Expert advice from the following academicians has been incorporated in the proposed syllabi-

1. Prof. Biman Bagchi
   Solid State and Structural Chemistry Unit
   Indian Institute of Science, Bangalore

2. Prof. S. K. Mehta
   Chemistry Department
   Panjab University, Chandigarh

3. Prof. Ashok Mukharjee
   Chemistry Department
   University of Burdwan, West Bengal

4. Prof. M. S. Chauhan
   Chemistry Department
   H. P. University, Shimla

5. Prof. V. K. Rattan
   Department of Chemistry and Engineering, Chandigarh

6. Prof. Ashok Kumar Prasad
   Department of Chemistry
   University of Delhi, Delhi

7. Prof. Isabel Rozas
   School of Chemistry
   Trinity College, Dublin, Ireland

8. Prof. P. Venugopalan
   Chemistry Department
   Panjab University, Chandigarh

9. Dr. Deepak Chopra
   Department of Chemistry
   IISER, Bhopal

Course contents of the following Universities have been taken into account to prepare the proposed syllabi-

1. Panjab University, Chandigarh
2. University of Delhi, Delhi
3. Maharishi Dayanand University, Rohtak
4. Banaras Hindu University, Banaras
5. University of Dublin, Ireland

Syllabi and Courses of Reading for M.Sc. Chemistry (Previous and Final) Classes w.e.f. 2013-2014 and 2014-2015.

SCHEME OF EXAMINATION

Paper No.	Nomenclature of the Paper	Max. Marks (Including internal assessment)	Time
	M.Sc. (Previous)		
Semester I			
I	Inorganic Chemistry (General)	60+20	3 hrs.
II	Physical Chemistry (General)	60+20	3 hrs.
III	Organic Chemistry (General)	60+20	3 hrs.
IVa	Chemistry of Life Science	60+20	3 hrs.
	OR		
IVb	Mathematics for Chemists	60+20	3 hrs.
	OR		
IVc	Introduction to Pharmacy and Pharmacology	60+20	3 hrs.
Semester II			
V	Inorganic Chemistry (General)	60+20	3 hrs.
VI	Physical Chemistry (General)	60+20	3 hrs.
VII	Organic Chemistry (General)	60+20	3 hrs.
VIII	Applications of Computer in Chemistry	60+20	3 hrs.
IX	Inorganic Chemistry Practicals	80+20	6 hrs. (Two sessions)
X	Physical Chemistry Practicals	80+20	6 hrs. (Two sessions)
XI	Organic Chemistry Practicals	80+20	6 hrs. (Two sessions)
	M.Sc. (Final)		
Semester III			
XII	Inorganic Chemistry (General)	60+20	3 hrs.
XIII	Physical Chemistry (General)	60+20	3 hrs.
XIV	Organic Chemistry (General)	60+20	3 hrs.
XV	Inorganic Chemistry (Special)	60+20	3 hrs.
XVI	Inorganic Chemistry (Special)	60+20	3 hrs.
	OR		
XV	Physical Chemistry (Special)	60+20	3 hrs.
XVI	Physical Chemistry (Special)	60+20	3 hrs.
	OR		
XV	Organic Chemistry (Special)	60+20	3 hrs.
XVI	Organic Chemistry (Special)	60+20	3 hrs.
	OR		
XV	Pharmaceutical Chemistry (Special)	60+20	3 hrs.
XVI	Pharmaceutical Chemistry (Special)	60+20	3 hrs.

Semester IV

XVII	Inorganic Chemistry (Special)	60+20	3 hrs.
XVIII	Inorganic Chemistry (Special)	60+20	3 hrs.
XIX	Inorganic Chemistry (Special)	60+20	3 hrs.
XX	Inorganic Chemistry (Special)	60+20	3 hrs.
	OR		
XVII	Physical Chemistry (Special)	60+20	3 hrs.
XVIII	Physical Chemistry (Special)	60+20	3 hrs.
XIX	Physical Chemistry (Special)	60+20	3 hrs.
XX	Physical Chemistry (Special)	60+20	3 hrs.
	OR		
XVII	Organic Chemistry (Special)	60+20	3 hrs.
XVIII	Organic Chemistry (Special)	60+20	3 hrs.
XIX	Organic Chemistry (Special)	60+20	3 hrs.
XX	Organic Chemistry (Special)	60+20	3 hrs.
	OR		
XVII	Pharmaceutical Chemistry (Special)	60+20	3 hrs.
XVIII	Pharmaceutical Chemistry (Special)	60+20	3 hrs.
XIX	Pharmaceutical Chemistry (Special)	60+20	3 hrs.
XX	Pharmaceutical Chemistry (Special)	60+20	3 hrs.
XXI	Inorganic Chemistry Practicals	80+20	18 hrs.
XXII	Inorganic Chemistry Practicals	80+20	(six sessions
XXIII	Inorganic Chemistry Practicals	80+20	spread over three days)
	OR		
XXI	Physical Chemistry Practicals	80+20	18 hrs.
XXII	Physical Chemistry Practicals	80+20	(six sessions,
XXIII	Physical Chemistry Practicals	80+20	spread over three days)
	OR		
XXI	Organic Chemistry Practicals	80+20	18 hrs.
XXII	Organic Chemistry Practicals	80+20	(Six sessions,
XXIII	Organic Chemistry Practicals	80+20	spread over three days)
	OR		
XXI	Pharmaceutical Chemistry Practicals	80+20	18 hrs.
XXII	Pharmaceutical Chemistry Practicals	80+20	(six sessions,
XXIII	Pharmaceutical Chemistry Practicals	80+20	spread over three days)
	Seminar	40	
	Grand Total	2000 marks	

Tutorials 1/2 hr. per paper per group

Note: 20% marks are reserved for Lab. Record in Practicals in M.Sc. (Previous) and M.Sc. (Final).

(Modified Syllabi)

M.Sc. Chemistry (Previous)
Inorganic Chemistry (General) Paper I

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION – A

Symmetry and Group Theory in Chemistry

Definitions of group, subgroup, relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Symmetry elements and symmetry operation, Point symmetry group. Schönflies symbols, representations 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, reducible and irreducible representations, The great orthogonality theorem (without proof) and its importance, Derivation of character tables of C_{2v}, C_{3v} and D_{2h} Character tables and their use. Molecular asymmetry, dissymmetry and optical activity.

SECTION - B

Stereochemistry and Bonding in Main Group Compounds

VSEPR Theory, Walsh diagrams (tri- atomic molecules), d_{π}-p_{π} bonds, Bent rule and energetics of hybridization, Huckel theory with reference to ethylene and butadiene, Some simple substitution reactions of covalently bonded molecules of boron, silicon and nitrogen.

SECTION – C

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.

Substitution reactions in octahedral complexes, theories of trans effect with respect to Pt(II) complexes, brief account of electron transfer reactions, inert and labile complexes.

SECTION - D

Metal-Ligand Bonding

Limitation of crystal field theory, crystal field effects, John Teller distortion, nephelauxetic series, spin-orbital coupling, molecular orbital theory of octahedral, tetrahedral and square planar complexes (with and without π -bonding).

Books Suggested

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harper & Row.
3. Chemical Applications of Group Theory; F.A. Cotton, Wiley, New York.
4. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
5. The Chemical bond; J.N.Murrel, SFA Kettle and JM. Tedder; Wiley, New York.
6. Modern Aspects of Inorganic Chemistry; H.J. Emeleus and Sharpe.
7. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H. McDaniel and J.J.Alexander; John Wiley and Sons.
8. Inorganic Chemistry, A Modern Introduction; T Moeller, John Wiley and Sons.

M.Sc. Chemistry (Previous) Semester I
Physical Chemistry (General) Paper II

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

Section - A

Real Gases: Concept of Fugacity and Activity

Recapitulation of thermodynamic laws. Concept of fugacity, methods for determining the fugacity of a real gas, its variation with temperature and pressure, activity, choice of standard states, dependence of activity on temperature and pressure, determination of activity by (i) measurement of vapour pressure, (ii) distribution of solute between two immiscible solvents, (iii) emf measurement and (iv) activity of one component from known value of the activity of the other.

Partial Molar Properties

Partial molar quantities, chemical potential and Gibbs-Duhem equation, variation of chemical potential with temperature and pressure, chemical potential for

an ideal gas, chemical potential in ideal gas mixture, determination of partial molar volume, thermodynamic functions of mixing (free energy, entropy, volume and enthalpy), concept of escaping tendency and chemical potential.

SECTION - B

Chemical Kinetics

Collision theory of reaction rates, the steric requirement, Arrhenius equation and activated complex theory (ACT), comparison of collision and activation complex theory, Potential energy surfaces (Only basic Idea), thermodynamic formulation of activated complex theory, chain reactions (hydrogen-halogen reaction), unimolecular reactions, Lindemann – Hinshelwood mechanism of unimolecular reactions.

SECTION – C

Electrochemistry

Debye-Hückel theory of ion-ion interaction and activity coefficient, applicability and limitations of Debye-Hückel limiting law, its modification for finite-sized ions, effect of ion-solvent interaction on activity coefficient. Physical significance of activity coefficients, mean activity coefficient of an electrolyte.

Debye-Huckel-Onsager (D-H-O) theory of electrolytic conductance , Debye-Falkenhagen effect, Wein effect. D-H-O equation - its applicability and limitations, Pair-wise association of ions (Bjerrum treatment), Modification of D-H-O theory to account for ion-pair formation.

Metal/Electrolyte interface, Concept of electrical double layer and its structure: Helmholtz-Perrin, Gouy-Chapman, and Stern models, electrokinetic phenomena, determination of zeta potential.

SECTION-D

Surface Chemistry and Catalysis

Gibbs adsorption equation, Langmuir adsorption isotherm and its kinetic derivation for non- dissociative and dissociative adsorption, BET adsorption isotherm, its kinetic derivation and applications.

Study of surfaces by STM, SEM. Heterogeneous catalysis, surface heterogeneity, surface catalyzed unimolecular and bimolecular reactions, temporary and permanent catalytic poisons, activation energy for surface reactions. Comparison of homogeneous and heterogeneous reaction rates.

Books Suggested

1. An Introduction to Chemical Thermodynamics, R.P. Rastogi and R.R. Misra, Vikas Pub.
2. Physical Chemistry, P.W. Atkins, Oxford University Press.
3. Thermodynamics for Chemists, S. Glasstone, Affiliated East-West Press.
4. Thermodynamics, I.M. Klotz and R.M. Rosenbers, Benzamin.
5. Chemical Kinetics, K.J. Laidler, McGraw Hill.
6. Kinetics and Mechanism, A. A. Frost and R.G. Pearson, John Wiley and Sons.
7. Electrochemistry, S. Glasstone, Affiliated East-West Press.
8. Physical Chemistry, G.W. Castellan, Narosa.
9. Heterogeneous Catalysis: Fundamentals and Applications, Julian R.H. Ross, Wiley-VCH; 2nd, Revised and Enlarged Edition edition (October 1, 2007)
10. Concepts of Modern Catalysis and Kinetics, I. Chorkendorff and J. W. Niemantsverdriet

M.Sc. Chemistry (Previous) Semester I
Organic Chemistry (General) Paper III

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting atleast one question from each section. All questions carry equal marks.

SECTION – A

Reaction Mechanism: Structure and Reactivity

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, 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, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, Generation, structure, stability and reactivity of carbocations, carbanions, carbenes and nitrenes.

SECTION - B

Mechanism of Nucleophilic Aliphatic Substitution

The limiting cases SN^1 and SN^2, detailed mechanistic description and border line mechanisms, nucleophilicity and solvent effects, competition between nucleophilicity and basicity, ambident nucleophiles, hard and soft nucleophiles and electrophiles, leaving group effects, steric and other substituent effects on substitution and ionization rates, stereochemistry of nucleophilic substitution, SN^i, $SN^{1'}$, $SN^{2'}$ and $SN^{i'}$ mechanisms.

Mechanism of Elimination Reactions

The El, ElcB and E2 mechanism, Orientation Effects in Elimination Reactions, Saytzeff and Hoffman rules, Stereochemistry of E2 Elimination Reaction and Eclipsing Effects in E2 Eliminations. Dehydration of Alcohols, Elimination not involving C-H Bonds, Pyrolytic eliminations.

SECTION – C

Stereochemistry-I

Symmetry elements, D-L, R-S, E-Z and threo-erythro nomenclature, interconversion of Fischer, Newman, Sawhorse and flying wedge formulae. conformational analysis, enantiomerism and diastereomerism of simple, cyclic (chair and boat configuration) and acyclic systems. Axial and planer chirality, optical isomerism in allenes, biphenyls (atropoisomerism), spiranes, hemispiranes. elementary ideas about stereochemistry of tertiary amines, quaternary salts, sulphur and phosphorous compounds.

SECTION - D

Stereochemistry –II

Topicity of ligands and faces, their nomenclature and prostereoisomerism, stereogenecity, chirogenicity, pseudoasymmetry and prochiral centre. stereospecific and stereoselective reaction.

Elementary idea of principle categories of asymmetric synthesis, Cram's rule and its modification, Prelog rule and horeaus rule.

Stereochemistry of sugars- C1 and 1C conformations of hexoses, c_2'-endo and c_3'-endo conformation of pentoses, homomorphous sugars, abnormal mutarotation and Δ-2 instability factor.

Stereochemistry of decalins,

Chemical correlation of configuration-determination of relative configuration of 2-butanol, isoserine, alanine, malic acid, lactic acid and mandelic acid.

Books Suggested

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

M.Sc. Chemistry (Previous) Semester I
Chemistry of Life Science Paper IVa

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set; two will be set from section A and three from each of the sections B & C. The candidates are required to attempt five questions in all selecting atleast one question from each section.

SECTION - A

Cell Structure and Metabolism

Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes - catabolism and anabolism. ATP - the biological energy currency. Carbohydrate metabolism-glycolysis, Kreb's cycle, glycogenolysis, glycogenesis pentose phosphate pathway and gluconeogenesis,

Carbohydrates

Structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars-N-acetylmuramic acid and sialic acid, disaccharides

Structure and biological functions of Structural polysaccharides - cellulose and chitin.Storage polysaccharides-starch and glycogen.

Heteropolysaccharides-glucosaminoglycans or mucopolysaccharides. Glycoconjugates- glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances.

SECTION - B

Lipids

Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins - composition and function, role in atherosclerosis.

Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure.

Lipid metabolism - β-oxidation of fatty acids.

Amino-acids, Peptides and Protein

Essential amino acids, Isoelectric pH,chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins, forces responsible for holding of secondary structures. α-helix, β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein- folding and domain structure. Quaternary structure. denaturation of proteins

SECTION – C

Nucleic Acids and Genetic Code

Structure of nucleotides, nucleosides, DNA (Watson-Crick model) RNA structure and conformation,

Study of prokaryotes

Replication of DNA (semi-conservative, conservative and dispersive replication Maselson-Stahl experiment), transcription, translation of genetic material, genetic code, universality of the code, codon, anticodon pairing, RNA, protein biosynthesis (initiation, elongation, termination and processing of the peptide chain).

Books Suggested

1. Principles of Biochemistry, A. L. Lehninger, Worth Publishers.
2. Biochemistry, L.Stryer, W.H.Freeman.
3. Biochemistry, J. David Rawn, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry, E. E.Conn and P. K. Stumpf, John Wiley.

Or

M.Sc. Chemistry (Previous) Semester I
Mathematics for Chemists Paper IVb

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from section A and three from each of the sections B & C. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION - A

Vectors

Examples of scalar and vectors, definitions of vectors in two, three spaces, representation and simple properties of vectors, addition and subtraction of vectors, vector addition by the method of triangles, resolution of vectors into rectangular components, addition of vectors by components, multiplication and differentiation of vectors. Scalar product of vectors, vector product, concept of normalization, orthogonality and complete set of unit vectors. Illustration of applications to spectroscopy and quantum chemistry.

Matrices and Determinants

Definition of matrix, types of matrices, viz. row matrix, column matrix, null matrix, square matrix, diagonal matrix, addition, subtraction and multiplication by a number, matrix multiplication. Transpose and adjoint of matrix, elementary transformation, representation and applications (without development of theory) to solution of linear equations. Definition of determinant, properties of determinants, evaluation of determinants. Illustration or applications to group theory, problems in chemistry.

SECTION - B

Logarithm

Need for logarithm in chemistry. Theory and application of logarithms for solving general and chemical problems.

Graphical Representation of Equations

Rectangular coordinates, straight lines, slope and intercept of the equation, slope and point equation, two point equation, parallel lines, points of intersection, distance between two points, change of origin. Examples from problems in chemistry, curve fitting for least squares method.

Elements of Algebraic and Trigonometric Functions

The binomial expansion, some example from chemistry, sines, cosines and tangents, trigonometric identities, polar coordinates in trigonometric functions.

Differential Calculus

Theory, rules of differentiation, powers, added and subtracted functions, constants, products, quotients, functions of a function, logarithmic differentiation, and parametric functions. Algebraic simplification, differentiation of implicit functions, graphical significance of differentiation, rate of change of slope, successive differentiation. Examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution. Exact and inexact differential with their application to thermodynamic principles.

SECTION-C

Partial Differentiation

The fundamental theorem, geometrical significance of partial differentiation, special cases of fundamental theorem, successive partial differentiation. Integral transforms (Fourier and Laplace). Reduction formulae, application to chemical problems. Methods of Lagrangian multipliers, Sterling's approximation, probability and errors.

Integral Calculus

Integral theory, rules of integration between limits, significance of 'e' exponential equations, methods of integration, viz. algebraic simplifications, substitution, integration by parts, integration by partial fractions, coordinate transformation (e.g., cartesian to spherical polar), curve sketching, integral as area. Illustration of application in chemistry. Evaluation of standard integrals used in chemistry.

Differential Equation

Simple differential equations, separable variables, homogeneous equations, exact equations, linear equations, equation of the first and second order, partial differential equation, application to physico-chemical problems.

Books Suggested

1. Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill.
2. Mathematical Preparation for General Physics, J.B. Marian, R.C. Davidson Saunder Company.
3. Mathematical Methods for Science Students, G. Stephemen, ELBS.
4. Chemical Thermodynamics, R.C. Reid.

Or

M.Sc. Chemistry (Previous) Semester I
Introduction to Pharmacy and Pharmacology Paper IVc

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two will be set from section A and three from each of the sections B & C. The candidates are required to attempt five questions in all selecting atleast one question from each section.

SECTION-A

General : Introduction to Pharmaceutical sciences, history and development of chemotherapeutic agents, its branches, standards for drugs, naming of drugs, therapeutic index, LD50 and ED50, Pharmaceutical literature, official books, routes of drug administration

Cell Structure & Cellular Physiology: Sub cellular organization, membrane processes, cell metabolism, cell division, Structure and function of epithelial connective, muscular and nervous tissues, Muscle contraction and properties, Nerve impulse generation and transmission. Skull & Skeleton.

Respiratory System: Structure respiratory volumes and capacities, ventilation, compliance and resistance, gaseous exchange and transport in blood, nervous and chemical regulations of respiration. Acid-base balance.

Renal system: Structure of kidney and urinary tract; nephorn transport processes concentration and dilution of urine, renal control of body fluids, plasma clearances, Maturation.

SECTION-B

Major Categories of formulations, Physical properties and Chemical characteristics of drugs influencing their formulations.

Metrology : Introduction, units of weight and volume in both imperial and metric system, Simple calculations involved in preparing solutions of solids in liquids and liquids based on imperial and metric systems, method of allegation.

Pre formulation considerations : Analytical methods for characterization of drugs, determination of pKa value, pH, solubility profile, and effect of tempeprature, solution and solid state stability.
Emulsions: Types, identification, and selection of emulgents, preparation and stability. Emphasis may be given on official products.
Suspensions and mixtures: Practical considerations, preparation of products of different categories evaluation, stability, and official suspensions.
Semi-Solid Dosage Forms: A brief description, preparation of ointments, creams jellies and suppositories.
Aerosol Dosage Forms: Advantages, formulation and standardization.

SECTION-C

Pharmacokinetics: ADME (Absorption, distribution, metabolism-Phase I and Phase II reactions, Excretion) of drugs, Important pharmacokinetic parameters-apparent volume of distribution, bioavailability, clearance.
Pharmacodynmics: Elementary idea about drug action, drug targets, neurotransmitters, the receptor role, Drug Receptor Interactions, types of receptors-ion channel receptors, G-protein coupled receptors, kinase-linked receptors, ion channels and their control, membrane bound enzymes-activation/deactivation, design of agonists and antagonists.
Principles of toxicology and treatment of poisoning : Introduction, Toxic agents, Toxicity-acute, subacute and chronic, descriptive toxicity tests in animals, General principles of management of poisoning, antidotes, Treatment of heavy metal poisoning and drugs (barbiturates, benzodiazepines, salicylates, morphine & morphine derivatives, alcohol)

Books Recommended:

1. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
2. B.G.Katzung, Basic and Clinical Pharmacology, L:auge Medical Publication, 1995.
3. Introduction to Pharmacology by P.C. Dandya and S.K. Kulkarni.

M.Sc. Chemistry (Previous) Semester II

M.Sc. Chemistry (Previous)
Inorganic Chemistry (General) Paper V

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION – A

Electronic Spectra and Magnetic Properties of Transition Metal Complexes-I

Electronic arrangements of microstates, calculation of the number of microstates in various electronic arrangements, spectroscopic term symbols, vector diagrams to indicates coupling of orbital angular momenta in p^2, p^3, d^2 configurations and spin orbit coupling for p^2 arrangement, spectroscopic terms, spectral terms of d^2 to d^8 metal ions, determining the ground state terms-Hund's rules, derivation of the term symbol for a closed subshell.

SECTION – B

Electronic Spectra and Magnetic Properties of Transition Metal Complexes-II

Interpretation of electronic spectra, Orgel diagrams, Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of Dq, B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

Circular Dichroism and Optical Rotatory Dispersion

Polarized light, fundamental symmetry requirements, for optical activity, interaction of polarized light with optically active matter, optical rotation, Cotton effect, configuration of Tris-chelated complexes.

SECTION - C

Metal л-Complexes

Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls;

preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.

SECTION - D

Metal Clusters

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

Books Suggested

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harper & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
5. Introduction to Ligand fields; B.N. Figgis, Wiley, New York.
6. Modern Aspects of Inorganic Chemistry; H.J. Emeleus and Sharpe.
7. Introduction to Ligand Field Theory; C.J.Ballahyen, McGraw Hill, New York.
8. Organometallic Chemistry; R.C.Mehrotra and A.Singh, New Age International.
9. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H.McDaniel and J.J.Alexander; John Wiley.
10. The Organometallic Chemistry of the Transition Metals; R.H. Crabtree, John Wiley.

M.Sc. Chemistry (Previous) Semester II
Physical Chemistry (General) Paper VI

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION-A

Quantum Mechanics-I

The postulates of quantum mechanics, Linear and Hermitian operators. Commutation of operators and Uncertainty Principle. Schrodinger equation, eigen function and eigen values, free particle, Schrodinger equation for a particle in a box, the degeneracy, particle in a box with a finite barrier, Schrodinger equation for linear harmonic oscillator and its solution, zero point energy, Tunneling Problem: Tunneling through a rectangular barrier.

SECTION – B

Quantum Mechanics-II

Energy levels and wave-functions of Rigid rotator. Hydrogen atom: Complete solution (separation of variables in spherical polar coordinates and its solution). Radial distributions. Angular momentum and its directional quantization, Angular momentum operators, commutation relation, shape of atomic orbitals upto d-level and their discussion.

SECTION – C

Basics of Polymers and Polymerization

Revision of Basic concepts, Kinetics of Polymerization: Mechanism and Kinetics of chain growth polymerization: free-radical, cationic, anionic and coordination polymerization. Mechanism and Kinetics of step-growth polymerization. Comparison between step-growth and chain polymerization. Molecular mass of polymers: Significance of average molecular mass. Poly-dispersity, Molecular mass distribution curves. Determination of molecular mass by osmometry and viscosity methods. Electrically conducting polymers, Fire resistant polymers, Liquid crystal polymers.

SECTION-D

Nuclear and Radiochemistry

Nuclear stability and binding energy. Mass and binding energy, Nuclear fission and nuclear fusion, fission cross section, chain fission, fission product and fission yield. Interaction of nuclear radiation with matter, Detectors (Proportional, Geiger-Muller and Scintillation counters) and their principles. Units for measuring radiation absorbed, radiation dosimetry.

Radiotracer technique, Activation analysis, isotope dilution technique, Radiochromatography, radiometric titrations, Neutron absorptiometry. Some applications

Books Suggested

1. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
2. Quantum Chemistry, I.M. Levine, Prentice Hall.
3. Essentials of Nuclear Chemistry, 4th Edition (1995), H.J. Arnikar, Wiley Eastern, New Delhi.
4. Nuclear & Radiochemistry, 3rd Edition (1981), G. Fridlander, J.W. Kennedy, E. S. Macias, and J. M. Miller, John Wiley, New York.
5. Introduction to Nuclear Chemistry, B. C. Harvey Prentice-Hall (1969).
6. Polymer Chemistry, Billmayer
7. Polymer Chemistry, Gowarikar
8. Principles of Polymerization, Geroge Odian.
9. Quantum Chemistry, B. K. Sen, Kalyani Publishers
10. Quantum Chemistry, R. Prasad, New Age International.

M.Sc. Chemistry (Previous) Semester II
Organic Chemistry (General) Paper VII

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two questions from each of the sections A, B, C & D. The candidates are required to attempt five questions in all, selecting atleast one question from each section. All questions carry equal marks.

SECTION – A

Aromatic Electrophilic Substitution

Theoretical treatment of aromatic substitution reactions, structure-reactivity relationship in mono substituted benzene ring, orientation in other ring system, energy profile diagram, Vilsmeir-Haak reaction, Reimer-Tiemann reaction, Bischler - Napieralski reaction, Pechamann reaction, Houben-Hoesch reaction, Fries rearrangement

Nucleophilic Aromatic Substitution

Mechanism of Nucleophilic substitution in aromatic systems via diazonium ions, by addition-elimination and elimination-addition machanism (involving arynes); von-Richter rearrangement, Sommelet-Hauser and Stevens rearrangements.

General aspects of generation, structure, stability and reactivity of arynes

SECTION-B

Aliphatic Electrophilic Substitution

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

Neighbouring Group Participation and Carbocation Rearrangements

Anchimeric assistance, neighbouring group participation by non-bonding electrons, sigma and π-bonds, classical and non-classical carbocation, carbocations rearrangements, migratory aptitudes, Wagner Meerwein rearrangement, pincol pinacolone rearrangement, Demjanove rearrangement, Tiffeneau-Demjanove ring expansion, aldehyde-ketone rearrangement, dienone-phenol rearrangement and trans-annular rearrangements.

SECTION – C

Free Radicals

General aspects of generation, structure, stability and reactivity of free radicals, types of free radical reactions, halogenation including allylic halogenation (NBS), auto-oxidation, decomposition of azo compounds and peroxides, coupling of alkynes, homolytic aromatic substitution, Sandmeyer reaction and Hunsdiecker reaction.

Addition to C-C Multiple Bond

Mechanism of addition of hydrogen halide, H_2O, halogens, HOX and mercuric salt to alkenes and alkynes. Hydroboration, formation of C-C bonds via organoboranes, hydroboration of acetylenes, nucleophilic addition to alkenes.

SECTION-D

Addition to Carbon-Hetero Atoms Multiple Bonds

Hydration and Addition of Alcohols to Aldehydes, Ketones and Acids. Addition - Elimination Reactions of Ketones and Aldehydes, Reactivity of carbonyl compounds towards Addition.

Mannich Reaction, lithium aluminium hydride, reduction of carbonyl compounds, acids, esters, nitriles, additions of Grignard reagents. Reformatsky reaction, Wittig reaction, Claisen condensation, Dieckman reaction, Aldol condensation, Knoevenagal condensation, Perkin reaction, Cannizzaro reaction, Benzoin condensation, Robinson-Mannich reaction, Ester hydrolysis, aminolysis of esters, amide hydrolysis.

Books Suggested

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

M.Sc. Chemistry (Previous) Semester II
Applications of Computer in Chemistry Paper VIII

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from section A and three from each of the sections B & C. The candidates are required to attempt five questions in all selecting at least one question from each section.

SECTION- A

Elementary Aspects of computer, memory size/architecture. Binary, octal & hexadecimal number systems. Using Internet, word processing package; Graphics Package and visualization. Introduction to Operating system (UNIX, Windows) and programming language. Algorithm, Flow charts. Writing simple programs, converting a flow chart into a program. Using graphics package plotting (a) $y = x$, x^2, sin(x), tan(x) (b) wavefunctions for s, p, and d – orbitals.

SECTION-B

Numerical Methods: Roots of Polynomials, Solution of Linear simultaneous equations, matrix multiplication and inversion. Numerical differentiation and integration. Statistical treatment of data, variance and correlations, linear regression, Curve fitting.

SECTION – C

Using ChemDraw. Writing programs for van der Waals equation, pH titration, kinetics, radioactive decay, evaluation of lattice energy and ionic radii from experimental data. Elementary structural features such as bond lengths, bond angles, dihedral angles etc. of molecules extracted from a database such as Cambridge database.

Books Suggested

1. Introduction to Computer Science, P.K. Sinha
2. Let Us C, Yashwant Kanetker
3. Computational Chemistry, A.C. Norris.
4. Programming in Fortran 90 and 95, V. Rajaraman.

M.Sc. Chemistry (Previous) Semester I & II
Inorganic Chemistry Practical (General) Paper IX

Time: 6 Hrs
(Two sessions)

Max. Marks: 80+20(IA)

I. **Qualitative analysis:** **30 Marks**

Total five radicals to be given containing two less common metal ions, one insoluble and two acid radicals.

Less common metal ions - W,Tl,Mo,Se,Ti,Zr,Th,V,U,Ce,Be.(two metal ions in cationic/anionic forms)

Insolubles: Halides (AgCl, AgBr, AgI); Sulphates ($PbSO_4$,$BaSO_4$) and Oxides(Al_2O_3,Cr_2O_3,SnO_2, TiO_2, SiO_2)

II **Quantitative Analysis** **15 Marks**

Separation of the metal ions and determination of any one of them using volumetric/gravimetric methods.

Cu-Ni, Cu-Zn, Cu-Al, Ca-Ba, Fe-Mg, Fe-Ni etc.

III **Preparations:** **10 Marks**

Preparation of selected inorganic compounds and their spectroscopic studies.

1. $Hg[Co(SCN)_4]$
2. $Ni(dmg)_2$
3. $[Cu(NH_3)_4]SO_4\ H_2O$
4. Prussian Blue and Turnbull's Blue.
5. $Na[Cr(NH_3)_2(SCN)_4]$
6. $Mn(acac)_3$
7. $[Ni(NH_3)_6]Cl_2$
8. $VO(acac)_2$

IV **Lab. Record** **15 Marks**

Viva-voce **10 Marks**

Books Suggested

1. A Text Book of Macro and Semi-micro Quantitative Analysis, A.I.Vogel, Orient Longman.
2. A Vogel's Text Book of Quantitative Inorganic Analysis, J. Bassett, R.C. Denney, G.B. Jaffery and J. Menaham, Longman, London.
3. Synthesis and Characterization of Inorganic Compounds, W.B. Jolly, Prentice Hall, Englewood.
4. Synthesis and Physical Studies of Inorganic Compounds, C.F. Bell, Pergamon Press
5. Inorganic Preparations; W.G. Palmer.

M.Sc. Chemistry (Previous) Semester I & II
Physical Chemistry Practical Paper X

Time: 6 Hrs
(Two sessions)
Max Marks: 80+20(IA)

I **Experiments**

Refractometry

[1] Determine the refractive index of simple organic liquids like methyl acetate, ethyl acetate, methanol, ethanol, n-hexane, chloroform.

[2] Determine the refractivity and molar refractivity of some organic liquids like methyl acetate, ethyl acetate, methanol, ethanol, n-hexane, chloroform.

[3] Determine the molar refractivities for CH_2, C, H and Cl.

[4] Study the variation of refractive index with concentration for KCl solution and thereafter determine the unknown concentration of given KCl solution.

Polarimetry

[5] (a) Study the variation of angle of optical rotation with the concentration of any optically active substance (sucrose or glucose) and thereafter determine the unknown concentration of the same substance in given solution.

(b) Determine the specific and molecular rotation of sucrose or glucose at number of concentrations.

[6] Study the kinetics of inversion of cane-sugar (sucrose) in presence of an acid.

Potentiometry

[7] Determine the standard electrode potential of Cu and Zn.

[8] Determine the strength of a given solution of ferrous ammonium sulphate by potentiometric titration with $K_2Cr_2O_7$ solution.

[9] Study the precipitation titration between KCl and $AgNO_3$ potentiometrically.

[10] Determine the strength of iodide, bromide and chloride in a mixture by potentiometric titration with silver nitrate.

Conductometry

[11] Determine the strength of strong acid by conductometric titration with strong base.

[12] Determine the strength of weak acid by conductometric titration with strong base.

[13] Determine the strength of strong acid and weak acid in a mixture by conductometric titration with strong base.

[14] Study precipitation titration between KCl and $AgNO_3$ conductometrically. Determine the strength of given solution of $AgNO_3$.

[15] Determine the basicity of mono-, di- and tri-basic acids conductometrically.

[16] Determine solubility and solubility product of sparingly soluble salts like $PbSO_4$, $BaSO_4$.

pH-metry

[17] Determine the strength of strong acid by pH-metric titration with strong base.

[18] Determine the strength of weak acid by pH-metric titration with strong base.

[19] Determine the dissociation constant of acetic acid using pH-meter.

Chemical Kinetics

[20] Study the hydrolysis of methyl acetate in presence of hydrochloric acid.

[21] Study saponification of ethyl acetate by sodium hydroxide solution using same initial concentration of both the reactants.

[22] Study saponification of ethyl acetate by sodium hydroxide solution taking the initial concentration of ester and base to be different.

Viscosity

[23] Determine the viscosity of methyl acetate and ethyl acetate using Ostwald viscometer.

[24] Study the variation of viscosity with concentration for a glycerol solution using Ostwald viscometer and thereafter determine the concentration of unknown solution of glycerol.

[25] Determination of molar mass of a polymer.

Distribution Law

[26] Determine distribution coefficient of ammonia between chloroform and water.

[27] Determine the formula of the complex formed between copper (II) ion and ammonia using distribution method.

Adsorption

[28] Verify the Freundlich and Langmuir adsorption isotherms for adsorption of acetic acid/oxalic acid on activated charcoal.

Note: Any experiment can be introduced or deleted in the practical class on the basis of availability of instruments/chemicals.

Experiment: **55 Marks**
Lab Record: **15 marks**
Viva-voce: **10 marks**

Books Suggested

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
5. Experiments in Physical Chemistry, D.P. Shoemaker
6. Experiments in Physical Chemistry, D.V. Jahagirdhar.
7. Senior Practical Physical Chemistry by B.D. Khosla, V. Garg and A. Gulati.
8. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.

M.Sc. Chemistry (Previous) Semester I & II
Organic Chemistry Practical XI

Time: 6 Hrs
(Two sessions)
Max. Marks: 80+20(IA)

I. Purification of organic compounds involving fractional crystallization, fractional distillation, steam distillation, sublimation and extraction.

Systematic identification of pure organic compounds: separation and identification of simple binary mixtures having acidic, basic and neutral components. Preparation of their derivatives.

II. Preparation of organic compounds involving two stages. Estimation of phenol and aniline. Determination of the molecular weight of an acid by titration and by the silver salt method.

III. **Experiment** **Marks: 55**

Lab record & Viva-voce **Marks: 15+10**

Books Suggested

1. A Hand book of Organic Analysis-Qualitative and Quantitative by H.T. Clarke, and revised by B.Haynee, Edward Arnold, London 1975.
2. Vogel's Text Book of Practical Organic Chemistry by B.S. Furhen et. al., Longman-Group Ltd.
3. Systematic Qualitative Organic Analysis by H. Middleton, Edward Arnold (Publishers) Limited, London 1959.
4. Elementary Practical Organic Chemistry by Arthur I. Vogel, EX CBS Publishers and Distributors.
5. Experiments in Organic Chemistry by Louis, F.Fieser, D.C. Heath and Company Boston, 1955.

M.Sc. Chemistry (Final) Semester III

M.Sc. Chemistry (Final)
Inorganic Chemistry (General) Paper XII

Time: 3Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from section-A and three each from sections B & C. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION - A

Hydrosphere

Chemical composition of water bodies - lakes, streams, rivers and wet lands etc., Hydrological cycle. Water pollution – inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters – dissolved oxygen, biochemical oxygen demand, solids, metals, content of chloride, sulphate, phosphate, nitrate and micro-organisms. Water quality standards.

Atmosphere

Chemical composition of atmosphere – particles, ions and radicals and their formation, Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S and their effect, pollution by chemicals, petroleum, minerals, chlorofluorohydrocarbons. Green house effect, acid rain, air pollution controls and their chemistry.

SECTION - B

Metal Ions in Biological Systems

Essential and trace metals.
Na^+/K^+ Pump

Role of metals ions in biological processes

Transport and Storage of Dioxygen

Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythrin, model synthetic complexes of iron and cobalt.

Electron Transfer in Biological Systems

Structure and function of metalloproteins in electron transport processes-cytochromes and iron-sulphur proteins, synthetic models.

Polarography

General principles, diffusion controlled current, Ilkovic equation (without proof), Half-wave potentials, over potential, theories of hydrogen overvoltage, (Tafel's theory / Recombination theory and Volmer, Erdy & Gruss theory / theory of slow discharge of ions).

SECTION - C

Vibrational Spectroscopy

Symmetry and shapes, and no. of IR modes AB_2, AB_3, AB_4, AB_5 and AB_6 (Group Theoretical treatment) mode of bonding of ambidentate ligands and diketonato complexes, application of resonance Raman spectroscopy particularly for the study of active sites of metalloproteins.

Mössbauer Spectroscopy

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

Photoelectron Spectroscopy

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

Books Suggested

1. Principles of Bioinorganic Chemistry: S.J. Lippard and J.M. Berg, University Science Books.
2. The Inorganic Chemistry of Biological Process; M.N. Huges; John Wiley & Sons.
3. Environmental Chemistry; S.E. Manahan; Lewis Publisher.
4. Environmental Chemistry; A.K.De, Wiley Eastern.
5. Physical methods in Chemistry; R.S.Drago; Saunders, Philadelphia.
6. Text Book of Quantitative Inorganic Analysis; A.I. Vogel ELBS; London.
7. Environmental Pollution Analysis; S.M. Khopkar, Wiley Eastern.
8. Fundamentals of Molecular Spectroscopy; C N Banwell; McGraw Hill.
9. Environmental Chemistry; S.K. Banerji; Prentice - Hall.

M.Sc. Chemistry Semester III
Physical Chemistry (General) Paper XIII

Time: 3 Hrs

Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from section A and three from each of the sections B & C. The candidates are required to attempt five questions in all selecting at least one question from each section.

SECTION – A

Unifying Principles

Electromagnetic radiation, Interaction of electromagnetic radiation with matter-absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering. Uncertainty relation and natural line width and line broadening, transition probabilities, results of the time dependent perturbation theory, transition moment, selection rule, intensity of spectral lines, Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels.

Microwave Spectroscopy

The rotation of molecules, rotational spectra of rigid diatomic molecules, intensities of rotational spectral lines, isotopic effect, non-rigid rotator, spectra of polyatomic linear molecules and symmetric top molecules.

Infrared Spectroscopy

The vibrating diatomic molecule, force constant, zero point energy, simple harmonic vibrator, anharmonicity, Morse potential, overtones, hot bands, diatomic vibrating rotators, P,Q,R branches, vibration of polyatomic molecules, normal mode of vibrations. Fourier transform spectroscopy.

Raman Spectroscopy

Classical and quantum theories, pure rotational Raman spectra of linear molecules, vibrational Raman spectra, mutual exclusion principle, polarization of the light and Raman effect, depolarization of Raman lines, technique.

SECTION – B

Nuclear Magnetic Resonance Spectroscopy

Basic principles of NMR, theory of nuclear magnetic resonance, spin lattice relaxation, spin-spin relaxation, experimental techniques chemical shift, the δ -scale

of chemical shift, the origin of shielding constant, pattern of coupling, origin of spin-spin coupling, the nuclear overhauser effect.

Electron Spin Resonance Spectroscopy

Basic principles of ESR, experimental technique, the g-value hyperfine structure, applications of ESR spectroscopy to the study of free radicals and fast reactions, spin densities and Mc Connell relationship.

Nuclear Quadrupole Resonance Spectroscpy

Basic principles of NQR, experimental techniques, Zeeman effect in NQR spectra, quadrupole interactions in molecules, applications.

SECTION – C

X-ray Crystallography

Symmetry elements in crystals, criteria for determining unit cell of lattice, stereographic projections, point groups (illustration of R, R-bar, Rm, R/m, R-bar/m point groups only), miller indices for planes, space lattices, space groups P1, Pbar1, P2, P21, Pm, Pc, Cc, C2, Cm, C2/m. Defects in crystal. Derivation of equilibrium concentration of Schottky and Frenkel defects.

Production of X-rays, X-ray spectra, absorption edges, X-ray filters, Reciprocal lattice concept and its importance, Definition of Reciprocal lattice vector (derivation excluded). Interplanar spacing using reciprocal lattice concept for cubic, tetragonal, orthorhombic and hexagonal crystal systems. Equivalence of Bragg's and Laue condition. Structure factor calculations for primitive, base-centered, body-centered and face centered unit cells. Relation of structure factor to electron density and intensities (derivation excluded). Data collection and data reduction, Phase problem – Patterson method and Heavy-atom method, refinement of structure by successive and difference fourier synthesis. Correctness of a structure (Discrepancy index).

Electron diffraction: Basics, Measurement technique, Comparison with X-ray diffraction technique. Applications in structure determination.

Neutron diffraction: Basics, measurement techniques, Applications and comparison with X-ray diffraction technique.

Books Suggested

1. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata McGraw Hill.
2. Modern Spectroscopy, J.M. Hollas, John Wiley.
3. Basic Principles of Spectroscopy, R.Chang, McGraw Hill.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
5. Physical Method in Chemistry, R.S. Drago, Saunders College.
6. Elementary Crystallography, L. Azaroff.

7. Structure Determination by X-ray Crystallography, M. Ladd and R. Palmer
8. X-Ray Structure Determination: A Practical Guide, 2nd Edition by George H. Stout and Lyle H. Jensen
9. Essentials of Crystallography, McKie & McKie, Blackwell Scientific Publications, 1986
10. Handbook of X-rays, Emmett and F. Kaelbse, McGraw Hill.

M.Sc. Chemistry (Final) Semester III
Organic Chemistry (General) Paper XIV

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two s from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting atleast one question from each section. All questions carry equal marks

SECTION - A

Ultraviolet and Visible Spectroscopy

Various electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

Infrared Spectroscopy

Instrumentation and sample handling. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. FT IR, IR of gaseous, solids and polymeric materials.

SECTION - B

Nuclear Magnetic Resonance Spectroscopy

General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), complex spin-spin interaction between two, three, four and five nuclei (first order spectra),

spin system-Pople notation, virtual coupling. Stereochemistry, concept of topicity, effect of enantiomeric and diastereomeric protons, hindered rotation, Karplus curve - variation of coupling constant with dihedral angle.Fourier transform technique,. Resonance of other nuclei-F, P.

Further tools for simplification (chemical and instrumental) and elucidate structures by NMR including an overview of 2D NMR Techniques- Deuteration, changing solvents, trifluoroacetylation, basification and acidification, shift reagents, spin decoupling, COSY, DEPT, INEPT, HETCOR, HSQC, HMBC and NOESY.

SECTION - C

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, Nitrogen rule, molecular weight determination molecular formula from isotopic ratio data, isotope profile of halogen compounds, factors affecting reaction pathways, fragmentation pattern - simple cleavage, retro-Diels Alder, Hydrogen transfer rearrangement like scrambling, ortho effect, McLafferty rearrangement, fragmentation patterns of hydrocarbons, alcohols, phenols, ethers, aldehydes, ketones, esters, carboxylic acids, amines, nitro, amides, nitriles.

Carbon-13 NMR Spectroscopy

General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. nuclear Overhauser effect (NOE).

Problems

Problems pertaining to sections A, B and C.

Books Suggested

1. Introduction to Spectroscopy- A Guide for Students of Organic Chemistry, 2nd Edn. By Donald L. Pavia, Gary M. Lampman and George S. Kriz. Saunders Golden Sunburst Series. Harcourt Brace College Publishers, New York.
2. Spectrometric Identification of Organic Compounds, R. M. Silverstein, G. C. Bassler and T. C. Morrill, John Wiley.
3. Application of Spectroscopy of Organic Compounds, J. R. Dyer, Prentice Hall.
4. Spectroscopic Methods in Organic Chemistry, D. H. Williams and I. Fleming, Tata McGraw-Hill.
5. Spectroscopy of Organic Compounds by P.S. Kalsi, Wiley Estern, New Delhi.
6. Organic Spectgroscopy by William Kemp, John Wiley.
7. Organic Mass Spectrometry by K.G. Das & E.P. James, Oxford & IBH Publishing Co.

8. Organic Spectroscopy (Principles & Applications) by Jagmohan.

M.Sc. Chemistry (Final) Semester III
Inorganic Chemistry (Special) Paper XV

Time :3 Hrs
Max.Marks:60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION – A

Reaction Mechanism of Transition Metal Complexes

Energy profile of a reaction, reactivity of metal 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 reactions.

SECTION - B

Electron Transfer Reactions

Redox reactions, electron transfer reactions, general discussion and kinetic rate laws., mechanism of one electron transfer reactions, outer-sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions, two electron transfer reactions, metal ion catalysed reactions, mixed valence complexes and their electron transfer.

SECTION - C

Reactions of metal complexes

Reactions of metal complexes having ligands as nitrile, phosphate and azide. Reactivity of coordinated hydrocarbons: a) Nucleophilic addition and substitution b) Rearrangement reactions, Redistribution reactions, Fluxional isomerism of organometallics.

SECTION – D

Inorganic Polymers

Classification, types of inorganic polymerization, comparison with organic polymers, boron-nitrogen polymers, silicones, coordination polymers, phosphorus-nitrogen compounds.

Non-aqueous Solvents

Reaction in non-aqueous media with respect to H_2SO_4, BrF_3, N_2O_4 and phosphoryl chloride; Kinetics and mechanism of coordination reactions in non-aqueous media.

Books Suggested

1. Mechanism of Inorganic Reactions; F.Basolo and R.G. Pearson, John Wiley and Sons, New York.
2. Inorganic Reaction Mechanism; M.L. Tobe; Nelson, Wlaton and Thames
3. Inorganic Chemistry; K.F. Purcell, J.C. Kotz; Holt-Sanders International Editions; Philadelphia.
4. The Chemistry of Molten Salts; H. Bloom Benjamin, New York.
5. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
6. The Organometallic Chemistry of the Transition Metals; R.H. Crabtree, John Wiley.
7. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International
8. Coordination Chemistry; Banerjea; Tata McGraw Hill.
9. Inorganic Chemistry, A Modern Introduction; T. Moeller; John Wiley and Sons.
10. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H. McDaniel and J.J. Alexander; John Wiley and Sons Inc.

M.Sc. Chemistry (Final) Semester III

Inorganic Chemistry (Special) Paper XVI

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION – A

Alkyls and Aryls of Transition Metals

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

Fluxional Organometallic compounds

Fluxionality and dynamic equilibria in compound such as η^2-olefin, η^3-allyl and dienyl complexes, Carbonyl scrambling.

SECTION - B

Compounds of Transition Metal-Carbon Multiple Bonds

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

Transition Metal Compounds with Bonds to Hydrogen

SECTION - 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 relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.

SECTION - D

Homogeneous Catalysis

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

Books Suggested

1. Mechanism of Inorganic Reactions; F.Basolo and R.G. Pearson, John Wiley and Sons, New York.
2. Inorganic Chemistry; K.F. Purcell, J.C. Kotz; Holt-Sanders International Editions; Philadelphia. .

3. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
4. The Organometallic Chemistry of the Transition Metals; R.H. Crabtree, John Wiley.
5. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.
6. Coordination Chemistry; Banerjea; Tata McGraw Hill.
7. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H. McDaniel and J.J. Alexander; John Wiley and Sons Inc.

Or

M.SC. CHEMISTRY SEMESTER III
PHYSICAL CHEMISTRY (SPECIAL) PAPER XV

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION - A

Quantum Mechanics-I

Problem of two electrons, exchange interactions. Approximate methods: First order time-independent perturbation theory for non-degenerate states. Variation theorem and variational methods. Ground and excited state of helium atom. Coupling of angular momentum for many electron system, spin-orbit coupling, Molecular Term symbols. Born-Oppenheimer approximation, the hydrogen molecule ion, the hydrogen molecule, their symmetric and antisymmetric solution (without actual evaluation of various integrals).

SECTION - B

Quantum Mechanics-II

Valence bond and MO (LCAO) treatment of hydrogen molecule. Comparison of the MO and VB treatments and their equivalence limit. Configuration Interaction. Extension of MO theory to other systems- Homonuclear and heteronuclear diatomics, simple polyatomic molecules.

The pi-electron approximation, Huckel theory of conjugated systems. Applications to ethylene, butadiene, cyclobutadiene and cyclopropenyl molecules. Calculation of properties- Delocalization energy, electron density, bond order.

SECTION-C

Quantum Mechanics - III

Time-independent perturbation theory for degenerate systems with examples. Applications of Time-dependent perturbation theory. Radiative transitions. Einstein coefficients. Quantum mechanical theory of absorption of light by molecules. Transition moment integral. Oscillator strength, rules governing the transition between two energy states. Self-consistent field method. Ab initio and Semi-empirical Methods for Closed Shell Systems.

SECTION-D

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, emulsions, micro emulsion: Mechanism of formation and their stability, reverse micelles. Micellar catalysis.

General Properties of Liquids

Liquids as dense gases, liquids as disordered solids, some thermodynamics relations, internal pressure and its significance in liquids, equation of state, critical constants, Different types of intermolecular forces in liquids, Different potential functions for liquids, additivity of pair potential approximation.

Books suggested:

1. Theoretical Chemistry, S. Glasstone, Affiliated East-West Press.
2. Quantum Mechanics, H.L. Strauss, Prentice Hall.
3. Quantum Chemistry, B. K. Sen, Kalyani Publishers
4. Quantum Chemistry, R. Prasad, New Age International.
5. A textbook of Physical Chemistry, Vol. 4, K.L. Kapoor, MacMillan India Ltd.
6. Quantum Chemistry, C.R. Gatz, E.M. Co.
7. P.W. Atkins and R.S. Friedman, Molecular Quantum Mechanics, 3 rd edition (1997), Oxford University Press. Oxford.
8. H. Eyring, J.Walter and G.E. Kimball, Quantum Chemistry, (1944) John Wiley, New York.
9. I.N. Levine, Quantum Chemistry, 5th edition (2000), Pearson Educ., Inc., New Delhi.
10. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum.
11. Significance of liquid structures, H. Eyring

M.Sc. Chemistry (Final) Semester III
Physical Chemistry (Special) Paper XVI

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION – A

Statistical Mechanics

Ensemble averaging, postulates of ensemble averaging. Micro canonical, canonical and grand canonical ensembles, corresponding distribution laws (using Lagrange's method of undetermind multipliers). Maxwell- Boltzmann statistics, Boltzmann distribution, derivation of the Boltzmann distribution expression, determination of the Boltzmann constant, Maxwell distribution law of velocities from Boltzmann distribution expression

SECTION – B

Quantum Statistics

The Bose-Einstein statistics, statistics of a photon gas, the Fermi-Dirac statistics, Fermi-Dirac systems, extreme gas degeneration, slight gas degeneration, electron gas in metals, thermionic emission and comparison of two statistics, non degenerate and degenerate systems.

SECTION – C

Statistical Thermodynamics

Partition function and thermodynamic properties, partition function and factorization of partition function, translational partition function, translational

thermodynamic function, atoms and monoatomic molecules, Sackur-Tetrode equation, diatomic molecules, separation of internal partition function. Rotational and vibrational energies, entropy due to internal degrees of freedom. Rotational partition function, rotational partition function for polyatomic molecules, vibrational partition function

SECTION -D

Determination and calculation of thermodynamic properties i.e. internal energy, entropy, Helmholtz and Gibbs free energy,ortho and para hydrogen states, free energy functions.Partition function and equilibrium constant, effect of nuclear spin, isomolecular reaction, isotopic exchange reactions.Einstein theory and Debye theory of heat capacities of monatomic solids.

Non-equilibrium Thermodynamics

General theory of non equilibrium thermodynamics, entropy production in heat flow, matter flow and electric current, the Onsager's reciprocal relations, their proof, transport parameters, thermoelectric effects, thermomechanical phenomena and thermocells.

Books Suggested

1. Introduction to Statistical Thermodynamics, H.Dole.
2. Theoretical Chemistry, S.Glasstone, Affiliated East-West Press.
3. Thermodynamics, Lewis and Randall.
4. Chemical Physics, J.C. Slater.
5. Non-equilibrium Thermodynamics, C. Kalidas

Or

M.Sc. Chemistry (Final) Semester III
Organic Chemistry (Special) Paper XV

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting atleast one question from each section. All questions carry equal marks.

SECTION - A

Organometallic Reagents I

Principle, preparations, properties and applications of the reagents of the following metals/non-metals in organic synthesis with mechanistic details
Li, Mg, Cd, Zn, Cu, S, Si, B and I

SECTION - B

Organometallic Reagents II

Principle, preparations, properties and applications of the reagents of the following metals in organic synthesis with mechanistic details Pd, Ni, Fe, Co, Rh, Cr and Ti compounds

SECTION -C

Oxidation

Introduction.Different oxidative processes.Hydrocarbons- alkenes, aromatic rings, saturated C-H groups (activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxylic acids.Amines, hydrazines, and sulphides.Oxidations with ruthenium tetraoxide, and thallium (III) nitrate.

SECTION –D

Reduction

Introduction. Different reductive processes. Hydrocarbons– alkanes, alkenes, alkynes and aromatic rings.Carbonyl compounds – aldehydes, ketones, acids and their derivatives. Epoxides.Nitro, nitroso, azo and oxime groups.Hydrogenolysis,

Books Suggested

1. Modern Synthetic Reactions, H.O. House, W.A. Benzamin.
2. Some Modern Method of Organic Synthesis, W. Carruther, Cambridge Univ. Press.
3. Advanced Organic Chemistry, Reactions Mechanism and Structure, J. March, John Wiley.
4. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional

M.Sc. Chemistry (Final) Semester III
Organic Chemistry (Special) Paper XVI

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting atleast one question from each section. All questions carry equal marks.

SECTION - A

Pericyclic Reactions

Molecular orbital symmetry, frontier orbital of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system classification of pericyclic reactions, Woodward - Hoffmann correlation diagram. FMO & PMO approach, Electrocylic reaction - conrotatory and disrotatory motions. 4n, 4n+2, allyl systems, Ring opening of cyclopropyl halides and tosylates, cycloadditions-antarafacial and suparafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3-dipolar cycloadditions and cheleotropic Reactions.

SECTION - B

Pericyclic Reactions

Sigmatropic Rearrangements-suprafacial and entarafacial shifts of H, sigmatropic shifts involving carbon moieties, retention and inversion of configuration, [3,3] and [5,5] sigmatropic rearrangements, detailed treatment of Sommelet-Hauser, Claisen and Cope rearrangements introduction to ene reactions. Simple problems on Pericyclic reactions, Group transfers and eliminations.

SECTION – C

Photochemistry

Excitation and excited states, Franck-Condon Principle, Jablonski diagram, energy transfer photsensitization, quenching, quantum efficiency and quantum yield.

Photochemistry of carbonyl compounds (Norrish type I and type II changes, photoreaction of cyclic ketones, Paterno-Buchi reaction and Photoreducation. Photochemistry of olefins and 1,6-Butadiene (cis-trans isomerisation, dimerisation and cycloadditions). Chemistry of vision.

SECTION – D

Photochemistry

Di-π-methane rearrangement, enone and dienone rearrangements, photochemistry of aromatic compounds (substitution, isomerization, cyclization and cycloaddition reactions), Photo-Fries rearrangement, photolysis of nitrile esters and Barton reaction, Hoffman-Loefller-Freytag reaction.

Application of photochemistry- photosynthesis, phototherapy.

Or

M.Sc. Chemistry (Final) Semester III
Pharamceutical Chemistry (Special) Paper XV

Time: 3 Hrs

Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting atleast one question from each section. All questions carry equal marks.

SECTION – A

Synthon approach-I

Definition of terms- Disconnection, synthons, functional group interconversions (FGI), synthetic equivalents. General principles of the disconnection approach, the importance of order of events in organic synthesis, one group C-X and two group C-X, One group C-C disconnections-alcohols and carbonyl compounds, chemoselectivity, reversal of polarity, amine synthesis.

SECTION - B

Synthon approach-II

Two group C-C disconnections-1,3 & 1,5-difunctionalized compounds, Stereochemistry in organic synthesis-stereoselectivity, stereospecificity, regioselectivity and regiospecificity

Synthon approach in the synthesis of the following drugs: Salbutamol, Propanolol, moxnidazole, nafimidone, drildone, belfosih. Ocfentanil, afornine

Principle of protection of alcoholic, amino, carbonyl and carboxylic groups

SECTION – C

Systematic (Hantzsch-Widman) nomenclature for monocylic and fused ring systems.

Methods of synthesis and Reactions including mechanism of the following five-membered 1,2- and 1,3-heterocycles: pyrazole, imidazole, oxazole, isooxazole, thiazole, isothiazole; their basic character.

SECTION – D

Methods of synthesis and Reactions including mechanism of the following six-membered heterocycles: purines and pyrimidines. Caffeine, xanthine, theobromine, theophylline

Methods of synthesis and Reactions including mechanism of-Indoles, quinolines and isoquinolines

Flavanoids: Occurrence, nomenclature and general methods of structure determination, isolation, importance and synthesis of Cyanin, Quercetin, Diadzein and Chrysin.

Books Suggested:

1. Designing Organic Synthesis, S.Warren, Wiley.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
3. Modern Synthetic Reactions, H.O.House, W.A. Benzamin.
4. Advanced Organic Chemistry Reactions, Mechanisms a Structures, J. March, Wiley.
5. Advanced Organic Chemistry Part B. F.A. Carey and R.J. Sundberg, Plenum Press.

6. Organic Chemistry, Vol. 2, I.L. Finar, ELBS.

M.Sc. Chemistry (Final) Semester III
Pharamceutical Chemistry (Special) Paper XVI

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION – A

General mode of action, Medicinal Uses and Synthesis of Important Drugs in the Following Categories.

Antineoplastic Agents: Metastasis, classification, mode of action of alkylating agents (synthesis of mephalan, thiotepa, busulfan, lomustine) and antimetabolites (synthesis of methotrexate, 5-fluorouracil, 6-mercaptopurine), hormone based therapies, plant products, radiotherapeutic agents. Taxol realated compounds.
Antiviral agents: RNA and DNA viruses, An introduction to AIDS, how HIV infects the system, mode of action of nucleoside reverse transcriptase inhibitors- AZT, ddI, ddC, d4T & 3TC and HIV-protease inhibitors-Ritonavir. Synthesis of AZT
An overview of HIV entry inhibitors, Integrase inhibitors, Chemokine receptor binders, Inhibitors of gp41 fusion activity
Antimalarials: Cinchona alkaloids, 4-aminoquinolines, 8-aminoquinolines, Mefloquine, 9-aminoacridines. Synthesis of Metaquine, chloroquine, primaquine

SECTION – B

<u>β-lactam antibiotics</u>
Penicillins: Discovery, mode of action, SAR, Penicillins and semi-synthetic penicillins, problems of sensitivity to acids, β-lactamases and narrow spectrum of activity; solving these problems leading to the development of penicillin V, oxacillin, cloxacillin, ampicillin, amoxycillin, carbenicillin and carfecillin; β-lactamase inhibitors-Clavulanic acid, Olivanic acids

Cephalosporins: Classification, SAR, synthesis of cephalosporin-C, recent advances of fourth generation cephalosporins

Sulfonamides-SAR, mode of action. Sulfanilamide analogs- synthesis of Sulfathiazole, sulfadiazine, sulfacetamide

Tetracyclins and aminoglycosides- Structure, mode of action, SAR, streptomycin, neomycin, gentamycin; Macrolides- mode of action, erythromycin, azithromycin; Synthesis of chloramphenicol

Quinolones, fluoroquinolones- Structure, mode of action, synthesis of nalidixic acid and ciprofloxacin

Lincomycins

SECTION – C

Prostaglandins: General Introduction, nomenclature of prostaglandins and eicosanoid biosynthesis

Non-Steroidal anti-inflammatory agents: Classification, mode of action, COX-2 inhibitors, salol principle

Synthesis of celecoxib, valdecoxib, aspirin, phenbutazone, mefanamic acid, indomethacin, piroxicam, diclofenac, Naproxen

Antipyretic-Analgesics: opoid antagonists and agonists-codeine and heroin), synthesis of meperidine, methadone, dextropropoxyphen

SECTION – D

Antifertility agents: Ovulation inhibitors and related hormonal contraceptives-norethindrone, norethynodrel, estradiol and mestranol.Recent Advances

Antihypertensive agents: Classification, Hypertension, Renin-Angiotensin system, mode of action, Calcium channel blockers, ACE inhibitors and β-blockers, centrally acting adrenergic drugs, Peripherally acting sympatholytics- Synthesis of atenolol, clonidine, methyldopa, guanabenz, diltiazem, captopril, enalapril.

Books Suggested:

1. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ed. Robert F. Dorge.
2. Burger's Medicinal Chemistry and Drug Discovery Vol-I Ed. M.E. Wolf, John Wiley.
3. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
4. Organic Chemistry Vol.-2 I.L. Finar, ELBS

M.Sc. Chemistry (Final) Semester IV

M.Sc. Chemistry
Inorganic Chemistry (Special) Paper XVII

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION - A

Errors and Evaluation

Definition of terms in mean and median. Precision-standard deviation, relative standard deviation. Accuracy-absolute error, relative error. Types of error in experimental data-determinate (systematic), indeterminate (or random) and gross. Sources of errors and the effects upon the analytical results. Methods for reporting analytical data. Statistical evaluation of data-indeterminate errors. Significance of the F test, the student 't' test and the Chi-test.

Nephelometry and Turbidimetry

Theory - light scattering, choice and comparison between nephelometry and turbidimetry, factors affecting measurement, instrumentation, applications

SECTION - B

Sewage and fertilizers

Sewage treatment, Biochemistry of sewage, fertilizers - Nitrogen; ammonification, nitrification, denitrification, fixation of nitrogen, biochemistry and ecology of nitrogen fixation, nitrogen and phosphorus fertilizers in agriculture, eutrophication, surfactants - cationic, anionic and non ionic, specific properties, degradation.

Analysis of air pollutants

Biochemical effect of As and Heavy metals such as Cd, Pb and Hg.

Molecular luminescence

Fluorimetry and Phosphorimetry: Introduction, principles of fluorescence and phosphorescence, interpretation of fluorescence spectra, factors, fluorescence intensity and concentration, instrumentation for fluorimetry, applications of fluorimetry.

Phosphorimetry, instrumentation, applications, comparison between fluorimetry and phosphorimetry

SECTION - C

Chromatography

General principles, types of chromatography, absorption chromatography, partition chromatography, vapour phase chromatography, paper and thin layer chromatography, retardation factor, retention volume, mechanism and efficiency of separations.

Ion-Exchange

General principles, ion exchangers-natural and synthetic, ion-exchange capacity, purification of water and other applications.

Solvent Extraction

General Principles, extraction coefficients, Batch, continuous, and counter current extractions, applications.

SECTION -D

Ion selective electrodes

Fundamental types of electrodes, gas sensors, ion sensors and enzyme electrodes, principle involved in measurements with ion selective electrodes with special reference to halide, sulphide and oxygen electrodes.

Thermal Techniques

Thermogravimetry, differential thermal analysis (DTA) and differential scanning calorimetry (DSC) principles and applications.

Books Suggested

1. A Textbook of Quantitative Inorganic Analysis, A.I. Vogel; ELBS, London.
2. Environmental Solution Analysis; S.M. Khopkar, Wiley Eastern.
3. Fundamentals of Analytical Chemistry; D.A. Skoog, O.M. West and F.J. Holler; W.B. Saunders.
4. Instrumental methods of Analysis; L.L. Merits, R.H. Willard and J.A. Dean; Van Nostrand-Reinhold.
5. Physical methods in Chemistry; R.S. Drago; Saunders.

6. Dynamics of Chromatography Part I.; J.C. Gidding; Dekker, New York.

7. Environmental Chemistry; S.K. Banerji, Prentice - Hall.

M.Sc. Chemistry Semester IV
Inorganic Chemistry (Special) Paper XVIII

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION -A

Electro analytical methods of Analysis

Electrogravimetry: Current-voltage relationship during an electrolysis, decomposition potential, constant current electrolysis, constant cathode potential electrolysis, apparatus, electrodes, mercury cathode, applications physical properties of electrolytic precipitates, chemical factors of importance in electrodeposition.

Electrolytical methods without cathode potential control

Coulometric analysis: Coulometric methods of constant electrode potential and coulometric titrations. Apparatus and applications.

Amperometric titrations, anodic stripping voltammetry, and cyclic voltammetry

SECTION -B

Atomic Absorption Spectroscopy

General principles, resonance line, its natural width, Doppler effect, broadening due to pressure, Hollow cathode lamp. Application to alkali and alkaline earth metals.

Flame photometry

Theory of flame photometry, flame temperature, Emission Flame photometry - intensity of spectral lines, selection of optimum working conditions, application of flame photometry in trace metal analysis.

SECTION -C

Spectrophotometry and Colorimetry

Fundamental concepts, instrumentation for absorption measurements, interferences, application of absorption spectroscopy and Colorimetry to analysis of inogganic substance.

Nuclear magnetic Resonance

Basic Principle of NMR, Nuclear relaxation, Factors affecting nuclear relaxation, effect of chemical exchange on spectrum and evaluation of reaction rate of fast reactions, Double resonance, Lanthanide shift reagents, an overview of NMR of other nuclides with emphasis on ^{31}P, ^{19}F, ^{195}Pt and ^{119}Sn NMR. Application in inorganic chemistry

SECTION -D

Electron Spin Resonance Spectroscopy

Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensor, application to transition metal complexes (having one unpaired electron) and inorganic free radicals such as PH_4, F_2^- and $[BH_3]^-$. Double resonance in EPR.

Circular Dichroism and Optical Rotatory Dispersion

Polarized light, fundamental symmetry requirements, for optical activity, interaction of polarized light with optically active matter, optical rotation, Cotton effect, configuration of Tris-chelated complexes.

Books Suggested

1. A Textbook of Quantitative Inorganic Analysis, A.I. Vogel; ELBS, London.
2. Fundamentals of Analytical Chemistry; D.A. Skoog, O.M. West and F.J. Holler; W.B. Saunders.
3. Instrumental methods of Analysis; L.L. Merrit, R.H. Willard and J.A. Dean; Van Nostrand-Reinhold.
4. Physical methods in Chemistry; R.S. Drago; Saunders.
5. Dynamics of Chromatography Part I.; J.C. Gidding; Dekker, New York.
6. NMR, NQR, EPR and MB Spectroscopy in inorganic Chemistry, R.V. Parish, Ellis Horwood.
7. Modern Optical Methods of Analysis; E.D. Olgen; McGraw Hill.
8. Introduction to Magnetic Resonance; McLachan and Carrington; Chapman and Hall.

M.Sc. Chemistry (Final) Semester IV
Inorganic Chemistry (Special) Paper) XIX

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION – A

Metal Storage Transport and Biomineralization

Ferritin, transferrin, and siderophores

Calcium in Biology

Calcium in living cells, transport and regulation, molecular aspects of intramolecular processes, extra cellular binding proteins

Coenzyme vitamin B_{12}, vitamin B_6.

SECTION - B

Metalloenzymes

Zinc enzymes – carboxypeptidase and carbonic anhydrase, alkaline phosphatase and alcohol dehydrogenase, Copper enzymes – superoxide dismutase. Molybdenum oxatransferase enzymes – xanthine oxidase

SECTION - C

Supramolecular Chemistry

Concepts and language.

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

b) Supramolecular reactivity and catalysis.

c) Transport processes and carrier design.

d) Supramolecular devices.

Some example of self-assembly in supramolecular chemistry

SECTION-D

Principles of Bio-Inorganic Medicine

Evaluation of modern therapeutical, means of administering chemicals to humans, concentration effects, and dose-response relationship, future developments and trends in bio-inorganic therapy

Metals in Medicine

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

Books Suggested

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
3. Supramolecular chemistry, J.M. Lehn, VCH.
4. The inorganic Chemistry of Biological Processes; M.N. Huges, John Wiley and Sons.

M.Sc. Chemistry (Final) Semester IV
Inorganic Chemistry (Special) Paper XX

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION - A

Photochemistry

Absorption, excitation, photochemical laws, quantum yield, electronically excited states- life times-measurements of the times.

Radiative and Non-radiative Processes

Energy dissipation by radiative and non radiative processes, bimolecular quenching, absorption spectra, Franck condon principle, photochemical kinetics, photochemical stages-primary and secondary.

SECTION-B

Excited States of Metal Complexes

Electronically excited states of metal complexes: charge-transfer spectra, charge transfer transition, photosubstitution reactions, photorearrangements, photoisomerisation, photoredox processes conditions of excited states to be useful redox reactant Illustration of some reducing and oxidising character of Ru(2+) tris-bipyramidal complex. Transformation of chemical energy into light energy

Metal Complex Sensitizers

Metal complex sensitizer, photosensitised reactions in metal complexes, water photolysis, nitrogen fixation and carbon dioxide reduction

SECTION - C

Solid State-I

Crystalline and non-crystalline materials, glass transition temperature Tg and melting temperature Tm, classes of compounds of the type A_2 B_3 and AB_3 Glass-ceramics, structures of polymers, glass and ceramics inorganic chains and rings.

Alloys-interstitial, substitutional and superconducting, Meissner effect, Hume-Rothery rules.

SECTION - D

Solid State-II

Perfect and imperfect crystals, intrinsic and extrinsic defects, point defects, line and plane defects, vacancies- schottky defects and Frankel defects, colour centers, non-stiochiometry and defects.

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, superconductors, Optical and Magnetic properties.

Books Suggested

1. Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.
2. Photochemistry of coordination compounds, K.Balzani and V.Carassti, Academic press.
3. Elements of Inorganic Photochemistry; G.J. Ferraudi, Wiley.
4. An Introduction to Crystal Chemistry; R.C. Evans, Cambridge University Press.
5. Introduction to solid state Physics; C.Kittel, Wiley New York.

6. Solid State Chemistry; N.B. Hannay; Prentic

Or

M.Sc. Chemistry (Final) Semester IV
Physical Chemistry (Special) Paper XVII

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

Section – A

Polymers

Recapitulation of basics of polymers and polymerization. Properties of commercial polymers: Polyethylene, polyvinylchloride, polyamides, polyesters, phenolic resins, epoxy resins and silicon polymers. Biodegradable polymers: Types of degradable polymers, Chemical and biodegradation. Applications of degradable polymers. Dendrimers, Hyperbranched – star polymers and Plasticizers. Polymer composites.

Glass transition temperature (Tg), factors influencing the glass transition temperature, importance of glass transition temperature Tg and molecular weight, Tg and melting point. Brief discussion on crystallization in polymers, amorphous polymers.

Section – B

Thermodynamics of Polymer Solutions

Average end-to-end distance, average radius of gyration of polymer chains, statistical distribution of end-to-end dimensions, freely jointed chain in three dimensions, influence of bond angle restrictions. Discussion about Gaussian chain model, the wormlike chain model.

Entropy of mixing and enthalpy of mixing by lattice model, Flory Huggins lattice theory, limitations of lattice model, entropy of mixing by free volume theory,

heat and free energy of mixing, partial molar quantities i.e., chemical potential, heat of dilution and partial molar entropy of mixing, excluded volume, thermodynamic relations for dilute polymer solutions.

Section – C

Phase transition phenomena in polymer solutions

Introductory discussion about Phase transition phenomena in polymer solutions (phase separation, hydration, association, gelation).

Determination of Molecular Mass of Polymers

Molecular mass determination of polymers. Sedimentation or ultracentrifugation: Sedimentation velocity method, sedimentation equilibrium method. Light scattering: Scattering of light by small molecules and polymer solutions, asymmetric scattering, Debye method, Zimm plot method, comparison of Zimm and Debye method, Small angle X-ray Scattering, determination of molecular mass by Gel Permeation Chromatography.

Section – D

Advanced Statistical Mechanics

Real gases, intermolecular potential and virial coefficients.

Structure of liquids-definition of distribution and correlation functions, Thermodynamic functions of a fluid and radial distribution function, Potential of mean force and superposition approximation, Kirkwood integral equation. Spectroscopic techniques for liquid dynamic structure studies.Theory of Brownian motion, Langevin theory, Fokker-Planck equation and Chandrasekhar equation.

Books Suggested

1. Polymer Chemistry, P.J. Flory.
2. Physical Chemistry of Polymers, A.Tager.
3. Physical Chemistry of Macromolecules, C.Tanford.
4. Polymer Chemistry by Gowalikar
5. Scaling Concepts in Polymer Physics, Pierre-Gilles Gennes
6. Introduction to Polymers, Third Edition, Robert J. Young and Peter A. Lovell
7. Polymer Physics (Chemistry), M. Rubinstein, Ralph H. Colby
8. Statistical Mechanics by Donald A McQuarrie

M.Sc. Chemistry (Final) Semester IV
Physical Chemistry (Special) Paper XVIII

Time: 3 Hrs

Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION-A

Solid State Chemistry

Free electron theory of metals, Quantum mechanical treatment explaining the origin of band gaps, density of states, Band theory, Bloch theorem, Brillouin zones, effective mass of charge carriers, Semiconductors: Direct and indirect band gap semiconductors, hole concept, temperature dependence of mobility, free carrier concentration in intrinsic and extrinsic semiconductors, mass active law, Generation of carriers and their recombination in semiconductors. Types of junctions (metal-semiconductor, semiconductor-semiconductor, junctions in organic materials), Surface and interface states, Analysis of p-n junction including I-V characteristics.

SECTION-B

Renewable energy sources

Renewable energy resources: Biomass-Biofuels, Hydrogen, Solar energy. Related environmental and economical issues.

Introduction to Photovoltaics. Basic PV system design. Design and physics of solar cells, I-V characteristics, external and internal quantum efficiency. Thermodynamics of light conversion. Solar radiation and conversion efficiency. Factors influencing solar cell efficiency. Future trends in PV energy conversion. Silicon solar cells, alternatives to silicon, III-V materials for solar cells, thin film solar cells and third generation solar cells. Concentrator photovoltaics. Thermodynamic limit of light concentrators. Photovoltaics storage system.

SECTION –C

Advanced Electrochemistry

Advanced concepts: Overpotential concept, Exchange current density, Butler-Volmer equation, Polarizable and non-polarizable interfaces. Tafel equations. Electrochemical Processes: Difference between kinetically and mass transport controlled electrochemical processes. Difference between single step and multiple step electrode reactions. Brief introduction and applications of various electrochemical methods: Principle of electrochemical methods such as chronoamperometry, cyclic voltammetry, chronopotentiometry, coulometry, ac-impedance,
spectroelectrochemistry and hydrodynamic methods. Electrocatalysis: Introduction to electrocatalysis. Homogeneous and heterogeneous electrocatalysis.

SECTION-D

Applied Electrochemistry

Corrosion: Forms of corrosion, Corrosion monitoring and prevention methods. Batteries and Fuel cells: Introduction. Nanostructured and surface modified electrodes: Introduction and their applications. Environmentally oriented electrochemistry: Electrochemistry of water splitting, electrolysis of sea water, electrochemical reduction of CO_2, Electrochemical sewage disposal, electrochemical decontamination of soil.

Ion Selective Electrodes

Electrical Properties of membrane, glass electrode with special reference to H^+, Na^+, K^+ ions, operation of solid membrane electrode, operation of liquid membrane electrode, coated type ion electrode, Applications of ion selective electrode in determination of some toxic metals and some anions (F^-, Cl^-, Br^-, I^- and NO_3^-).

Books Suggested

1. Principles of the Solid State, H.V. Keer, Wiley Eastern.
2. Solid State Physics, C.Kittel, John Wiley
3. Solid State Physics by Neil W. Ashcroft and N. David Mermin
4. The Physics of Solar Cells (Properties of Semiconductor Materials) by Jenny Nelson
5. Physics of Solar Cells: From Basic Principles to Advanced Concepts (Physics Textbook) by Peter Würfel
6. Optoelectronics of Solar Cells (SPIE Press Monograph Vol. PM115), Greg P. Smestad
7. Electrochemical Methods: Fundamentals and Applications, 2nd Ed., A. J. Bard and L. R. Faulkner John Wiley & Sons: New York, 2002.
8. Modern Electrochemistry 1: Ionics 2nd Ed., Springer (1998), J. O' M. Bockris & A. K. N. Reddy.
9. Modern Electrochemistry 2B: Electrodics in Chemistry, Engineering, Biology and Environmental Science 2nd Ed., Springer (2001), J. O' M. Bockris & A. K. N. Reddy.
10. Modern Electrochemistry 2A: Fundamentals of Electrodics 2nd Ed., Springer (2001), J. O' M. Bockris, A. K. N. Reddy and M. E. Gamboa-Aldeco.
11. Instrumental methods of analysis:Willard, Merritt & Dean
12. Advanced Analytical Chemistry: Meiter and Thomas
13. Instrumental methods of chemical analysis: Braun
14. Principles of Instrumental analysis, 5th edition, D. A. Skoog, F. J. Holler, T. A. Nieman, Brooks Cole.

M.Sc. Chemistry (Final) Semester IV
Physical Chemistry (Special) Paper XIX

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION - A

Thermal Methods of Analysis-I

Introduction to thermal analysis, TG and DTG, static thermogravimetry and dynamic thermogravimetry, Instumentation, thermogram, factors affecting thermograms, application of thermogravimetry. Reaction kinetics–Kinetics by single and multiple heating rates. Differential thermal analysis, DTA theories, DTA curves, factors affecting DTA curves, Instrumentation, applications of DTA, simultaneous determination in thermal analysis. Correlation of DTA and TGA data with examples.

Differential Scanning Calorimetry (DSC)

Introduction, Instrumentation, Power compensated DSC, Heat Flux DSC, DSC-curves, factors affecting DSC curves, applications.

SECTION – B

Material Chemistry

Definition of nanomaterials, various techniques for the preparation of nanomaterials,Thermodynamics and Kinetics of Nucleation, Thin Films and Langmuir-Blodgett films - Preparation techniques, evaporation/sputtering, chemical processes, MOCVD, sol-gel. Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films.

Electronic structure and properties of nanomaterials, optical, electrical and magnetic properties, diffusion and chemical behaviour, applications of nanomaterials.

SECTION – C

Photochemistry

Revision of basic concepts of photochemistry, Life times of excited electronic states of atoms and molecules. Charge transfer transitions

The Frank-Condon principle, emission spectra, environment effect on absorption and emission spectra, Wigner's spin conservation rule.Modes of decay of excited states, quenching of fluorescence, delayed fluorescence, collisional quenching, Stern–Volmer equation. Excimer and exciplex formation and decay.

Techniques for the study of transient species in photochemical reactions.Lasers in photochemical kinetics.

Examples of supramolecular photochemistry (Vision, Photosynthesis) and photochemical supramolecular devices

SECTION – D

Biophysical Chemistry

Chemical bonds in biological systems; Properties of water; Thermodynamic principles in biological systems; Thermodynamics of Biopolymer Solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical system.

Introduction to protein folding problem.

Cell Membrane and Transport of Ions: Structure and functions of cell membrane. Active transport across cell membrane, irreversible thermodynamics treatment of membrane transport.

Optical methods and applications: Optical techniques in biological systems: Absorption spectroscopy, Fluorescence spectroscopy, Linear and Circular Dichroism.

Books Suggested

1. Fundamentals of Photochemistry, K.K. Rohtagi & Mukherjee, Wiley Eastern.
2. Photochemistry, J.G. Calvert and J.N. Pitts, Wiley.
3. Photochemistry and Spectroscopy, J.P. Simons, Wiley Interscience.
4. Principles and Applications of Photochemistry by Brian Wardle
5. Instrumental methods of analysis:Willard, Merritt & dean
6. Advanced Analytical Chemistry: Meiter and Thomas
7. Instrumental methods of chemical analysis: Braun
8. Principles of Biochemistry, A.L.Lehninger, Worth Publishers.
9. Biochemistry, L.Stryer, W.H.Freeman.

10. Biochemistry, J.David Rawn, Neil Patterson.
11. Biochemistry, Voet and Voet, John Wiley.
12. Outlines of Biochemistry, E.E.Conn and P.K.Stumpf, John Wiley.
13. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, H.Dugas and C. Penny, Springer-Verlag.
14. Macromolecules: Structure and Function, F.Wold, Prentice Hall.
15. Biophysical Chemistry, Vol. 1-3, C. R. Cantor & Schimmel
16. Physical Biochemistry: Applications to Biochemistry and Molecular Biology by D. M. Freifelder
17. Biophysical Chemistry: Principles and Techniques by A. Upadhyay, Himalaya Publishing House

M.Sc. Chemistry (Final) Semester IV
Physical Chemistry (Special) Paper XX

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION-A

Advanced Chemical Kinetics

London-Eyring-Polanyi method of calculation of energy of activation. Application of activated complex theory of reaction rates.Temperature dependence of pre-exponential factor. Thermodynamic aspects of reaction rates.Kassel's theory (RRK), Rice-Ramsperger-Kassel-Marcus (RRKM) theory, unimolecular reactions and its validity.

SECTION-B

Reaction Dynamics

Molecular beams, principle of crossed-molecular beams. Molecular encounters and principal parameters, e.g. Impact parameter, Collision cross-section, Reaction cross-section and relation between reaction cross-section and reaction rate (single velocity). Dependence of collisional cross-section on translational energy.

Probing the transition state, Dynamics of barrierless chemical kinetics in solution, dynamics of unimolecular reactions.

Solution Kinetics

Ion-ion reaction, ion-dipole reaction and enzyme kinetics (effect of pH and temperature). Lineweaner-Burk plot for the analysis of enzymolysis. Reactions between polar molecules, kinetic salt, salt effect.

SECTION-C

Kinetics of Fast Reactions

General treatment of chain reaction, apparent activation energy of chain reactions, chain lengths, theories of branching chain and explosion (hydrogen-oxygen reaction). Modern techniques in gas phase and in solution, flash photolysis, flow methods, relaxation techniques (temperature jump, pressure jump) and shock tube technique.

SECTION-D

Liquid Crystals

Mesmorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; smectic – nematic transition and clearing temperature – homeotropic, planar and schlieren textures, twisted nematics, chirals nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

Books Suggested

1. Theoretical Chemistry, S. Glasstone, Affiliated East-West Press.
2. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum.
3. Material Science Engineering, W.D. Callisler, Jr.
4. Chemical Kinetics, K.J. Laidler, McGraw Hill
5. Theories of Chemical Reaction Rates, K.J. Laidler, McGraw Hill.
6. Theory of Rate Processes, S. Glasstone, K.J. Laidler and H. Eyring, McGraw Hill.
7. Reaction Kinetics Oxford Press (1997), M. J. Pilling and P. W. Seakins.
8. Thermotropic Liquid Crystals, G.W. Gray, John Wiley.
9. Handbook of Liquid Crystals, Kelkar and Hatz, Chemie Verlag.
10. Significance of liquid structures, H. Eyring

Or

M.Sc. Chemistry (Final) Semester IV
Organic Chemistry (Special) Paper XVII

Time: 3 Hrs

Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all,\ selecting atleast one question from each section. All questions carry equal marks.

SECTION - A

Disconnection Approach-I

An introduction of synthons and synthetic equivalents, general principles of the disconnection approach, functional group interconversions, the importance of order of events in organic synthesis, one group C-X and two group C-X disconnections, one group C-C disconnection, chemoselectivity, regioselectivity, regiospecificity, stereoselectivity and stereospecificity.

SECTION - B

Disconnection Approach-II

Reversal of polarity, amine synthesis,Synthesis of alkenes-use of wittig reagents,use of acetylene and aliphatic nitro compounds in organic synthesis, synthesis of three membered rings, photochemistry in organic synthesis-synthesis of four membered rings , uses of ketones in organic synthesis, synthesis of five and six membered rings

SECTION - C

Disconnection Approach-III

Principle of protection of alcoholic, amino, carbonyl and carboxylic groups, Two group C-C disconnection- Diels Alder reactions, 1,3-difunctionalized compounds and α,β unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalized compounds- Michael addition, and Robinson Annelation. disconnection approach towards the synthesis of Juvabione and their relative merits and demerits.

SECTION - D

Principle of Green chemistry and its applications

Basic Principle and need of green chemistry, Different tools for green synthesis (Elementary idea of green reagent, green solvent, green catalyst, solid phase, mw and ultrasound assisted) atom economy, Role of biocatalysts in green synthesis-enzyme catalyzed oxidation, reduction and hydrolytic reactions, synthesis involving basic principle of green chemistry-synthesis of adipic acid and BHC synthesis of Ibuprofen.

Supramolecular chemistry

An idea of supramolecular chemistry, Phase Transfer Catalysis, Crown ethers, cryptates, cyclodextrins, calixarenes, and micelles

Book Suggeted

1. Designing Organic Synthesis, S.Warren, Wiley.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
3. Handbook of Green Chemistry- Green Catalysis- Paul T. Anastas, Robert H. Crabtree, Wiley-VCH

4. Methods and Reagents for green synthesis: An introduction, Pietro Tundo, Alvise Perosa, F. Zecchin, Wiley

M.Sc. Chemistry (Final) Semester IV
Organic Chemistry (Special) Paper XVIII

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting atleast one question from each section. All questions carry equal marks.

SECTION - A

Reactions
A detailed study including mechanism or Arndt-Eistert synthesis Beckmann, Hofmann, Curtius, Lossen, Schmidt, Favorskii, Neber, Fritsch-Butenberg-Wiechell, Baeyer-Villiger, Benzilbenzillic acid rearrangements.

SECTION - B

Reactions
A detailed study including mechanism Darzens synthesis, stroke enamine synthesis, Shapiro reaction; Sharplcss asymmetric epoxidation,Prevost and Woodward hydroxylation

Flavonoids
Occurrence, nomenclature, general (chemical and spectroscopic) methods of structure determination of flavonoids, Isolation and synthesis of Cyanin, Quercetin, Diadzein and Chrysin. Biosynthesis of Flavonoids: Acetate pathway and Shikimic acid pathway, biosynthesis of catechin.

SECTION - C

Heterocyclic compounds

Systematic (Hantzsch-Widman) nomenclature for monocylic and fused ring systems. Methods of synthesis and Reactions including mechanism of the following. Five-membered heterocycles: pyrazole, imidazole, oxazole, isooxazole, thiazole, isothiazole; their basic character

SECTION – D

Heterocyclic compounds

Methods of synthesis of the following six-membered heterocycles: pyrimidines and purines.

Aromaticity, Metallocenes and Nonbenzenoid Aromatics Compounds

Aromaticity (aromatic, non-aromatic, and antiaromatic), aromaticity in charged rings, homoaromaticity, psuedo-aromaticity, HMO and PMO for determining aromatic, non-aromatic and anti-aromatic character of annulenes having various π-electron systems, application of ^{1}H-NMR in determining aromatic character of annulenes.

General considerations, synthesis and reactions of representative compounds

Ferrocene, Azulene, Tropones and Tropolones.

Book Suggeted

1. Designing Organic Synthesis, S.Warren, Wiley.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
3. Modern Synthetic Reactions, H.O.House, W.A. Benzamin.
4. Advanced Organic Chemistry Reactions, Mechanisms a Structures, J. March, Wiley.
5. Advanced Organic Chemistry Part B. F.A. Carey and R.J. Sundberg, Plenum Press.
6. Organic Chemistry, Vol. 2, I.L. Finar, ELBS.
7. Heterocylic Chemistry, T.L. Gilchrist, Longman Scientific Technical.
8. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, eds. Pergaman Press.
9. Polycyclic Aromatic Hydrocarbons, E. Clar, Academic Press.

M.Sc. Chemistry (Final) Semester IV
Organic Chemistry (Special) Paper XIX

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting atleast one question from each section. All questions carry equal marks.

SECTION - 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. Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots, reversible and irreversible inhibition.

Mechanism of Enzyme Action

Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion

SECTION - B

Mechanism of action of chymotrypsin, carboxypeptidase A and papain.

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, Mechanisms of reactions catalyzed by the above cofactors

Prostaglandins: General Introduction, nomenclature and biological roles of prostaglandins. Synthesis of PGE_2 and $PGF_{2\alpha}$.

SECTION - C

Terpenoids

General aspects of structure determination of terpenoids, structure and synthesis of Geraniol, α-terpineol, α-pinene, camphor and squalene. Biogenetic isoprene rule and biogenesis of terpenoids.

SECTION – D

Steroids

Isolation and nomenclature of steroids, structure, synthesis (Woodward) and stereochemistry of cholesterol, methods for the following conversions.

i) Cholesterol → Testosterone
ii) Cholesterol → Progesterone
iii) Cholesterol → 5-α and 5-β cholanic acids.
iv) Johnson's hydrochrysene approach towards the synthesis of, Androsterone.

Books Suggested

1. Organic Chemistry, Vol 2, I. L. Finar, ELBS.
2. Natural Products: Chemistry and Biology Significance, J.Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
3. Biochemistry, A.L. Lehninger.
4. Outlines of Biochemistry, Cohn & Stumpf.

M.Sc. Chemistry (Final) Semester IV
Organic Chemistry (Special) Paper XX

Time: 3 Hrs

Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting atleast one question from each section. All questions carry equal marks.

SECTION A

Drug Design

Classification and discovery of new drugs, history and development of chemotherapeutic agents, therapeutic index, LD50 and ED50, naming of (new) drugs.

Elementary idea about drug action: the receptor role, neurotransmitters and receptors, ion channels and their control, membrane bound enzymes-activation/deactivation, chemical basis of messenger induced change of shape by the receptor, design of agonists, antagonists and partial agonists

Drug development: screening of natural products, isolation and purification, structure determination, structure-activity relationships (SAR), synthetic analogues, isosteres and bioisosteres, concept of lead compounds.

Brief overview of pharmacokinetics and pharmacodynamics, concept of prodrugs and synergism.

SECTION B

Synthesis, General Mode of Action and Medicinal Uses of Important Drugs in the Following Categories.

Antineoplastic Agents: Mechlorethamine, Chlorambucil, cyclophosphamide, carmustine, aminopterin, 6-mercaptopurine, paclitaxel (synthesis of paclitaxel excluded)

Antimalarials: Chloroquine, primaquine, chloroguanide, pyrimethamine'

Analgesics, Antipyrics and Antiinflammatory agents: Morphine and related compounds (codeine and heroin), meperidine, methadone, aspirin, acetaminophen, indomethacin, phenylbutazone, mefenamic acid, ibuprofen, diclofenac, naproxen, celecoxib.

Antifertility agents: Ovulation inhibitors and related hormonal contraceptives - norethindrone, norethynodrel, estradiol, mestranol, non hormonal contraceptive-centchroman (synthesis of all the drugs excluded).

Cardiovascular Drugs: Calcium channel blockers and β-blockers: sorbitrate, diltiazem, atenolol and verapamil.

AIDS and drugs against HIV: How HIV infects the system, structure and mode of action of important drugs against HIV (nucleoside reverse transcriptase inhibitors) - AZT, ddI, ddC, d4T and 3TC (synthesis only of AZT).

SECTION -C

Antibiotics

Cell wall biosysnthesis and protein synthesis inhibitors: Penicillins and semi-synthetic penicillins, synthesis, structure elucidation and medicinal uses of penicillin G, problems of sensitivity to acids, β-lactamases and narrow spectrum of activity, solving these problems leading to the development of penicillin V, oxacillin, cloxacillin, ampicillin, amoxycillin, carbenicillin and carfecillin.

Cephalosporins - Discovery, structure elucidation and synthesis of cephalosporin-C.

SECTION -D

Alkaloids

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

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

Books Suggested

1. Pericyclic Reactions, S.M. Mukherji Macmilan India.

2. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ed. Robert F. Dorge.
3. Burger's Medicinal Chemistry and Drug Discovery Vol-I Ed. M.E. Wolf, John Wiley.
4. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
5. Organic Chemistry Vol.-2 I.L. Finar, ELBS.
6. Organic Photochemistry, J Coxan & B. Halton, Cambridge University Press.
7. Introductory Photochemistry,.A. Cox and T. Camp McGraw Hill.
8. The Conservation of Orbital Symmetry, R.B. Woodward and R. Hoffmann" Verlag Chemie Academic Press.
9. Problem Solving approach to Orbital Symmetry, R.E. Lehr and A.P. Merchand
10. Organic Reactions and Orbital Symmetry, T.L. Gilchrist and R.C. Storr, Cambridge University Press, Cambridge, 2nd Edn. 1979.

Or

M.Sc. Chemistry (Final) Semester IV
Pharmaceutical Chemistry (Special) Paper XVII

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting atleast one question from each section. All questions carry equal marks.

SECTION-A

Mechanistic and biosynthetic approach to plant secondary metabolites:

Acetate-malonate pathway: Biosynthesis of plant fatty acids, biosynthesis and oxidation of ricinoleic acid). Polyketides: Biosynthesis of 6-methylsalicyclic acid, pencillic acid, griseofulvin

Acetate- mevalonate pathway: Biosynthesis of psoralen, gibberellic acid, cholesterol, conessine

Shikimic-acid pathway: Biosynthesis of chlorogenic acid and cichoriin, Cyanin, Quercetin,

Biosynthesis of Porphyrins

SECTION-B

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, synthesis, biosynthesis and biological importance of the following: Ephedrine, (+)-Coniine, Nicotine, Quinine and Reserpine.

Carotenoids; Structure, synthesis and biogenesis of β-carotene and Vitamin-A

SECTION – C

Carbohydrates: Introduction, stereoisomerism, mutarotation of monosaccharides, ring structure of glucose, structure elucidation, of disaccharides, sucrose, maltose, lactose, polysaccharides, starch, glycosides, general structure elucidation

Terpenes

General introduction, isoprene rule, isolation of terpenes, General methods of structure determination of terpenes, structure elucidation of citral, menthol and camphor

SECTION – D

Steroids: Isolation, nomenclature, structural elucidation with special reference to Cholesterol, ergosterol and cardiac glycosides

Methods for the following conversions:

v) Cholesterol → Testosterone

vi) Cholesterol → Progesterone

Porphyrins

Structures elucidation of chlorophyll, General structural features of haemoglobin (not structure elucidation).

Books Suggested:

1. Organic Chemistry, Vol 2, I. L. Finar, ELBS.
2. Natural Products: Chemistry and Biology Significance, J.Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.

M.Sc. Chemistry (Final) Semester IV
Pharamceutical Chemistry (Special) Paper XVIII

Time: 3 Hrs

Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting at least one question from each section. All questions carry equal marks.

SECTION – A

Drug Design

Introduction, Procedure followed in drug design-Screening of natural compounds, isolation, purification, structure determination, Search for lead Compounds, Molecular Modification of Lead Compound, prodrugs- utility, drug latentiation, carrier linked and bioprecursor prodrugs, Prodrugs of compounds containing alcohols, carboxylic acids, amines and carbonyl groups, drug synergism, hard and soft drugs. Structure-Activity Relationship (SAR), isosterism, Bioisosterism, Factors affecting Bioactivity, Theories of Drug Activity; Occupancy theory, Rate theory, Induced Fit theory

SECTION – B

Quantitative structure-activity relationships (QSAR)- Development of QSAR, Physicochemical parameters- Lipophilicity parameter, Polarizability, Electronic parameter, Ionization Constants, steric Parameters- Taft's steric factor, molar refractivity, Verloop steric parameter, chelation parameters, Surface activity parameter, redox potential, hansch analysis, Craig plot, Topliss Scheme, Free-Wilson Approach

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, Mechanisms of reactions catalyzed by the above cofactors

SECTION – C

Combinatorial Chemistry

Introduction to Combinatorial chemistry, Combinatorial approaches, solid phase techniques, liquid phase synthesis, Chemical Peptide and small molecular libraries, split synthesis and parallel synthesis- applications and methodology, deconvolution, Combinatorial Organic Synthesis, High throughtput screening (HTS), Planning and designing a combinatorial synthesis-scaffolds, X-ray crystallography, docking procedures.

SECTION – D

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. Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots. Enzyme inhibitors- reversible, irreversible, suicide substrates.

Mechanism of Enzyme Action

Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion

M.Sc. Chemistry (Final) Semester IV
Pharmaceutical Chemistry (Special) Paper XIX

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting atleast one question from each section. All questions carry equal marks.

SECTION-A

Patents

Brief introduction to IPR, Definition, need for patenting, Types of Patents, conditions to be satisfied by an invention to be patentable, features

Introduction to "The Patents Act 1970" and "The Patent Rules 2003" , "The Patent Rules 2005"with special emphasis on the forms to be submitted alongwith a patent application.

Drug & Cosmetic Act with special reference to schedule Y and M.

GATT, WTO

SECTION-B

Stability testing of new drug substances and products: Drug substance – criteria, storage conditions, long term testing, accelerated testing, frequency, evaluation, labelling; Drug product – Selection of batches criteria, specification, conditions of storage and testing, Calculation of shelf life and expiry date of products

Quality control and Quality Assurance: Requirements of GMP, cGMP, GLP, ISO-9000, regulatory requirements of drugs and pharmaceutical (USFD-NDA/ANDA), total quality management (TQM) Concept.

SECTION-C

Impurity and Stability: New drug products – Dissolution, disintegration, hardness friability, uniformity of dosage units, water contents, microbial limits; Oral liquids – uniformity of dosage units, pH, microbial limits, antimicrobial preservative content, anti-oxidant preservative content, extractables, alcohol content, dissolution particle size distribution, redispersibility, rheological properties, specific gravity, reconstitution time; Parenteral products – uniformity of dosage units, pH, sterility, endotoxins, pyrogens, particulate matter, water content, antimicrobial perservative content, antioxidant perservative content, extractables, functionality testing of delivery systems osmolarity, particle size distribution, redispersibility and reconstitution time. Decision trees for acceptance criteria – New drug substance, degradation product, particle size.

SECTION-D

Processing of Tablets: Types of tables, granulation-manufacture of granules, their basic characteristic and properties with reference to different types of substances.

Various additives included in formulation of tablets, Compression of tablets compressing machines and their tooling, processing problems and their remedy, standardization and evaluation of tablets as per official standards.

Coating of tablets : Principles and equipment; Taste masking sugar coating; tensile strength of films, evaluation of coated tablets, defects of films.
Processing of capsules: Hare gelatin capsules, materials and production, filling equipment, hand filling, semi-automatic and automatic filling operations, formulation, finishing and evaluation. Soft gelatin capsules, manufacturing process, naturee of capsule shell and contents, physical stability, packing and evaluation.
Microencapsulation : Its importance and applications in pharmaceutical formulations, techniques and equipment for microeneapsulation.

M.Sc. Chemistry (Final) Semester IV
Pharmaceutical Chemistry (Special) Paper XX

Time: 3 Hrs
Max. Marks: 60+20(IA)

Note: Eight questions will be set, two from each of the sections A, B, C & D. The candidates are required to attempt five questions in all selecting atleast one question from each section. All questions carry equal marks.

SECTION-A

Heat Transfer: Introduction, modes of heat transfer, Fourier's law of heat flow, thermal conductivity, steady state conduction. Equipments: Finned tube (extended surface) heat exchanger, plate heat exchanger, spiral heat exchanger, scraped heat exchanger and air cooled heat exchanger.
Distillation: Introduction, vapour – liquid equilibrium, partial vaporization, partial condensation, volatility, relative volatility, methods of distillation for two component systems–fractional distillation, azeotropic distillation, steam distillation, extractive distillation.
Filtration: Introduction, classification of filters, plate & frame filter presses, candle filter, filter media, filter aids, washing of filter cakes, filtration theory – constant pressure filtration, constant rate filtration, filtration cycle, centrifuges, batch top driven centrifuge, batch under driven centrifuge, disk type centrifuge.

SECTION-B

Drying: Introduction, rate of drying, constant rate period, critical moisture content, falling rate period, equilibrium moisture, free moisture, bound and unbound moisture, drying equipments – tray dryers, drum dryers, rotary dryers, spray dryers, flash dryers.

Crystallization: Introduction, supersaturation, modes of generation of supersaturation, nucleation, primary nucleation, secondary nucleation, crystal growth, □L law of cyrstal growth, growth rate and grouth coefficients, crystallisation equipments – Tank crystallizers, circulating magma – vaccum crystallizers, circulating liquid evaporator crystallizers.

Fluid Flow: Introduction, Newtonian and non-Newtonian fluids, viscosity, effect of temeprature on viscosity, kinematic viscosity, laminar and turbulent flows, Reynolds number, Bernoullis equation without friction, orificemeter, venturimeter, pumps, types of pumps

SECTION-C

Reactors: Introduction to reactor design, ideal batch reactor, space time, space velocity, steady state mixed flow reactor, steady state plug flow reactor

Chemical process development: Process design development, types of design process development, plant location, plant layout, plant operation and control, material handling.

Safety and loss preventation : Health and safety hazards, source of exposure, exposure evaluation, exposure hazard control, fire and explosion hazard, safety regulation, loss preventation.

SECTION-D

Chromatographic techniques: Principles of separation, applications and recent trends in chromatography:

Column, Paper, Thin layer and gas chromatography, HPLC, HPTLC, Size exclusion chromatography, Affinity chromatography, Ion-exchange chromatography

Biological Standardization: Bioassay and Radioimmunoassay: ELISA, radioimmunoassay of drugs like Digitalis & insulin

Books Recommended

1. Cooper and Gunn's Dispensing for Pharmaceutical Students, Ed.S.J. Carter, CBS publishers & Ddistributors.
2. Cooper and Gunn's, Tutorial Pharmacy.
3. L.Lachman, "Theory and Practice of Industrial Pharmacy" Lea & Fabiger.
4. Bentley and Drivers, "A textbook of Pharmaceutical Chemistry", Oxford Press.
5. ISO Reports.
6. Indian Pharmacopoeia, Govt. of India, Ministry of Health and Family Welfare.
7. British Pharmacopoeia.
8. Indian Patent Act.
9. Sharma P.P., GMP, Vallabh prakashan.

10. A. Osol, “Remington’s Pharmaceutical science”. Mack Publishing company.
11. Introduction to Chemical Engineering, Bedger et al., McGraw Hill.
12. Unit Operations of Chemical Engineering, Mc. Cable & Smith
13. Handbook of Chemical Engineering by parry.
14. Principles and methods of Pharmacy management, Harrg, A.; smith Loa & Febiger, Philadelphia.
15. Materials management by Gopalkrishna, Prentice Hall, India.
16. W.d. Mc Cabe. J.C. Smith & P. Harriott, Unit Operations of chemical Reactor Design and Operation.”
17. K.R. Westreterp, W.P. M. Swaaij, AACM, Beanackers, “Chemical Reactor Design and Operatiof”.
18. W.L.Badger and J.T. Benchard, Introduction to chemical Engineering, Mc Graw Hill.
19. Max peters, “Elementary chemical Engineering”.
20. D.G. Joreden, “Chemical Process Development”-Pt.l.
21. M.S. Peters & K.D. Timmerhans, “ Plant Design and Economics for chemical Engineers”.
22. Grogging, P.H. (ed) Unit Process in Organic synthesis”.-McGraw Hill.
23. Shreve, R.N.,”Chemical Process Industries” McGraw Hill.

Reference books

Coulson & Richardson, “Chemical Engineering.

M.Sc. Chemistry (Final) Semester III & IV
Inorganic Chemistry Practical Papers-XXI, XXII and XXIII

Time: 18 Hrs
(Six sessions, spread over 3 days to all papers)

PAPER XXI

Max. Marks: 80+20(IA)

Preparations

Preparation of selected inorganic compounds and their study by spectroscopic methods (IR, NMR, EPR etc)

1. Chloropentaamminecobalt (III) Chloride.
2. Nitro/Nitritopentaamminecobalt (III) Chloride (Distinction between nitro and nitrito by IR)
3. Preparation of Tin(IV) Iodide and Tin(II) Iodide (Ref Inorganic synthesis 1953, 4, 119).
4. Potassium trioxolatoferrate (III)
5. Chromous acetate
6. Metal complexes of dimethyl sulfoxide (IR): $CuCl_2$.2DMSO, $RuCl_2$.4DMSO [J.Chem. Educ., 1982, 59, 57).
7. Cis and trans $[Co(en)_2Cl_2]$.
8. Tris(acetyl-acetonato) manganese(III).
9. Bromination of Cr(III) acetylacetonato $Cr(acac)_3$. [J.Chem. Edu. 1986, 63].
10. Separation of optical isomers of cis$[Co(en)_2Cl_2]Cl$: J.Chem Soc. 1960, 4369.
11. Preparation and uses of Ferrocene. J.Chem. Edu. 1966, 43, 73; 1976, 53, 730.

12. Preparation of copper glycine complex-cis and trans bis(glycinato Cu(II); J. Chem. Soc. Dalton 1979, 1901; J.Chem Edu. 1982,59, 1052.
13. Tris(acetylacetonato) cobaltate (III).
14. Tris(Thiourea) Copper(I) Sulphate. (Estimation of Cu-Iodomedtrically) Any other compound prepared in the lab.

I	**Preparation**	**55 Marks**
II	**Lab. Record**	**15 Marks**
III	**Viva-voce**	**10 Marks**

PAPER XXII

Max. Marks: 80+20(IA)

Instrumentation

1. Spectrophotometric Determinations
2. Conductometric Titrations
3. Flame Photometry
4. Potentiometric/pH-analysis
5. Electrogravimetric Analysis
6. Polarographic analysis
7. Any other techniques introduced

I	**Instrumentation**	**55 Marks**
II	**Lab. Record**	**15 Marks**
III	**Viva-voce**	**10 Marks**

PAPER XXIII

Max. Marks: 80+20(IA)

Quantitative analysis of elements or groups in the complexes, mixtures, ores, alloys etc. by available analytical techniques.

I	**Quantitative analysis**	**55 Marks**

II **Lab. Record** **15 Marks**

III **Viva-voce** **10 Marks**

Books Suggested

1. Synthesis and Characterization of Inorganic compounds W.L. Jolly, Prentice Hall, Englowood.
2. Synthesis and Physical Studies of Inorganic Compounds, C.F.Bell, Pergamon Press.
3. A Text Book of Quantitative Analysis; A.I. Vogel, ELBS. London.
4. Inorganic Preparations; W.G. Palmer

Or

M.Sc. Chemistry (Semester III & IV)
Physical Chemistry Practicals Paper-XXI, XXII and XXIII

Time: 18 Hrs
(Six sessions, spread over 3 days to all papers)
Max. Marks: 80+20(IA), 80+20(IA) & 80+20(IA)

Paper XXI

Potentiometry

1. Determination of activity coefficient of Ag^+ in a solution of silver nitrate and to study the effect of potassium nitrate on the activity coefficient of silver nitrate.
2. Determination of the cell Pt, $H_2|HCl\ AgCl|Ag$ with various concentrations of HCl and to obtain the activity coefficient of HCl.
3. Determination of solubility of silver halides in water.
4. Determination of first and second ionization constant of phosphoric acid.
5. Study of silver-ammonia complex and determination of the stability constant.
6. Determination of strength of ferrous ammonium sulphate using potassium dichromate or ceric sulphate and determination of redox potential.
7. Determination of strength of HCl and CH_3COOH in a mixture using NaOH.
8. Titration of weak/strong acid with strong base using quinhydrone and determination of dissociation constant of the acid.
9. Study of equilibrium constant of the reaction $Fe^{+++} + Ag \rightarrow Fe^{++} + Ag^+$.
10. To determine the degree of hydrolysis of aniline hydrochloride.

11. Titration of halides with $AgNO_3$ individually and in the mixture of two halides.
12. Determination of liquid junction potential.

Chemical Kinetics

13. Determination of velocity constant of the reaction of ethyl acetate with NaOH and activation energy and temperature coefficient of the reaction.
14. Determination of the velocity constant and energy of activation of the reactions between H_2O_2 and HI.
15. Investigation of the reaction between acetone and iodine (with respect to H^+, I_2 and acetone).
16. Determination of the order and velocity of the reaction between potassium persulphate and potassium iodide.

Experiment **Marks: 55**

Lab record & Viva-voce **Marks: 15+10**

Books Suggested

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

Paper XXII

Conductometry

1. Determination of the equivalent conductance of weak acid (benzoic and acetic acid) at several concentrations and the dissociation constant of the acid.
2. Determination of the equivalent conductance of strong electrolytes such as HCl, KCl, KNO_3 and NaCl and the validity of Onsagar equation.
3. Determination of solubility of silver halides.
4. Study of degree of hydrolysis of aniline hydrochloride.
5. Conductometric titration of: (i) Strong acid vs. strong base, (ii) Strong acid vs. weak base, (iii) Weak acid vs. strong base, (iv) Weak acid vs. weak base, (v) CH_3COOH + HCl vs. NaOH, (vi) $MgSO_4$ vs. $BaCl_2$.
6. Determine the critical micelle concentration (CMC) of a surfactant (sodium lauryl sulphate) by conductivity method.

pH-metry

7. Preparation of buffer solution of various pH and the determination of their pH values.
8. pH-titratioins of: (i) Acetic acid vs. NaOH, (ii) hydrochloric acid vs. NaOH, (iii) acetic acid vs. ammonium hydroxide and (iv) HCl vs. NH_4OH.
9. Determination of the degree of hydrolysis of aniline hydrochloride.

10. To find dissociation constants of weak acids.

Colorimetry/Spectrophotometry

11. Verification of the Lambert-Beer's law using solutions such as $K_2Cr_2O_7$, $CuSO_4$, $KMnO_4$ in water and I_2 in CCl_4.
12. Study of iron-tiron and iron-salicylic acid complexes.
13. Determination of the composition of various mixtures spectrophotometrically: (i) Potassium dichromate and potassium permanganate (ii) Crystal violet and aurine
14. Determine the dissociation constant of an indicator spectro- photometrically.

Experiment **Marks: 55**

Lab record & Viva-voce **Marks: 15+10**

Books Suggested

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science.
4. Experimental Physical Chemistry, R.C. Das and B. Behera,McGraw Hill.

Paper XXIII

Dielectric Constant and Dipole Moment

1. Determination of dielectric constants of some organic liquids and composition of unknown mixtures.
2. Determination of dipole moments of some organic liquids.

Polarography

3. To determine dissolved oxygen in aqueous solution of organic solvent.
4. Determination of half wave potentials of some cations in aqueous and in non-aqueous solutions.
5. Determination of half wave potentials of ions in mixtures.
6. Amperometirc titrations involving: (i) $Pb(NO_3)_2$ vs. $K_2Cr_2O_7$ and (ii) $Pb(NO_3)_2$ vs. K_2SO_4.

Polarimetry

7. Determination of relative strength of acids by the study of inversion of sucrose.
8. Determination of velocity constant of mutarotation of glucose in the presence of acid or alkali.

Interferrometry

9. Determination of speed of sound of pure liquids/mixtures using interferrometer.

Flame Photometry:

10. Determination of Na^+, K^+ Ca^{2+} and Mg^{2+} in tap water, juice, electral etc.

Note: Any experiment may be introduced/deleted in the practical class based on the availability/non-availability of the instruments/chemicals.

Experiment **Marks: 55**

Lab record & Viva-voce **Marks: 15+10**

Books Suggested

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B.P. Levitt and Zindley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Gailand McGraw Hill.
6. Systematic experimental Physical Chemistry, T.K. Chandershekhar & S.K. Rajbhoj
7. Experimental Physical Chemistry, V.D.Athawale and Parul Mathur, New Age International.

Or

M. Sc Chemistry (Fianl) Semester IV

Organic Chemistry Practicals Paper-XXI, XXII and XXIII

Time: 18 Hrs

(Six sessions, spread over 3 days to all papers)

Max. Marks: 80+20(IA), 80+20(IA) & 80+20(IA)

Paper XXI

1. **Qualitative Analysis**: Separation of compounds of a binary (liquid-liquid, liquid-solid or solid-solid) organic mixture using physical and chemical methods and characterization of the components with the help of chemical

analysis and confirmation of their structures with the help of IR and PMR spectral data (IR & PMR spectra to be provided).

Experiment **Marks: 55**

Lab record & Viva-voce **Marks: 15+10**

Books Suggested

1. "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B.Maynes, Edward Arnold (Pub.)., Ltd. London, 1975).
2. "Systematic Qualitative Organic Analysis" by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.
3. "A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis" by Arthur I. Vogel, Longmans Green and Co., Ltd., London 1966.
4. "Elementary Practical Organic Chemistry" by Arthur I. Vogel, CBS Publishers & Distributors.
5. "A Guide to spectroscopy in Organic Chemistry' by PAVY
6. "Spectrometric Identification of Organic Compounds", Fifth Ed., R.M. Silverstein, G.S. Bassler and T.C.Morrile, John Wiley and Sons, New York.
7. "Organic Spectroscopy', 3rd Ed., by William Kamp. John Wiley & Sons.
8. "Spectroscopic" Methods in Organic Chemistry, D.H. William & Ian Fleming.
9. Vogel's Text Book of Practical Organic Chemistry by B.S. Furners et. al., Longman Group Ltd.

Paper XXII

1. **Preparation of Organic Compounds:** Preparation of Organic Compounds involving two or three stages; Isolation and purification of natural products.

2. **Techniques of Purification and Separation**; Separation of mixtures using TLC, vacuum distillation and sublimation.

Experiment **Marks: 55**

Lab record & Viva-voce **Marks: 15+10**

Books Suggested

1. Text Book of Vogel's Practical Organic Chemistry by Longman Group, B.S. Furness et al., Ltd.
2. "Experiments in Organic Chemistry" Louis F. Fieser O.C. Heath and Company Boston, 1955.
3. "Organic Synthesis" Collective Vol. I.
4. 'Laboratory Manual in Organic Chemistry' by R.K. Bansal, Wiley Eastern Ltd., New Delhi-1980.

Paper XXIII

1. **Quantitative estimation of the following**

   Amino group, hydroxyl group, acetoxy group, carbonyl group, unsaturation, reducing and non-reducing sugars, saponification value and iodine value of fats and oils, formalin and glycine

2. **Colorimetric determination of the following**

   Carbohydrates, ascorbic acid, amino acids, proteins, cholesterol urea.

Experiment **Marks: 55**

Lab record & Viva-voce **Marks: 15+10**

Books Suggested

1. "Elementary Practical Organic Chemistry by Arthur I.Vogel Longmans, Green and Co. 1958.
2. "An Introduction to Practical Biochemistry", by David T. Plummr, Tata McGraw Hill Publishing Company, Ltd., N. Delhi, 1988.
3. Practical Organic Chemistry' by Mann and Saunders.

M.Sc. Chemistry (Final) Semester IV
Pharmaceutical Chemistry Practicals
Paper-XXI, XXII and XXIII

Time: 18 Hrs
(Six sessions, spread over 3 days to all papers)
Max. Marks: 80+20(IA), 80+20(IA) & 80+20(IA)

Paper- XXI

1) Preparations of organic compounds of medicinal interest.
2) Techniques of Purification.
3) Separations and identification of components of binary organic mixture using chemical methods and spectral data.

Experiment **Marks: 55**
Lab record & Viva-voce **Marks: 15+10**

Books Suggested

1. "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B.Maynes, Edward Arnold (Pub.)., Ltd. London, 1975).

2. "Systematic Qualitative Organic Analysis" by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.
3. "A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis" by Arthur I. Vogel, Longmans Green and Co., Ltd., London 1966.
4. "Elementary Practical Organic Chemistry" by Arthur I. Vogel, CBS Publishers & Distributors.
5. Introduction to Spectroscopy: Guide for Students of Organic Chemistry by D.L. Pavia, Gary M. Lampman, George S. Kriz, D.L. Pania.
6. "Spectrometric Identification of Organic Compounds", Fifth Ed., R.M. Silverstein, G.S. Bassler and T.C.Morrile, John Wiley and Sons, New York.
7. "Organic Spectroscopy', 3rd Ed., by William Kamp. John Wiley & Sons.
8. "Spectroscopic" Methods in Organic Chemistry, D.H. William & Ian Fleming.
9. Vogel's Text Book of Practical Organic Chemistry by B.S. Furners et. al., Longman Group Ltd.

Paper-XXII

1) Preparation and evaluation of the following :
Emulsion, simple syrup, aqueous idodine solution, strong iodine solution, calamine lotion, boroglycerine, lannic acid/glycerine, phenol/glycerine, pipermint water, rose swater, non-staining iodine ointmind cum methyl salicylate, formulation of simple and medicated ointments, magnesium hydroxide mixture (milk of magnesium), simple and complex powders.

Experiment **Marks: 55**
Lab record & Viva-voce **Marks: 15+10**

Paper-XXIII

(i) Determination of specific rotation of ibuprofen and determination of its percentage in the unknown sample.
(ii) Volumetric determination of ibuprofen in the given tablet.
(iii) Spectrophotometer determination of aspirin content in the soluble aspirin table.
(iv) Spectrophotometer determination of Paracetamol in the tablet.
(v) Determination of Vitamin C in given formulation.
(vi) Determination of phenobarbilone in the given cough syrup.
(vii) To perform I.P. monograph of tablet
(viii) to perform I.P. monograph of hard gelatine capsule.
(ix) Determination of Chloramphenicol in given capsule.
Experiment **Marks: 55**
Lab record & Viva-voce **Marks: 15+10**