganic polymers - Classification of inorganic polymers, general properties, preparation of condensation, addition and coordination polymers.

Silicone polymers - General preparation, properties and applications of silazanes, polysilazenes, organosiloxy and poly - carbosilanes.

Ferrocene - Synthesis and applications of ferrocene containing polyamide and polyurea polymers.

UNIT-III

Phosphorus-nitrogen polymers - Synthesis and important properties of organo metallic poly - phosphazene, liquid-crystalline-high refractive index polyphosphazene, polycarbo phosphazene, poly thio phosphazene and other types of phosphazenes such as organic polymer with cyclophosphazene side groups,

cyclo linear and cyclomatrix material, inorganic ceramics derived phosphazene, applications of polyphosphazene and other related polymers such as advanced elastomers and premedical materials.

UNIT-IV

Environmental inorganic chemistry -

(i) Inorganic pollutants and monitoring -

Air pollution – Types of air pollutants, sources and control, ozone layer depletion and effect on biotic community, climate protection of ozone layer, sampling and monitoring, analysis of CO, NO_x, SO_2, H_2S, particulate matter.

Water pollution and monitoring - Inorganic chemicals, metals and minerals as pollutants, radioactive materials and their effects, sampling and monitoring of water pollutants.

UNIT-V

Industrial pollution - Cement, nuclear power plants, pollution due to metallurgy and mining activity.

Metallic medicine - Metal deficiency and disease, metals used in diagnosis and chemotherapy with particular reference to cancer drugs, tracer technique in biological systems.

Toxicology - Biochemical effects of As, Cd, Pb, Hg, Co, NO_x, SO_2, CN^-

Books Recommended

1. Environmental Chemistry, S.E. Manahan, Lewis Pub.
2. Environmental Chemistry, Sharma and Kaur, Krishna Pub.
3. Environmental Chemistry, A.K. De, Wiley, Eastern.
4. Environmental Chemistry, C. Baird, W.H. Freem
5. Concepts of Inorganic Photochemistry, A.W. Adamson and P.D Fleischauer, Wiley.
6. Photochemistry of Coordination Compounds, V. Balzani and Carassiti, Academic Press.
7. Elements of Inorganic Photochemistry, G.J. Ferraudi, Wiley.
8. Inorganic Polymers - Grahm and Stone.
9. Development in Inorganic Polymer Chemistry, M.F. Lappert and G.J. Leigh.
10. Inorganic and Organometallic Polymers, M. Zeldon, K.J. Wynne and H.R. Allcock.

M.Sc. (FINAL) CHEMISTRY, 2005-2006

PRACTICALS, GROUP-A

Duration: 18 Hrs. (Spread over three days) **M.M. 200**

Distribution of Marks

1.	Exercise 1 is compulsory	50 Marks
2.	Out of unit 2-9, three exercise would be given selecting not more than one from each unit :	25 x 3 = 75 Marks
3.	Seminar	20 Marks
4.	Report on Industrial Tour	15 Marks
3.	Viva-voce	20 Marks
4.	Sessional/Record	20 Marks
	Total	**200 Marks**

Exercises

1. Volumetric estimation of two or three component in a mixture (cations as well as anions) from (i) Synthetic mixture (ii) Ores and minerals (iii) Alloys (iv) Water/Industrial effluent samples

2. Preparation of selected inorganic compounds and their physico-chemical studies. (atleast 15 preparations)

3. Spectrophotometric Determinations

(i) Manganese/Chromium/Vanadium in steel sample

(ii) Nickel/Molybdenum/Tungsten/Vanadium/Uranium by extractive spectrophotometric method.

(iii) Fluoride/Nitrite/Phosphate.

(iv) Iron-phenanthroline complex by Job's method of continuous variations.

(v) Zirconium-alizarin Red-S complex by mole ratio method

(vi) Copper-ethylenediamine complex by slope-ratio method.

(vii) Stability constant by Bjerrum's method.

(viii) Stability constant by Turner-Anderson method

4. Flame photometric determinations

(i) Sodium and potassium, when present together

(ii) Lithium/Calcium/Barium/Strontium

(iii) Cadmium and magnesium in tap water

5. Nephelometric determinations

(i) Sulphate

(ii) Phosphate

(iii) Silver

6. Chromatographic separations

(i) Cadmium and zinc

(ii) Zinc and magnesium

(iii) Thin layer chromatography; Separation of nickel, manganese, cobalt and zinc, Determinations of R_f values.

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

7. Solvent extraction (any one)

a. Uranyl nitrate from thorium nitrate with the help of tributyl phosphate

b. Separation of metal from a mixture

c. Study of the solvent extraction of Hg and Al with 8-hydroxyquinoline.

8. Magnetochemistry (one exercise) -

Determination of magnetic susceptibility and moment by Gouy's method.

9. Polarography – Determination of cadmium, lead, etc.

PAPER–III (B)
MODERN ASPECTS OF ORGANIC CHEMISTRY

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

Reagents containing phosphorus, silicon and boron – preparation, properties and applications of following in organic synthesis and mechanistic details.

Selective organic name reactions – Hoffmann-Loffer-Fretag reaction, chichibabin reaction, Sharpless, asymmetric epoxidation, Barton reaction, ene reactions, Stork enamine reaction.

UNIT-II

Oxidation – Introduction, different oxidative processes, hydrocarbons (alkenes, aromatic rings, activated and inactivated saturated C - H groups), alcohols, diols, aldehydes, ketones, ketals and carboxylic acids, singlet oxygen, ruthenium tetroxide and Tl (III) nitrate as oxidizing agent, Provost reaction, Wacker's process, Barbier-Wieland degradation

Reduction – Introduction, different reductive processes, hydrocarbons (cyclo alkanes, alkenes, conjugated system, alkynes and aromatic rings), carbonyl compounds, nitro, azo and oxime compounds, hydrogenolysis, reductions using Wilkinson's catalyst, Meerwein –Pondrof - Verley reduction.

UNIT-III

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

A detailed study of the following rearrangements - Pinacol-Pinacolone, Wagner-Meerwin, Demjanov, Benzil - Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Backmann, Hofmann, Curtius, Schmidt, Benzidine, Bayer-Villiger and Shapiro reaction.

UNIT-IV

Disconnection approach – An introduction to synthons, synthetic equivalents, functional group

interconversions, elementary idea of disconnection in Diels-Alder reaction, 1,3 – and 1, 5- difunctionalised compounds, α, β - unsaturated carbonyl compounds, Michael reaction, Robinson annelation.

Protecting group – Principle of protection of hydroxy, amine and carbonyl groups.

UNIT-V

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

Applications of the following in the organic synthesis – Phase transfer catalysts, polymer supported reagents. biocatalysts, microwave and ultrasound induced reactions.

Chemistry of fullerenes

Books Recommended :

1. Modern Synthetic Reactions, H.O. House, W.A Benjamin

2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.

3 Principles of Organic Synthesis, R.O.C Norman and J.M. Coxon, Blackie Academic & Professional

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

5. Rood's Chemsitry of Carbon Compounds, S. Coffey.

6. Organic Synthesis-Concept, Methods and Starting Materials, J. Fuhmop and G. Penzillin.

7. Guide Book to Organic Synthesis, R.K. Mackie & D.M. Smith, ELBS.

8. Organic Synthesis, V.K. Ahuwalia and Renu Agarwal, Narosa

9. Synthesis, Approaches in Organic Chemistry, R.K. Bansal, Narosa

10. Advanced Organic Chemistry -Reactions, Mechanism and Structure, Jerry March, John Wiley.

11. Designing Organic Synthesis, S.Warren, Wiley.

PAPER IV (B)
CHEMISTRY OF HETEROCYCLIC AND NATURAL PRODUCTS

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

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

Small ring heterocycles - Three membered heterocycles with one and two hetero atoms-synthetic methods, physical, spectroscopic and chemical

properties of aziridines, oxiranes, thiiranes, diaziridines, diazirines, oxaziridines, four membered heterocyclic compounds - Synthetic methods, physical, spectroscopic and chemical properties of azetines, azetidines, oxetanes, thietanes and their carbonyl derivatives.

UNIT-II

Benzo-fused five membered heterocycles - Synthetic methods, physical and chemical properties of benzopyrroles, benzofuranes and benzothiophenes.

Six-membered heterocycles - Synthetic methods, physical and chemical properties of pyrilium salts, pyrones, quinolizinium salts, pyridazines, pyrimidines, pyrazines, acridines and phenanthridines

Seven membered heterocycles - Synthetic methods, physical and chemical properties of azepines, oxepines, thiepines and diazepins.

Meso-ionic heterocycles - Synthetic methods, properties of 1,3-oxazolium-4-olates, 1,3-oxathiolium-4-olates, 1,3-diazolium-4-olates, 1,2,3-oxadiazolium-5-olates and 1,2-diathiolium-4-olates

UNIT-III

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, a-Terpineol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and **β**-Carotene

Porphyrins - Structure and synthesis of haemoglobin and chlorophyll.

UNIT-IV

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

Plant pigments - Occurrence, nomenclature and general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7, arabinoside, Cyanidin and Hirsutidin.

Biosynthesis of flavonoids - acetate pathway and shikimic acid.

UNIT-V

Steroids - Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone, biosynthesis of steroids.

Prostaglandins – Occurrence, nomenclature, classification, biogenesis and physiological effects, synthesis of PGE_2 and $PGF_2\alpha$.

Pyrethroids and Rotenones – Synthesis and reactions of pyrethrodis and rotenones.

Books Recommended-

1 Heterocyclic Chemistry, 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. An Introduction to the Heterocyclic Compounds, R. M. Acheson, John Wiley.

6. Comprehensive Heterocyclic Chemistry, A.R Kartritzky and C.W Rees.

7. Stereoselective Synthesis: A Practical Approach, M. Nogradi.

8. New Trends in Natural Products Chemistry, Atta-ur-Rahman and M.I. Choudhary.

9. Chemistry of Natural Products, S.N. Bhat

M.Sc. (FINAL) CHEMISTRY, 2005-2006

PRACTICALS, GROUP-B

Duration: 18 Hrs. (spread over three days) **M.M. 200**

Distribution of Marks

1.	Mixture	50 Marks
2.	Estimation	30 Marks
3.	Preparation (Synthesis/Natural Sources)	25 Marks
4.	Spectrophotometric estimation/ Spectral analysis	20 Marks
5.	Seminar	20 Marks
6.	Report on Industrial Tour	15 Marks
7.	Record/ Sessional	20 Marks
8.	Viva-voce	20 Marks
	Total	**200 Marks**

Exercises

1. Qualitative Analysis - Separation, purification and identification of components of a mixture of three organic compounds (three solids or two solids-one liquid), separable by ether, $NaHCO_3$, solution, dil. NaOH, dil. acid and distillation, derivatives of components to be prepared, wherever possible.

2. Quantitative Analysis - (one experiment to be given in the examination)

(i) To estimate the percentage of nitrogen in the given organic sample by Kjeldahl's method.

(ii) To estimate a halogen in the given sample by the alkaline reduction method (Modified Stepenow method).

(iii) To estimate the percentage of sulphur in the given organic sample by Messenger's method.

3. Synthesis of organic compounds (one synthesis to be given in the examination). The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic technique.

Photochemical reaction -

Benzophenone → Benzpinacol → Benzpinacolone

Backmann rearrangement -

Benzophenone → Benzophenone oxime → Benzanilide → Benzoic acid.

Acetophenone → Acetophenone oxime → Acetanilide → p-Nitroacetanilide or p- bromoacetanilide.

Hoffman and Sandmeyer reaction -

Phtahlic anhydride → Phthalimide → Anthranilic acid → o-Chlorobenzoic acid.

Benzillic acid rearrangement -

Benzoin → Benzil → Benzilic acid

Fisher-Indole synthesis - Preparation of 2-phenylindole or 2-methylindole or 1,2,3,4-tetrahydrocarbazole.

Enzymatic reduction- Reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ethyl-3-hydroxybutanoate and to determine its optical purity

Synthesis using microwaves -

Alkylation of diethyl malonate with benzyl chloride

Synthesis using phase transfer catalyst -

Alkylation of diethyl malonate or ethyl acetoacetate with alkyl halides.

OR

Extraction of organic compounds from natural sources (any one experiment is to be given in the examination).

1. Isolation of caffein 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 R_f value reported).

4. Isolation of nicotine dipicrate from tobacco.

5. Isolation of cinchonine from cinchona bark

6. Isolation of lycopene from tomatoes

7. Isolation of piperine from black pepper.

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.

4. Spectrophotometric (UV/VIS) Estimation (any one experiment is to be given in the examination).

- Amino acids
- Proteins
- Carbohydrtates
- Cholesterol
- Ascorbic acid
- Aspirin
- Caffeine

OR

Spectral Analysis

Characterization of simple organic compounds on the basis of given xerox copies of spectra (UV, IR, PMR and Mass)

Books Recommended :

1. Systematic Identification of Organic Compounds, R.I Shriner, R.C. Fusen and D.Y. Curtin.

2. Spectrometric Identification of Organic Compounds, R.M. Silverstin, C.G. Bassler and T.C. Merruill.

3. Spectral and Chemical Characterisation of Organic Compounds, W.J. Criddle and G.P. Ellis.

4. Experimental Organic Chemistry, M.P. Doyle and W.S. Mungall.

5. Experimental and Techniques in Organic Chemistry, D. Pasto. C. Jhonson and M. Miller.

6. Elementary Practical Organic Chemistry, Arthur I. Vogel.

7. Comprehensive Practical Organic Chemistry, V.K. Ahluwalia and R. Aggrawal.

8. Advanced Practical Organic Chemistry, N.K. Vishnoi.

9. A Hand-book of Organic Analysis, Hans T. Clarke

10. An Introduction to Chromatography, David Abbott and R.B. Andrews.

11. Systematic Qualitative Organic Analysis, H. Middleton

PAPER-III (C)
CHEMICAL KINETICS

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

Techniques for rate determination - Slow reactions (solution and gas phase), fast reactions - stopped flow, relaxation, shock – tube method, flash photolysis, NMR, optical and laser methods

Methods for determining reaction mechanism and rate law.

UNIT-II

Principles of reactivity - Significance of entropy, enthalpy and Gibb's free energy, Arrhenius equation, uses of activation parameters, potential energy diagrams and models, curve-crossing model, nature of activation barrier in chemical reaction

Structure effect on rate - Linear free energy constants relationship, Hammett equation, substitution constants, theories of substituent effect, interpretation of σ values and reaction constant ρ, deviation from Hammett equation, the Taft model, σ_I and σ_R scales, steric acceleration, molecular measurements of steric effect upon rates.

UNIT-III

Kinetic isotope effect - Theory of isotope effects, primary and secondary kinetic effect, heavy atom isotope effect, tunneling effect, solvent isotope effect.

Solvation and solvent effect on rate - Factors affecting reaction rate in solution, quantitative understanding of solvent solute effects on reactivity - thermodynamic measures of solvation, effect of solvation, effect of solvation on reaction rate, solvent effect on ion - ion, ion – dipole and dipole – dipole reactions, preliminary idea about diffusion - controlled reactions.

UNIT-IV

Homogeneous catalysis - Acid-base catalysis, specific and general catalysis, Bronsted catalysis, nucleophilic

and electrophilic catalysis, acidity function and their applications,

Electron transfer processes in solution - Inner-sphere, outersphere, bridged transition states, Marcus theory and its modifications, one equivalents and two equivalent exchange reaction, reactions of solvated electron with metal ions.

UNIT-V

Reaction on surfaces - Adsorption isotherm, structure of solid surface and adsorbed layers, mechanism of surface reactions, unimolecular and bimolecular surface reactions, transition state theory of surface reactions, surface chemistry in industrial processes.

Gas phase reaction - Hydrogen-oxygen reaction, combustion of hydrocarbons, decomposition of N_2O_5 and acetaldehyde, Gold, Finger- Lettort –Niclause rule and inhibition mechanism.

Books Recommended :

1. Surface activity and Detergency, K. Durham, Ed. McMillan.
2. Emulsion and Foams, S. Berkman and G. Egloff, Reinhold.
3. Surface Chemistry, J.B. Bikeman, Academic
4. Chemical Kinetics, K.J. Laidler
5. Chemical Kinetics and Mechanism, A.A Frost and R.G. Pearson

PAPER-IV(C)
QUANTUM MECHANICS AND PHOTOCHEMISTRY

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

Experimental foundation of quantum theory, mathematical techniques, postulates of quantum theory and consequences of the postulates, Heisenberg principle of uncertainty, angular momentum, eigen values.

Solution of the Schrodinger equation for some simple systems - Particle in a box, rigid rotator, harmonic oscillator and the hydrogen atom.

Approximate methods – Variation principle and peturbation theory, time dependent perturbations.

UNIT-II

Group theory and symmetry properties – Definition of group, symmetry operation and point groups, representation of group characters, reducible representation, relationship of group, group characters and reducible representation.

Huckel molecular orbital theory and its applications to organic chemistry-simple molecular orbital calculations, calculation of electron densities, bond order and free valence.

Ligand filed theory of the free atom, the atom in complex, energy level diagrams, magnetic and spectral properties of complexes.

UNIT-III

Laws of photochemistry, units and dimensions, types of electronic transitions, charge transfer transitions, potential energy diagram, Franck-Condon principle, crossing of potential energy surfaces, geometry of some electronically excited molecules.

Types of photophysical pathways, radiation less transitions, internal conversion (IC) and intersystem crossing (ISC), fluorescence emission and structure, triplet states and phosphorescence emission, delayed fluorescence.

UNIT-IV

Stern-Volmer equation, excimer and excited state, quenching by added substances, charge transfer mechanism, quenching by oxygen, nitric oxide, paramagnetic metal ions and triplet energy states, intramolecular energy transfer, energy transfer processes in rare earth chelates and coordination compounds, fast multi step migration of excitation energy.

Classification of photochemical reactions, rate constants and lifetimes of reacting energy states, effect of light intensity on the rate of photochemical reaction, photofragmentation, isomerization and other rearrangement reactions.

UNIT-V

Light sources and their standardization, actionometry, chemical actinometry, measurement of emission characteristics, fluorescence, phosphore-scence and chemiluminescence, techniques for study of transient species in photochemical reactions, laser and photochemical reactions.

Origin of life, mutagenic effects of radiation, photosynthesis, photoelectrochemistry of excited state redox reactions, solar energy conversion and storage.

Books Recommended :

1. Basic Quantum Chemistry by Leon, Wiley (1965)

2. Quantum Chemistry, R.K. Prasad

3. Photochemistry, J.G. Cavert and J.N. Pitts, Wiley (1966)

4. Molecular Photochemistry, N.J. Turro, Benjamin (1966)

5. Fundamentls of Photochemistry, K.K. Rohatgi-Mukherjee, New Age

6. Photochemistry, R.P. Wayne, Butterworth, (1970)

7. Quantum Chemistry, I. Levine

M.Sc.(FINAL) CHEMISTRY, 2005-2006

PRACTICAL, GROUP-C

Duration: 18 Hrs. (spread over three days) **M.M. 200**

Distribution of Marks

1.	Experiment-I	50 Marks
2.	Experiment-II	50 Marks
3.	Experiment-III	25 Marks
4.	Seminar	20 Marks
5.	Report on Industrial Tour	15 Marks
6.	Viva-Voce	20 Marks
7.	Record/Sessional	20 Marks
	Total	**200 Marks**

Exercises :

1. Thermodynamics

(i) Determination of partical molar volume of solute (e.g. KCl) and solvent in a binary mixture.

(ii) 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 calculation of the partial molar heat of solution.

2. Spectroscopy

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

(ii) Determination of stoichiometry and stability constant of inorganic (e.g. ferric-salicyslic acid) and organic (e.g. amine-iodine) complexes.

(iii) Characterization of the complexes by electronic and IR spectral data.

(iv) Estimate P as P_2O_5 in given sample of rock phosphate.

(v) Estimate iron in given sample of lime, dolomite, etc.

3. Polarography

Determination of dissolved oxygen in the aqueous solution of organic solvents.

4. Chemical kinetics

(i) To study primary salt effects in oxidation of iodide ion by persulphate ion.

(ii) The effect of solvent on alkaline hydrolysis of crystal violet.

(iii) Reduction of aqueous solution of ferric chloride by stannous chloride.

(iv) To study the kinetics of reaction between persulphate and iodide.

(v) To study the kinetics of potassium dichromate and oxalic acid reaction.

(vi) Determination of activation energy and entropy of activation.

5. Conductivity

(i) Conductometric titration of a mixture of KCl and KI.

(ii) Determination of hydrolysis constant of aniline hydrochloride

(iii) To verify Debye-Huckel-Onsager limiting law

(iv) Determination of solubility and solubility product of sparingly salts (e.g. $PbSO_4$, $BaSO_4$)

6. Photochemistry :

(i) Kinetics of photohydration of pyridine in aqueous solution

(ii) Photochemical reduction of Fe(III) by citrate ion

(iii) A Chemiluminescence clock reaction

(iv) Chemical Actinometry

Books Recommended :

1. Practical Physical Chemistry, Alexander and Findlay.

2. Experimental Physical Chemistry, Berman and Tipper

3. Practical Physical Chemistry, Arthur M. James.

4. Advanced Physical Chemistry Experiments, J. Rose.

5. Experiments in Physical Chemistry, Wilson, New Cowrbe, Denaro, rickert and Wincent.

6. Practical Physical Chemistry, J.B. Yadav.

7. Experiments in Physical Chemistry, J.C. Ghosh.

8. Findlay's Practical Physical Chemistry, Revised, B.P. Levitt.

9. Experimental Physical Chemsitry, D.P. Shoe-maker, C.W Garland and J.W Niber.

PAPER-III(D)
ELECTROANALYTICAL AND SEPARATION METHODS

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

UNIT-I

Polarographic techniques - A.C. polarography, square wave and pulse polarography, oscillopolarography

Voltammetry - Reversible and irreversible electrode process, equation for cathodic and anodic waves, current controlled by linear diffusion towards special surfaces, llkovic equation, kinetic and catalytic

currents, coupled chemical reactions and their significance.

UNIT-II

Voltammetric sweep techniques - Single sweep technique, cyclic voltammetry, differential pulse polarography, anodic stripping voltammetry (ASV), differential pulsed anodic stripping voltammetry, advanced chromotechniques.

Ion selective electrodes - Principles, construction and selection, general applications, applications in analysis of common ions.

UNIT-III

Separation techniques -

Adsorption and partition chromatography - (a) Definition of terms, techniques and chemical concepts, (b) Column adsorption chromatography, (c) Partition chromatography-column, paper and TLC

UNIT-IV

High performance liquid chromatography - Introduction, choice of the system, instrumentation and applications.

Gas liquid chromatography - Introduction, choice of the system, instrumentation, qualitative and quantitative analysis of mixtures.

Gel permeation/size exclusion chromatography - introduction, theory and applications.

UNIT-V

Ion-exchangers - Theory, action of ion-exchange resins, ion-exchange chromatography, exchange capacity, ion-exchange resins and liquid ion-exchange resins, applications of cation and anion ion-exchangers.

Solvent extraction - Introduction, principles, factors that influence solvent extraction, ion association complexes and applications of solvent extraction.

Books Recommended :

1. Analytical Chemistry, G.D Christian, J. Wiley.
2. Fundamental of Analytical Chemistry, D.A Skoog, D.M. West and F.J. Holler, W.B. Saunders.
3. Analytical Chemistry-Principles and Techniques, L.G. Hargis, Prentice Hall.
4. Analytical Chemistry-Principles, J.H. Kennedy, W.B. Saunders.
5. Principles of Instrumental Analysis, D.A Skoog and J.L. Loary, W.B. Saunders.
6. Quantitative Analysis, R.A Day, Jr. and A.L. underwood, Prentice Hall
7. Environmental Solution Analysis, S.M. Khopkar, Wiley Eastern.

8. Basic Concept of Analytical Chemistry, S.M. Khopkar, Wiley Eastern.

9. Handbook of Instrumental Techniques for Analytical Chemistry, F. Settle, Prentice Hall

10. Instrumental Methods of Analysis, Chatwal and Anand.

11. Vogel's Textbook of Quantitative Inorganic Analysis, L. Barret et al. ELBS (Longmann's Ed.)

PAPER-IV (D)
ANALYTICAL CHEMISTRY AND SPECTRAL METHODS

Time: 3 Hrs. **M.M. 100**

Note: The paper will be divided into THREE sections.

Section-A : Ten questions (short type answer) two from each Unit will be asked. Each question will be of one mark and the candidates are required to attempt all questions. **Total 10 marks**

Section-B : Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 10 marks. **Total 50 marks**

Section-C : Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 20 marks. **Total 40 marks**

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

glasswares, sample preparations-dissolution and decompositions. gravimetric techniques, selecting and handling of reagents. laboratory notebooks, safety in the analytical laboratory.

Errors and evaluation - Definition of terms - mean and median, precision standard deviation, relative standard deviation, accuracy-absolute error, relative error, types of errors in experimental data-determinate (systematic), indeterminate (or random) and gross, sources of errors and the effects upon the analytical results, methods for reporting analytical data, statistical evaluation of data, indeterminate errors, the use of statistics.

UNIT-II

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.

Analysis of water pollution - Origin of waste water, types of water pollutants and their effects, sources of water pollution-domestic, industrial, agricultural, soil and radioactive wastes as sources of pollution, objectives of analysis-parameters 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, general survey of instrumental techniques for the analysis of heavy metals in aqueous systems, measurements of DO, BOD and COD, pesticides as water pollutants and analysis, water pollution laws and standards.

UNIT-III

Analysis of soil, fuel, body fluids and drugs

(a) Analysis of soil - Moisture, pH, total nitrogen, phosphorus, silica, lime, magnesia, manganese, sulphur and alkali salts.

(b) Fuel analysis - Solid, 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-producer gas and water gas-calorific value.

(c) Clinical chemistry - Composition of blood-collection and preservation of samples, clinical analysis, serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulin, barbiturates, acid and alkaline phosphates, immunoassay, principles of radio immunoassay (RIA) and applications. the blood gas analysis - trace elements in the body.

(d) Drug analysis - Narcotics and dangerous drugs, classification of drugs, screening by gas and thin layer chromatography and spectrophotometric measurements.

UNIT-IV

Flame photometry - Basic principles, experimental techniques, schematic diagram and its applications in analytical work with special reference to alkali and alkaline earth metals.

Atomic absorption spectroscopy - Basic principles, advantage over flame photometer techniques, detection limit and sensitivity, interference and its applications in trace element analysis.

Mossbauer and Photoelectron spectroscopy - Principles and applications.

UNIT-V

Emission spectroscopy - Principle, excitation spectra, equipment for spectrographic analysis, qualitative and quantitative analysis.

Microwave spectroscopy - Theory, techniques and analytical applications.

Fluorescence and Phosphorescence methods - Fluorescence intensity as related to concentration, filter fluorometers, phosphorescence spectrometer, phosphorescence methods, excitation conditions, X-ray fluorescence techniques, theory and applications.

Nephelometry and Turbidimetry - General discussion, instrumentation and applications

Books Recommended :

1. Analytical Chemistry, G.D Christian, J. Wiley.
2. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, W.B.Saunders.
3. Instrumental Methods of Analysis, B.K. Sharma
4. Instrumental Methods of Analysis, Chatwal and Anand.
5. Vogel's Textbook of Quantitative inorganic Analysis L. Barret et.al. ELBS (Longmann's Ed.)

M.Sc. (FINAL) CHEMISTRY, 2005-2006

PRACTICALS, GROUP-D

Duration: 18 Hrs (spread over three days) **M.M. 200**

Distribution of Marks -

1.	Exercise-I	50 Marks
2.	Exercise -II	50 Marks
3.	Exercise -III	25 Marks
4.	Seminar	20 Marks
5.	Report on Industrial Tour	15 Marks
6.	Viva-Voce	20 Marks
7.	Record/Sessional	20 Marks
	Total	**200 Marks**

Exercises -

1. Estimation of Ca, Na, K, by flame photometry.
2. Determination of Ca, Mo, Zn, Cu, phosphate and silica contents of soil samples
3. Analysis of sludge obtained from Zinc Smelter
4. Analysis of cement
5. Determination of water in mixture by Karl-Fisher method

6. Separation of amino acids by ion exchange and chromatographic method
7. Analysis of oils and fats-saponification and iodine value
8. Colorimetric estimation of fluoride, Fe in drinking waters
9. Determination of fats, protein and solid in milk
10. Polarimetric estimation of sugar
11. Analysis of aspirin, sulpha drugs and vitamin C.
12. Potentiometric estimation of Ni, Zn, etc.
13. Analysis of lime, brass and gun-metal.
14. Analysis of HCl extract or fusion with Na_2CO_3 for Al, Fe, Ca, Mg, P and K
15. Estimation of soluble salts in soils by conducto-metric method
16. Separation and identification of most common acidic and basic drugs by TLC
17. Analysis of fertilizers
18. Estimation of lead and tin in solder or bismuth, cadmium and lead in low melting alloys such as Woods metal using EDTA (volumetrically)
19. Analysis of German silver (copper, zinc and nickel)

Mohanlal Sukhadia University
Udaipur (Raj.)

Syllabus

Scheme of Examination and Courses of Study

FACULTY OF SCIENCE

M. Sc. CHEMISTRY

Previous Examination : 2004-2005

Final Examination : 2005-2006

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