

Syllabus

(2010-2011)

Department of Chemistry

Chaudhary Devi Lal University,

Sirsa -125 055

M. Sc. Previous (Chemistry) 2010-2011

First Year: There will be two semesters in a year. Examination will be held at the end of each semester.

First Semester

Marks 550

Five Common Paper (100 Marks Each, 80 + 20 Internal)
One compulsory optional Paper, only qualifying (50 Marks)

Sr. No.	Course Code	Subject	Course Hours	Teaching Schedule (Workload)	Exam. Schedule (Marks)	Duration of Exams
1.	CH-101	Inorganic Chemistry-I	60	4hrs/week	80+20	3hrs
	CH-102	Organic Chemistry-I	60	4hrs/week	80+20	3hrs
	CH-103	Physical Chemistry-I	60	4hrs/week	80+20	3hrs
	CH-104	Spectroscopy-I	60	3hrs/week	80+20	3hrs
2.	CH-105A* OR CH-105B**	Mathematics for Chemists OR General Biology	45	2hrs/week	50 (Compulsory) Qualifying)	2hrs
3.	CHI-106	Inorganic Practical	90	6hrs/week	50	6hrs.
	CHP-107	Physical Practical	90		50	6hrs.
	CHO-108	Organic Practical	90		50	6hrs.

Total Marks = 550

* For students without Mathematics in B. Sc.

** For students without Biology in B. Sc.

(Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Chaudhary Devi Lal University, Sirsa

Syllabi and Scheme of Examination for M. Sc. (Chemistry)

2010-2011

M. Sc. (Chemistry) First Semester

Paper (Codes)	Course Papers (Theory)	Course Hours	Marks
Paper I (CH-101)	Inorganic Chemistry-I	60	80+20
Paper II (CH-102)	Organic Chemistry-I	60	80+20
Paper III (CH-103)	Physical Chemistry-I	60	80+20
Paper IV (CH-104)	Spectroscopy-I	60	80+20
Paper V (CH-105A)	*Mathematics for Chemists (Qualifying)	45	50
	OR		
Paper V (CH-105B)	**General Biology(Qualifying)		
Practicals			
Paper VI (CHI-106)	Inorganic Practical	90	50
Paper VII (CHP-107)	Physical Practical	90	50
Paper VIII (CHO-108)	Organic Practical	90	50

Total Marks =550

*For students without mathematics in B. Sc.

**For students without biology in B. Sc.

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Detailed Course Outlines

M. Sc. Chemistry (Ist Semester)

Paper-I CHI-101 Inorganic Chemistry-I

80 Marks

Symmetry and Group Theory

Molecular symmetry, representation of symmetry operations as matrices (Representation for the C_n , C_{nv} , C_{nh} , D_{nh} etc.), set of symmetry operations of molecules satisfying the conditions of point groups, multiplication tables.

Representation: basis of representation, representation of point groups. Great Orthogonality theorem (without proof) and various relationships derived from it. Derivation of character Tables of C_{2v} point group.

Introduction to Ligands

Introduction, Stability (Kinetic and thermodynamic) of complexes in aqueous solution, stepwise and overall formation constants of complexes, their determination by spectrophotometric method and pH measurement method. Labile and inert octahedral complexes according to VBT and CFT factors affecting lability and stability of complexes (Irving-William order). Chelate effect, Macrocyclic effect, multidentate ligands. Classification of ligands, π acid ligands, π acceptor character in terms of MOT diagrams, π acid ligands of other groups of periodic table.

Polyelectronic Atoms-

Angular momentum, addition of angular momentum, LS and JJ coupling.

Racah parameters and their relationship, determination of ground terms of d^1 to d^{10} metal ions;

Zeeman and Stark effect.

Valence Bond Theory- Outer and inner octahedral complexes, limitations of VBT, crystal field theory. Crystal field splitting octahedral, tetragonal, square planar and tetrahedral complexes. Distorted octahedral complexes (Jahn teller effect), spectrochemical series, Comparison of CFSE value of d^1 to d^9 ion in terms of orbital splitting (LS and HS).

Colours of transition metal complexes, spinel structure, heat of hydration, limitations of CFT.

Molecular Orbital Theory-composition of ligand groups, orbitals, sigma and pi-molecular orbitals, MOT diagrams.

Charge transfer spectra, spectrochemical series, Nephelauxetic effect, angular overlap model as applied to transition metal complexes.

Selection rules of d-d transitions, Orgel and Tanabe-Sugano diagrams.

Magnetic Properties of Free Ions – Effect of L-S coupling on magnetic properties.

Temperature independent paramagnetism (**TIP**) in terms of crystal field theory (**CFT**) and molecular orbital theory (**MOT**).

Quenching of orbital momentum by crystal field in complexes in terms of splitting.

Suggested Readings:

Advanced Inorganic Chemistry, F. A Cotton & G. Wilkinson, IV Edition.

Inorganic Chemistry, J. E. Huheey, 3rd Edition.

Inorganic Electronic Spectroscopy, A. B. Lever.

Introduction to Magnetic Chemistry, Earnshaw.

Chemical Application of group theory, F. A. Cotton.

Introduction to Ligand Fields, B. N. Figgis.

Guide Lines for paper Setter

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M. Sc. Chemistry (Ist Semester)

Paper-II CHO-102 Organic Chemistry-I

60Hrs. (3hrs./week)
80 Marks

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(σ) and reaction constants(ρ). Taft equation, kinetic and thermodynamic control, Hammond's postulate, methods of determining mechanisms, isotope effects. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes.

Mechanism of Nucleophilic aliphatic Substitution

The limiting cases SN^1 and SN^2 reactions, 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 , $SN^{i'}$, SN^1 , $SN^{1'}$, SN^2 and $SN^{2'}$ mechanisms.

Mechanism of Elimination Reactions

The E1, E1cB 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.

Aromatic Electrophilic Substitution

Theoretical treatment of aromatic substitution reactions, structure-reactivity relationship in mono substituted benzene ring, orientation in other ring system, Vilsmeier-Haack reaction, Reimer-Tiemann reaction, Bischler – Napieralski reaction, Pechmann 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 mechanism (involving arynes); Von-Richter rearrangement, Sommelet-Hauser, Smiles and Stevens rearrangements. General aspects of generation, structure, stability and reactivity of arynes.

Aliphatic Electrophilic Substitution

Bimolecular mechanisms – S_E^2 and S_E^1 . The S_E^1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and solvent polarity on the reactivity.

Suggested Readings:

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

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

Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.

Modern Organic Reactions, H.O. House, W. A. Benjamin.

Principles of Organic synthesis, R.O.C. Norman and J.M. cozon, blackie Academic & Professional.

Reaction mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.

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

Stereochemistry of Organic compounds, P.S. Kalsi, New Age International.

Stereochemistry of Carbon compounds, E.L. Eliel, McGraw-Hill, New York, Latest Edition.

Mechanism and Theory in Organic Chemistry, Lowry and Richardson, 3rd edition. Harper and Paw, New York, 1987.

Organic Chemistry, McMurry 2nd edition. Brooks/cole Monterey, CA 1988.

Guide Lines for paper Setter

Note: **Section A (16 Marks)** it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

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Paper-III
CHP-103
Physical Chemistry-I

80 Marks

Chemical Kinetics:

Methods of determining rate laws, collision rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions: single and double sphere models, influence of solvent and ionic strength.

Chain reactions: hydrogen-bromine reaction, pyrolysis of acetaldehyde, decompositions of ethane. Photochemical reactions (hydrogen-bromine & hydrogen-chlorine reactions). General treatment of chain reaction (hydrogen-bromine reactions) apparent activation energy of chain reactions, chain length, Rice – Herzfeld mechanism of organic molecules decomposition (acetaldehyde).

Thermodynamics:

Brief resume of first and second law of thermodynamics. Entropy changes in reversible and irreversible processes; variation of entropy with temperature, pressure and volume, entropy concept as a measure of unavailable energy, free energy functions and their significance, criteria for spontaneity of a process; partial molar quantities (Free energy, volume heat content), Gibb's – Duhem equation; Clausius – Clapyeron equation; law of mass action and its thermodynamic derivation. Third law of thermodynamics (Nernst heat theorem, determination of absolute entropy, unattainability of absolute zero) and its limitation.

Phase Rule, Fugacity & Activity:

Phase Rule, Phase diagram for two completely miscible components systems. Concepts of fugacity, fugacity of gases and its determination. Activity and activity coefficient, choice of standard states, determination of activity coefficient for solute and solvent.

Quantum Chemistry -I:

The Schrodinger wave equation and the postulates of quantum mechanics. Discussions of the solutions of Schrodinger equation to some model systems, viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom. The variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate). Application of variation method and perturbation theory to Helium atom.

Suggested Readings:

Quantum Chemistry, I. M. Levine, Prentice-Hall.
Introduction to Quantum Chemistry, A. K.Chandra, Tata Mc Graw Hill.
R P. Rastogi & S. S Mishra, Chemical Thermodynamics.
S. Glasstone: Thermodynamics for Chemists.
Prigogine: Introduction to Thermodynamics of Irreversible processes.
Chemical Kinetics, Keith J. Laidler, McGraw Hill.
Kinetics and Mechanisms, Arthur A. Frost and R. G.Pearson.
Chemical Statistics and Kinetics of solutions, E. A. Huges.

Guide Lines for paper Setter

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Paper-IV
CH-104
Spectroscopy and Diffraction Methods

Max. Marks: 80

Nuclear Magnetic Resonance:

The Nuclear spin, Larmor frequency, the NMR isotopes, population of nuclear spin level, spin and spin lattice relaxation. Measurement techniques (CW & FT method), solvent used.

Chemical shift, reference compounds, shielding constant, range of typical chemical shifts simple application of chemical shifts, ring current and aromaticity. Shifts for ^1H and ^{13}C .

Spin – spin interactions, Low and High resolution spectra with various examples, correlation of H bound to carbon, ^1H bound to other nuclei such as nitrogen, oxygen, sulphur, Complex spin-spin interactions, between two or more nuclei.

Effect of chemical exchange, fluxional molecules, hindered rotations on NMR spectrum, Karplus relationship, nuclear magnetic double resonance, chemically induced dynamic nuclear polarization (CIDNP). Brief introduction to multipurpose NMR spectroscopy.

Application of structure elucidation of simple organic molecules Lanthanide shift reagents.

Electron Spin Resonance Spectroscopy

Features of ESR spectra, measurement technique hyperfine coupling in isotropic system, anisotropic splitting.

Electron – electron interaction, transition metal complexes g-value and factors affecting g-value, Zero - field splitting, Kramers degeneracy, spin Hamilton, linewidth in ESR. Application to p-benzoquinone, DPPH, pyrazine.

Mass Spectrometry:

Elementary theory, measurement techniques (EI, CI, FD, FAB), resolution, exact masses of nuclides, molecular ions, isotope ions, fragment ions of odd and even electron types, rearrangement ions. Factors affecting cleavage, cleavage patterns, simple cleavage, cleavages at a heteroatom, multicentre fragmentation rearrangements, Diels – Alder fragmentation.

Cleavage associated with common functional groups (aldehydes, ketones, cyclic and acyclic esters, alcohols, olefins, aromatic amine compounds). Special method of GC-MS, high resolution MS, Interpretation of the spectrum of an unknown compound.

X-Rays Crystallography

Use of X-ray diffraction to find atomic arrangements. Point group, space group and unit cell. Concept of reciprocal lattice. Bragg's law in reciprocal space.

Combining waves to obtain an image; elementary treatment of structure factor and Fourier synthesis. Anomalous scattering and its effect.

Representation of structural results, Chirality and absolute structure, packing in crystals, thermal and photochemical reactions in solids state.

Suggested Readings:

W.Kemp, Organic Spectroscopy, ELBS, London.

D.H. Williams and I. Fleming Spectroscopic Methods in Organic Chemistry.

R.M. Silverstein & G.C. Bassler, Spectrometric Identification of Organic compounds.

H.S. Randhawa, Molecular Spectroscopy

E.A.V.Ebsworth; D.W.H Rankin; S.Cradock, Structural Methods in Inorganic Chemistry.

R.S Drago, Physical Methods in Chemistry (Ist and IInd edition), Saunders College.

C.N. Banwell, Fundamentals of Molecular Spectroscopy.

S.Walker and H.Straugh, Spectroscopy, Vol.I.

N.N.Greenwood & T.C.Gibb, Mossbauer Spectroscopy, Chapman and Hall, 1971.

K.Nakamoto, Infrared and Raman Spectra of Inorganic and co-ordination compounds, Wiley.

Guide Lines for paper Setter

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Paper – V
CH-105A
Mathematics for Chemists
(Compulsory & Qualifying)

Max. Marks: 50
Exam Time 02 hrs

Note :

Matrices & Determinants:

Definition and expansion properties of determinants, product of two determinants of 3rd order. Introduction to various terms Matrix, row, column, diagonal unit, sub, Square, equal matrices, null, symmetrical, order of character of transpose of, adjoint of, inverse of, matrices. Addition, multiplication, diagonalization, similarity transformation of matrices, characteristic equation statement of Cayley Hamilton theorem. Rank of matrix, condition of consistency of a system of linear equations. Eigen vectors and eigen values using matrices.

Differential Calculus I:

Differentiation of standard functions, theorems relating to the derivative of the sum, difference, product and quotient of functions, derivative of trigonometric functions, inverse trigonometric functions, logarithmic functions and exponential functions, differentiation of implicit functions, logarithmic differentiation, derivative of functions, expressed in parametric form, derivatives of higher order. (Only formulae to be given and applications to be emphasized). Maxima and minima (absolute, local), Rolle's theorem and mean theorem, curve sketching, meaning of differential errors and approximations.

Integral Calculus:

Integration as an inverse of differentiation summation, area under a curve, indefinite integrals of standard form, method of substitution, method of partial fractions, integration by parts, definite integrals, reduction formulae, definite integrals of limit of sum and geometrical interpretation.

Vectors:

Definition of vector in two, three and multi-dimensional spaces, addition, multiplication and differentiation of vectors. Concept of normalization, orthogonality and complete set of unit vectors, physical significance of divergence, gradient and curl, physical significance of divergence, gradient and their applications.

Beta, gamma and Dirac delta functions.

Suggested Readings:

Santi Narayan – Differential Calculus.
Santi Narayan- Intergral Calculus.
B.S Grewal- Higher Engineering Mathematics.
Joseph B.Dence-Mathematical Techniques in Chemistry.
Margenau and Murphy, the Mathematics of physics and
Chemistry.
B.L. Moncha and H.R. Choudhary- A Text Book of Engineering
Mathematics.

Guide Lines for paper Setter

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Paper-V
CH-105B
General Biology
(Compulsory & Qualifying)
(For non-medical students)

Max. Marks: 50
Exam Time 02 hrs

The Organisation of Life

A view of Life: Specific organization, metabolism, homeostasis, growth, movement, responsiveness, reproduction, adaptation.

Biologically important molecules: carbohydrates, lipids, proteins and nucleic acids. The life of cells – the cell theory, general characteristics of cells, difference between prokaryotic and eukaryotic cells, difference between plant and animal cells, cell organelles. Cellular respiration and biosynthesis: glycolysis and the citric acid cycle, anaerobic pathways. Tissues, organs and organ systems.

Producing a new generation – eukaryotic chromosomes, genes, meiosis and spermatogenesis.

The basic principle of heredity: Mendel's law, monohybrid cross, dihybrid cross, Incomplete dominance, gene, interaction, polygenic, inheritance, multiple alleles, linkage and crossing over, DNA – double helix structure and replication.

Gene expression: Transcription and translation, genetic code.

Guide Lines for paper Setter

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Suggested Readings:

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

Biochemistry, L. Stryer and W. H. F. Freeman.

Biochemistry, Voet and Voet, John Wiley.

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

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M. Sc. Chemistry (Ist Semester) - Practicals

Inorganic Chemistry

CHI-106

Time: 90 [6 Hrs/week]

Max marks = 50

Qualitative Analysis:

Identification of rare cations including less familiar elements by spot tests assisted by group analysis (6 cations).

Quantitative analysis:

Separation of the metal ions and determination of any one of them using volumetric/gravimetric methods: Cu-Ni, Cu-Zn, Cu-Al, Fe-Ni and analysis of alloys.

Separation Techniques:

Ion exchange: Separation of Inorganic cations/anions (2 or 3 components).
Chromatographic Separation.

Books Recommended:

A text book Qualitative Inorganic Chemistry, A.I. Vogel

M. Sc. Chemistry (Ist Semester) - Practicals

Organic Chemistry

CHO-107

Time: 90 [6 Hrs/week]

Max marks = 50

1. Purification of organic compounds involving fractional crystallisation, fractional distillation, vacuum distillation, steam distillation and extraction.
2. To carry out the analyses of common analgesics by the (Any three): paracetamol, aspirin, caffeine, phenacetin, salicylamide.
3. Separation of components of a binary (liquid – liquid, liquid- solid or solid- solid) organic mixtures using physical and chemical methods and characterization of the components with the help of chemical analysis and conformation of their structures with help of IR and PMR spectral data, the students should also check the purity of the separated components on TLC.
4. Colorimetric determination of the following:
Carbohydrate, ascorbic acid, amino acids, proteins, cholesterol, urea.

M. Sc. Chemistry (Ist Sem) - Practicals

Physical Chemistry

CHP-108

Time: 90 [6 Hrs/week]

Max marks = 50

Partial Molar Quantities:

- To determine the partial molal volume of urea in aqueous solution from density measurements.

Adsorption:

- To determine the adsorption isotherms of acetic acid from aqueous solution by charcoal.
- To study the adsorption of I₂ from alcoholic solution by charcoal.

Acid and Saponification value:

- To find out the acid value of a given sample.
- To find out the saponification value of given vegetable oil.
- To determine the viscosity of highly viscous liquid.

Molecular weight of polymer:

- To determine the molecular weight of a given polymeric solution by viscosity method.

Surface Tension/Interfacial Tension

To find surface tension/interfacial tension between two immiscible liquids.

Viscosity

To find viscosity of unknown liquids by Ostwald's viscometer method.

Distribution Law

To study the distribution of benzoic acid between benzene and water at room temperature and show that benzoic acid dimerizes in benzene.

Chemical Kinetics:

- Determination of the effect of (a) change in temperature, (b) change in concentration of reactants and catalysts (c) ionic strength of the media on velocity constant of hydrolysis of an ester.
- Determination of the rate constant of an ester catalyzed by an acid or a base.
- Study of a second order reaction.

Books Recommended:

Zindley's Practical Physical Chemistry, B. P. Levitt, Longman.

Experimental Physical Chemistry, R. C. Das and B. Behara, Tata McGraw Hill.

Physical Methods of Chemistry, R. S. Drago, Saunders Company.

Practical Physical Chemistry, A. M. James and F. E. Prichard, Longman.

Practical Physical Chemistry, S. R. Palit and S. K. De, Science Book agency.

Experiments in Physical Chemistry, Shoemaker and Gailand, McGraw Hill.

Chaudhary Devi Lal University, Sirsa
Syllabi and Scheme of Examination for M. Sc. (Chemistry)

2010-2011

M. Sc. (Chemistry) Second Semester

Paper (Codes)	Course Papers (Theory)	Course Hours	Marks
Paper I (CHI-201)	Inorganic Chemistry-II	60	80+20
Paper II (CHO-202)	Organic Chemistry-II	60	80+20
Paper III (CHP-203)	Physical Chemistry-II	60	80+20
Paper IV (CHS-204)	Spectroscopy - II	60	80+20
Practicals			
1. (CHI-205)	Inorganic Chemistry	90	50
2. (CHO-206)	Organic Chemistry	90	50
3. (CHP-207)	Physical Chemistry	90	50

Total Marks = 550

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Detailed Course Outlines

M. Sc. Chemistry (2nd Semester)

Paper-I

CHI-201

Inorganic Chemistry-II

80 Marks

Nuclear Chemistry-I: Fundamental particles of nucleus (nucleons): concept of nuclides, representation of nuclides. Isobars and isotopes specific examples.

The size concept of nucleus and atom. The possible forces operating between (n-n, p-p, n-p) and the magnitude of nuclear forces (short range); qualitative idea of the stability of nuclear (n/p ratio), shell and liquid drop models (qualitative ideas); natural and artificial radio-activity disintegration series; Radioactive disintegration rate, half – life average life.

Nuclear Chemistry –II: Nuclear binding energy, mass defect, Einstein's mass energy relation, calculation of mass defect and binding energy, Artificial transmutation nuclear reactions – spallation, nuclear fissions and fusion, radioactive isotopes, tracer chemistry, carbon dating, some typical applications in industry, agriculture, medicine and bio-chemistry: therapeutic uses of isotopes. Basic principals and types of nuclear reactors, scintillation counters. Radio-active waste disposal.

Non aqueous Solvents: Dynamics of Inorganic in aqueous and non- aqueous solutions. Basic principles. Thermodynamics, kinetics and spontaneity of reactions, Electrode potential and its relation to spontaneity and application in the prediction of chemical reactions, Reaction in non-aqueous media with reference to H₂SO₄, BrF₃, CH₃COOH, HCN and N₂O₄. Reactions in molten salts.

Introduction to Metal Complexes

Metal carbonyls, nitrosyls and dinitrogen complexes, Orbital diagrams of bi and trinuclear carbonyls, semi-bridging in metal carbonyls and nitrosyls. Magnetic, IR and X-ray diffraction evidence of their structure, π acidity and softness in terms of HSAB principle, Symbiosis and antisymbiosis

Suggested Readings:

Advanced Inorganic Chemistry, F. A Cotton & G. Wilkinson, 4th Edition.

Inorganic Chemistry, J. E. Huheey, 3rd Edition.

Inorganic Electronic Spectroscopy, A. B. Lever.

Introduction to Magnetic Chemistry, Earnshaw.

Chemical Application of group theory, F. A. Cotton.

Introduction to Ligand Fields, B. N. Figgis.

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M. Sc. Chemistry (IInd Semester)

Paper-II CHO-202 Organic Chemistry-II

80 Marks

Neighbouring Group Participation and Carbocation Rearrangements:

Anchimeric assistance, neighbouring group participation by non-bonding electrons, sigma and π -bonds, classical and non-classical carbocations, carbocation rearrangements, migratory aptitudes, Wagner meerwein rearrangement, Pinacol-pinacolone rearrangement, Demyanov rearrangement, Tiffeneau-Demyanov ring expansion, Aldehyde-ketone rearrangements, Dienone-phenol rearrangement and Trans-annular rearrangements.

Addition to Carbon-Heteroatom Multiple Bonds

Hydration and addition of alcohols to aldehydes and ketones. Addition – elimination reactions of ketones and aldehydes, reactivity of carbonyl compounds towards addition. Lithium aluminium hydride reduction of carbonyl compounds, acids, esters, nitriles, additions of Grignard reagents. Reformatsky reaction, Mannich Reaction, Wittig reaction, Michael addition reaction, Claisen condensation, Dieckman reaction, Aldol condensation, Knoevenagel condensation, Perkin and Stobbe's reaction, Cannizzaro reaction, Benzoin condensation, Robinson annulation reaction, ester hydrolysis, aminolysis of esters, amide hydrolysis.

Stereochemistry-I

Chiral Molecules, symmetry elements, D-L, R-S, E-Z, and threo and 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. Stereochemistry of decalins, conformation of sugars,

Optical isomerism in allenes, biphenyls, spiranes and cyclooctene.

Cram's rule and its modification, Prelog rule and assignment of configuration.

Stereochemistry-II

Stereospecific and stereoselective reactions, concept of prostereo isomerism and chiral synthesis, Principle categories of asymmetric synthesis.

Elementary ideas about stereochemistry of tertiary amines, quaternary salts, sulphur and phosphorous compounds.

Addition to C-C Multiple Bond

Mechanism of addition of hydrogen halide, H₂O, halogens, HOX and mercuric salt to alkenes and alkynes. Hydroboration, formation of C-C bonds via organoboranes, hydroboration of acetylenes, nucleophilic addition to alkenes.

Suggested Readings:

- Advanced Organic Chemistry: Reactions: Mechanism and Structure, Jerry March, John Wiley.
- Advanced Organic Chemistry, Part B, F.A Carey and R.J. Sundberg, Plenum press.
- A guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
- Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
- Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
- Modern Organic Reactions, H.O. House, W. A. Benjamin.
- Reaction mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
- Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
- Stereochemistry of Organic compounds, P.S. Kalsi, New Age International.
- Stereochemistry of Carbon compounds, E.L. Eliel, McGraw-Hill, New York, Latest Edition.
- Organic "Chemistry" Baker and Engel , West Publishing company, St. Paul, MW, 1992
- Organic chemistry" Ege, 2nd Ed. D.C Heath, New York 1989.
- Physical organic chemistry Isaac, Wiley, New York 1987.
- Physical and Mechanistic Organic Chemistry" Jones, 2nd ed. Cambridge University press, Cambridge, 1984.
- London "Organic Chemistry 2nd edition benjamin/Cummings, Menlv part CA, 1988.
- Mechanism and Theory in Organic Chemistry, Lowry and Richardson, 3rd edition. Harper and Paw, New York, 1987.
- Organic Chemistry, McMurry 2nd edition. Brooks/cole Monterey, CA 1988.
- Organic Chemistry, Solomons , 5th edition Wiley New york, 1992.
- Organic Chemistry, Vollhard, W.H. Freeman, San Francisco, 1987.

Guide Lines for paper Setter

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

M. Sc. Chemistry (IInd Semester)

**Paper-III
CHP-203
Physical Chemistry-II**

80 Marks

Quantum Chemistry II:

Ordinary angular momentum, eigen values and eigen functions for angular momentum, operator using ladder operators, and Pauli's exclusion principle.

Electronic Structure of Atoms:

Electronic contribution, R-S terms and coupling schemes, Slater-Condon parameters, spin orbit coupling, Zeeman splitting.

Molecular Orbital Theory:

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

Enzyme Kinetics:

Kinetics of (one intermediate) enzymatic reaction: Michaelis –Menton treatment, evaluation of Michaelis's constant for enzyme - substrate binding by line weaver-Burk plot by Dixon and by Eadie-Hofstae methods. Competitive and non – competitive inhibition.

Fast Reactions:

General features of fast reactions, study of fast reactions by flow methods, relaxation method and flash photolysis.

Non Equilibrium Thermodynamics:

General theory of non – equilibrium processes, entropy production and entropy flow; thermodynamic criteria for non –equilibrium states, entropy production in heat flow, mass flow, electric current, chemical reactions, Saxen's relation, Onsager's reciprocity relation, thermomolecular pressure difference, electro kinetic phenomenon, coupled reactions.

Unimolecular Reactions:

Dynamics of unimolecular reactions (Lindemann- Hinshelwood and Rice-Ramsperger-Kassel-Marcus [RRKM] theories of Unimolecular reactions.

Chemistry of Nanomaterials:

Definition, historical perspective, consequence of nanoscale, nanoparticle morphology, Introduction to synthesis and characterization techniques for nanomaterials & applications of nanomaterials.

Guide Lines for Paper Setter

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Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Suggested Readings:

- 01) Quantum Chemistry, I. M. Levine, Prentice-Hall.
- 02) Introduction to Quantum Chemistry, A. K. Chandra, Tata Mc Graw Hill.
- 03) R P. Rastogi & S. S. Mishra, Chemical Thermodynamics.
- 04) S. Glasstone: Thermodynamics for Chemists.
- I. Prigogine: Introduction to Thermodynamics of Irreversible processes.
- 05) Chemical Kinetics, Keith J. Laidler, McGraw Hill.
- 06) Kinetics and Mechanisms, Arthur A. Frost and R. G. Pearson.
- 07) Chemical Statistics and Kinetics of solutions, E. A. Huges.

M. Sc. Chemistry (IInd Semester)

Paper-IV

CHS-204

Spectroscopy-II

Max. Marks: 80

Ultraviolet and Visible Spectroscopy:

The energy of electronic excitation, measurement techniques, Beer-lambert law, Molar extinction coefficient. The Frank Condon principle. Different types of transition noticed in UV spectrum of organic functional groups and their relative energies, chromophore, auxochromes, factors affecting ϵ_{\max} . Effect of steric hindrance to coplanarity, solvent effects. Absorption spectra of Charge Transfer Complexes. Applications of UV spectroscopy.

Rotational (Microwave) Spectroscopy:

Rotational energies of linear molecules, Rotational energy level populations, merits and demerits of microwave spectroscopy, rotational spectra of rigid, linear molecules, non-rigid rotators. Determination of moment of inertia and bond length from rotational spectra, relative intensities of spectral lines. Rotational spectra of non-linear molecules (brief mention), vibrations in polyatomic molecules, effects giving rise to absorption bands. Group vibrations and limitations of group vibration concepts.

Vibrational (Infrared) Spectroscopy

Harmonic and Anharmonic Oscillators, vibrational energies of diatomic molecules. Absorption of radiations by molecular vibration, selection rules, force constant.

Vibrational energy levels, selection rules, force constant, fundamental vibrational frequencies, factors influencing vibration frequencies (Vibrational Coupling, Hydrogen bonding, Electronic effect, Bond angles, Field effect). Sampling techniques, absorption of common functional groups, interpretation, finger print regions. Applications.

Raman Spectroscopy

Polarization of light, theories of Raman Effect, merits and demerits of Raman spectroscopy. Pure rotational Raman spectra of linear molecules, Vibrational Raman spectra, selection rules, rule of mutual exclusion. Factors affecting absorption frequencies. Interpretation and finger printing regions.

Guide Lines for Paper Setter

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Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Suggested Readings:

- W. Kemp, Organic Spectroscopy, ELBS, London.
- D.H. Williams and I. Fleming Spectroscopic Methods in Organic Chemistry.
- R.M. Silverstein & G.C. Bassler, Spectrometric Identification of Organic compounds.
- H.S. Randhawa, Molecular Spectroscopy
- E. A. V. Ebsworth; D.W.H Rankin; S. Craddock, Structural Methods in Inorganic Chemistry.
- R. S Drago, Physical Methods in Chemistry (Ist and IInd edition), Saunders College.
- C. N. Banwell, Fundamentals of Molecular Spectroscopy.
- S. Walker and H. Straugh, Spectroscopy, Vol. I.
- J. E.Wertz & J. R Boulton, Electron Spin Resonance , Elementary Theory and Practical Applications, Chapman and Hall(p.49-65).
- N. N. Greenwood & T. C. Gibb, Mossbauer Spectroscopy, Chapman and Hall, 1971.
- K. Nakamoto, Infrared and Raman Spectra of Inorganic and co-ordination compounds, Wiley.

M. Sc. Chemistry (2nd Semester) - Practicals

Inorganic Chemistry

CHI-205

100 Marks

Preparation of Complexes:

Preparation of chloropentaminecobalt (III) chloride and its conversion into nitro and nitrite isomers (an IR study).

Preparation of cis and trans $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$ (UV- and IR Study).

Preparation of bis(acetylacetonato)copper (II) (UV – VIS, esr spectroscopy).

Preparation of mercury tetraisothiocyanatocobaltate (II)
 $\text{Hg}[\text{Co}(\text{NCS})_4]$ magnetic suscep., IR study.

Preparation of sodium hexanitritocobaltate(III), $\text{Na}_3[\text{Co}(\text{NO}_2)_6]$, and its IR interpretation.

Preparation and resolution of tris(ethylenediamine) cobalt (III) ion. Measurement of optical rotation of these resolved complexes.

Preparation of Potassium dioxalatocuprate(II)dihydrate
 $\text{K}_2[\text{Cu}(\text{C}_2\text{O}_4)_2] \cdot 2\text{H}_2\text{O}$. (magnetic susceptibility, ESR, IR and UV-VIS studies).

Preparation of cis- and trans- potassium dioxalatodiaquochromate (III). Interpretation of their IR and electronic absorption spectral data.

Preparation of iron(II) oxalate and potassium trioxaltoferrate(III),
 $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$, Interpretation of their magnetic and e.p.r. data.

To prepare ammonium tetrathiocyanatodiamminechromate(III),
 $\text{NH}_4[\text{Cr}(\text{SCN})_4(\text{NH}_3)_2]$

To prepare glycinato-bis-(1,2-diaminodiane)cobalt (III) chloride, I.R. study.

To prepare dichlorodipyridylcobalt (II) octahedral and tetrahedral complexes and study them by magnetic moment, IR and UV/vis studies.

To prepare cis and trans isomers of bis-glycinato copper(II) and distinguish them on the basis of IR spectroscopy.

To prepare a macrocyclic ligand 5,7,7,12,14,14-hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-diene dihydrogeniodide, and its complexes with Ni(II).

Books Recommended:

- 01) G. Marr and B. W. Rockett, Practical Inorganic Chemistry, Van Nostrand Reinhold Company, London, 1972.
- 02) Bull. Chem. Soc., Japan, 29, (1965)852.
- 03) Inorg. Chim. Acta .23, 35 (1977).
- 04) J. Chem. Edu., 79, 581(1977).
- 05) Advances to Inorganic and Radiochemistry, Vol.7.
- 06) Inorganic Chemistry, 1966, Vol.5, 615.
- 07) J. Chem. Soc, 1962, 84, 3404.

M. Sc. Chemistry (2nd Semester) - Practicals

Organic Chemistry

CHO-206

Max Marks = 100

Preparation of organic compounds involving two or three stages.

- 01) Formation of benzophenone oxime and its Beckmann rearrangement (Beckmann rearrangement).
- 02) Synthesis of paracetamol from nitrobenzene via reduction of nitrobenzene to phenyl hydroxylamine, its rearrangement to p-aminophenol and acetylation.
- 03) Benzylidene acid from benzoin via its oxidation to benzil followed by Benzylidene acid rearrangement.
- 04) Synthesis of m-nitroaniline from nitrobenzene via its nitration and selective reduction.
- 05) Synthesis of 3-nitrobenzoic acid from benzoic acid via its esterification nitration and saponification.
- 06) Synthesis of 2-phenylindole via Fischer indole synthesis.
- 07) Synthesis of 1,3,5-tribromobenzene from aniline via bromination, diazotization and reduction.
- 08) Synthesis of methyl-2-pentyl ketone from ethyl acetoacetate.
- 09) Synthesis of diethylbarbituric acid from diethyl malonate.

Quantitative analysis of organic compounds.

- 01) Estimation of phenol/aniline using bromate – bromide solution,
- 02) Determination of the number of hydroxyl or amino groups in the given sample by acetylation method.
- 03) Estimation of reducing sugars by Fehling solution.
- 04) Estimation of sulphur by fusion method / Lassaigne's method.
- 05) Estimation of unsaturation in an organic compound.
- 06) Estimation of iodine and saponification value of oils and fats.

Suggested Readings:

- Experimental Organic Chemistry. Dupont Durst, George W, Gokel P, McGraw Hill Book Co, New York.
- Laboratory Experiments in Organic Chemistry, R.Adams, J.R. Johnson and C.F. Wilcox The Machmillan limited, London.
- A Handbook of Organic analysis Qualitative and Quantitative “ by H.T. Clarke and revised by B.Maynes, Edward Arnold(Pub). Ltd, London,1975.
- Introduction to Organic Laboratory Techniques – A Comprehensive Approach, D.L. Pavia, G.M. Lapman. and G.S Kriz, W.B. Saunders company,1976.
- Systematic Qualitative Organic Analysis by H. Middleton, Edward Arnold (Publishers) Ltd., London 1959.
- A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, Arthur I. Vogel, Longman, Green and Co., Ltd., London 1966.
- Introduction to Spectroscopy – A Guide for Students of Organic chemistry by Donald L Pavia, Gary M lapman and George S. Kriz, .

R.M. Silverstein, G.S. Bassler and T.C. Morrill, John Wiley and Sons, New York.

Experiments in Organic Chemistry, Louis F. Fieser, O. C. Heath, Company Boston, 1955.

Organic Synthesis, Collective Vol. I-VIII.

Laboratory' Manual in Organic Chemistry, R. K. Bansal, Wiley Eastern Ltd., New Delhi, 1980.

An Introduction to Practical Biochemistry, David T. Plummer, Tata McGraw Hill Publishing Company, Ltd., N. Delhi, 1988.

Text Book of Vogel's Practical Organic Chemistry by Longman Group, B. S. Furness et al., Ltd.

An Introduction to Practical Biochemistry by David T. Plummer, Tata McGraw Hill Publishing Company, Ltd., New Delhi, 1988.

Practical Organic Chemistry' by Mann and Saunders.

M. Sc. Chemistry (2nd Semester) - Practicals

Physical Chemistry

CHP-207

Max marks = 100

Refractometry

- (i) Determination of refractive index of simple organic liquids.
- (ii) Variation of refractive index with composition for a mixture of two organic liquids.

pH Metry:

- (i) Determination of the strength of strong and weak acids in a given mixture using a potentiometer or a pH meter.
- (ii) Acid base titration of a non-aqueous media using pH meter.
- (iii) Determination of dissociation constant of acetic acid in DMSO, DMF, acetone and Dioxane by titrating it with KOH.

Conductometry

- (i). Determination of the equivalent conductance of strong electrolytes such as HCl, KCl, KNO₃, AgNO₃ and NaCl and the validity of Onsager equation.
- (ii). Determination of the solubility of lead sulfate and silver halides.
- (iii). Conductometric titration of (a). strong acid vs. strong base, (a). weak acid vs. strong base, (a). strong acid vs. weak base and (a). weak acid vs. weak base.

Colorimetry / Spectrophotometry

Verification of Lambert's - Beer law using solutions such as I₂ in CCl₄, and K₂Cr₂O₇, CuSO₄ and KMnO₄ in water.

Books Recommended:

- 01) Zindley's Practical Physical Chemistry, B. P. Levitt, Longman.
- 02) Experimental Physical Chemistry, R. C. Das and B. Behara, Tata McGraw Hill.
- 03) Physical Methods of Chemistry, R. S. Drago, Saunders Company.
- 04) Practical Physical Chemistry, A. M. James and F. E. Prichard, Longman.
- 05) Practical Physical Chemistry, S. R. Palit and S. K. De, Science Book agency.
- 06) Experiments in Physical Chemistry, Shoemaker and Gailand, McGraw Hill.

M. Sc. (Chemistry) Final

There will be three specializations in the Department of Chemistry; namely Inorganic Chemistry, Organic Chemistry and Physical Chemistry. The students admitted in third Semester will be divided equally in all three specializations on the basis of the merit of 1st semester and the choice of students. There will be two semesters in second year. Examination will be held at the end of each semester.

Third Semester

Marks 600

Course Papers	(Theory)	Course Hours	Marks
Paper I (CHC-301)	Computer for Chemistry	60	50
Paper II (CHE-302)	Environmental Chemistry	60	80+20
Paper III (CH-303) (CHP-303/CHI-303/CHO-303)	Physical/ Inorganic/Organic Special-I	60	80+20
Paper IV(CH-304) (CHP-304/CHI-304/CHO-304)	Physical/Inorganic/Organic Special-II	60	80+20
Paper V(CH-305) (CHP-305/CHI-305/CHO-305)	Physical/Inorganic/Organic Special-III	60	80+20
Practicals CHC-306	Computer Lab (2 hours duration)	60	50
CHI-307/ CHO-307/ CHP-307 Inorganic Pract./Physical Pract./Organic Pract.		90	50

Marks = 550

Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

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Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

M. Sc. (Chemistry) Final

Semester III

Paper I

CHC-301

Computer for Chemists

M. Marks: 50

Introduction to Computers and Computing:

Basic structure and functioning of computers with a PC as an illustrative example. Memory, I/O devices. Secondary storage. Computer languages. Different types of softwares, Algorithms and flow – charts, Computer Generations

Programming for problems related to Chemistry:

Development of small computer codes in C language involving simple formulae in chemistry, such as Vander Waals equation, pH titration, kinetics, radioactive decay. Evaluation of lattice energy and ionic radii from experimental data. Linear simultaneous equations to solve secular equations within the Huckel theory.

Use of Software Packages:

The students will learn how to operate a PC and how to run standard programs and packages. Further, the students will be acquainted with the basic functionality of packages such as MS-WORD/MS-Excel

Suggested Readings:

1. Computers and Common Sense, R. Hunt and J. Shelley, Prentice Hall
2. Computational Chemistry, A.C. Norris.
3. Microcomputer Quantum Mechanics, J. P. Killngbeck, Adam Hilger.
4. Computer Programming in FORTRAN IV, V, Rajaraman, Prentice Hall
5. An Introduction to Digital Computer Design, V. Rajaraman and T. Radhakrishananm Prentice.

Guide Lines for paper Setter

Note: Section A (10 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (25 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

Section C (15 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Semester III

Paper II

CHE-302

Environmental Chemistry

M. Marks: 50

The Environment:

Introduction, components, chemical and physical characteristics of the atmosphere, Environment pollution, classification of pollutants.

Air Pollution:

Natural and Anthropogenic air pollution, Sources and types of air pollutants, carbon oxides, sulfur compounds, nitrogen compounds, Hydrocarbons, and their derivatives particulate matter.

Health effect of criteria pollutants such as carbon monoxide, sulfur oxides, nitrogen oxides particulate matter, hydrocarbons, ozone, lead, health effects of hazardous air pollutants such as Be, Hg, Asbestos, vinyl chloride, Benzene.

Water Pollution:

Definition and types of water pollution, limits of various pollutants, water quality parameters.

Physico-chemical analysis of water: - colour, turbidity, total solids, total alkalinity and acidity as CaCO_3 , Dissolved oxygen (DO), BOD, COD, Analysis of anions and cations by recommended technique.

Waste-water treatment/sewage: Treatment and disposal. Primary, secondary and tertiary treatment of water.

Soil Pollution Definition of soil, components, its function and formation, sources pollution: Chemical pesticides, disposal of industrial and domestic solid wastes on soils, contamination with toxic inorganic compounds., Prevention and elimination of inorganic chemical contaminants, Advantages and disadvantages of organic wastes to soil.

Soil Analysis, Sampling, site selection, method of collection and sample preparation. Determination of physical constants, determination of pH, electrical conductivity, calcium carbonate, water soluble salts, organic matter, N, P and K of the soil.

Toxicology

Definition of toxicology, its history, scope and its literature, Dose-response relationship. Absorption, distribution and excretion of toxic materials. Toxicity of metal ions, (Pb, Hg, Al, Ni, As) organic toxicants such as Halogenated hydrocarbons, pesticides and solvents, Chemical Carcinogens.

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Section C (15 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Suggested Readings:

1. Air Quality, Thad Godish.
2. Chemical and Biological Methods for Water Pollution Studies, R. K. Trivedy.
3. Analytical Agricultural Chemistry by Kanwar & Chopra.
4. The Nature and Properties of Solides by Nyle, C. Brady.
5. Toxicology, The Basic Science of Poisons by Caserett & Doulls.
6. Fundamental of Ecology by E. P. Odum.
7. Kirk – Othmer. Encl. of Chemical Technology, Vol. 23.

Semester III

Paper – III

CHP-303

Physical Chemistry-I

Max Marks: 80

Statistical Mechanics:

Concept of distribution, thermodynamic probability and most probable distribution; canonical, grand canonical and micro canonical ensembles. Maxwell-Boltzmann statistics, Boltzmann distribution, derivation of the Boltzmann distribution expression, determination of the Boltzmann constant, Maxwell distribution law of velocity from Boltzmann distribution expression, The Bose Einstein statistics, statistics of a photon gas, the Fermi - Dirac statistics, and comparison of three statistics.

Statistical thermodynamics:

Partition function and thermodynamic properties; factorization of partition function, relationship of atomic and molar partition function to thermodynamic properties; Translational partition function, calculation of absolute entropy of an ideal monoatomic gas, Sackur-Tetrode equation. Diatomic molecules, separation of internal partition function. Vibrational and Rotational partition function of diatomic molecules. Calculation of contribution of vibrational, rotational partition functions towards various thermodynamic properties. Electronic partition function, effect of change of zero point energy on partition function. Chemical equilibrium and equilibrium constant in terms of partition functions.

Electrochemistry-I:

Electrified Interfaces: Thermodynamics of electrified interfaces: electrocapillary thermodynamics, non-polarizable interface and thermodynamic equilibrium, fundamental thermodynamic equation of polarizable interfaces, determination of excess charge density on the electrode, electrical capacitance and surface excess of the interface, potential of zero charge, Helmholtz-Perrin model, Gouy-Chapman model & Stern model.

Electrochemistry-II:

Contact- adsorption on the electrode, free energy of contact adsorption, the degree of contact adsorption and the measurement of contact adsorption, the influence of the contact adsorption on the capacity of the interface, capacity- potential curve, the position of the OHP and the constant capacity, the capacitance hump, variation of the population of contact- adsorbed ions with electrode charge, the lateral-repulsion model and the water Flip-Flop model of contact adsorption, the contribution of adsorbed water dipoles to the capacity of the interface.

Suggested Readings:

1. An Introduction to Chemical Thermodynamics, R. P. Rastogi and R. R. Mishra, Vikas Publication.
2. Introduction to Statistical Thermodynamics, M Dole.
3. Chemical Physics, J. C. Slater.
4. Theoretical Chemistry, S. Glasstone, Affiliated East-West press.
5. Modern Electrochemistry, J. O. M Bockris & A.K.N Reddy, Plenum Publishing Corp.
6. An Introduction to Electrochemistry, S Glasstone, Affiliated East- west press.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

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Semester IIIrd
Physical Special-II

CHP-305

Max Marks – 80

Solid State Chemistry-I:

Thermal decomposition reactions, nucleation, free energy of nucleation; laws, classification, functions and growth of nuclei. Kinetic expressions for diffusion controlled, phase boundary controlled and nucleation and growth controlled reactions. Perfect and imperfect crystals, intrinsic and extrinsic defects, point defects, line and plane defects, vacancies- Schottky defects and Frenkel defects, Thermodynamics of Schottky and Frenkel defect formation colour centres, non- stoichiometry and defects.

Solid State Chemistry-II:

Classification of solids, Lattice energy, evaluation of Madelung constant (NaCl), calculation of repulsive potential exponent; lattice heat capacity Einstein Model and Debye model of lattice heat capacity, Debye T^3 law.

Electronic Properties and Band Theory:

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

Optical properties; optical reflectance, photoconduction–photoelectric effects. Magnetic Properties; Classification of material, quantum theory of paramagnetics-cooperative phenomena, magnetic domains, hysteresis.

Organic Solids: electrically conducting solids, organic charge transfer complex organic metals, new superconductors.

Diffraction Methods: Lattice, unit cell, Bragg's Law, reciprocal lattice, structure determination by X-Ray diffraction, powder method in detail, NaCl, KCl structure Single crystal Weissenberg method, Heavy atom method, Fourier synthesis factor, brief method of intensity data collection, Neutron and electron diffraction methods, comparison of XRD.

Suggested Readings:

Solid State Chemistry and its Applications, A.R. West, Plenum.
Principles of the Solid State, H.V. Keer, Wiley Eastern.
Solid State Chemistry, N.B. Hannay.
Solid State Chemistry, D. K. Chakrabarty, New age International.
Solid State Chemistry, W. E. Garner,
X-Ray Structure Determination, G.H. Stout and L. H. Jensen, McMillan.
The powder method, Azaroff.
Surfactants and Interfacial Phenomenon, Milton J. Rosen, John Wiley and Sons.
Emulsions: Theory and Practice, Paul Becher, American Chemical Society.
Handbook of Surfactants, M R Porter, Chapman and Hall.

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Semester -III
Paper IV
Physical Special -III

Max Marks 80

Polymer Chemistry

Classification of polymers, Polymerization: condensation, addition, radical chain, ionic, co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems. Kinetics of Polymerization. Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution.

Polymer Characterization:

The practical significance of molecular weight. Measurement of molecular weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, Impact. Tear resistance. Hardness and abrasion resistance.

Structure and Properties of Polymers:

Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structures, size and shape of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point T_m – melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, T_g - relationship between T_m and T_g , effects of molecular weight, diluents, chemical structure chain topology, branching and cross linking.

Solid State Chemistry

Solid state reaction: General Principles, experimental procedures, co-precipitation as a precursor to solid state reactions, kinetics of solid state reactions.

Introduction to electron diffraction and neutron diffraction.

Basics principles of photoelectron spectroscopy; photoelectron spectroscopy of simple molecules, ESCA, Chemical information from ESCA.

Suggested Readings:

Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.

Polymer Science, V.R.Gowariker, N.V. Viswanathan and J.Sreedhar, Wiley-Eastern.

Functional Monomers and Polymers, K. Takemoto, Y.Inaki and R.M Ottanbrite.

Contemporary Polymer Chemistry, H.R Alcock and F.W. Lamb, Prentice Hall.

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

Macromolecules: Structure and Function, F. Wold, Prentice Hall.

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Semester -III
Paper III
CHI-303
Inorganic Special -I

80 Marks.

Photo inorganic Chemistry

Basis of Photochemistry:

Absorption, excitation, photochemical laws, quantum yield, electronically excited states lifetime – measurements of times,. Flash photolysis, stop flow techniques. Energy dissipation by radiative and non radiative processes, absorption spectra, Franck codon principle, photochemical stages- primary and secondary processes.

Excited States of Metal Complexes:

Excited states-structure, dipole moment, acid- base strength, reactivity, photochemical kinetics calculations of rates of radiative processes. Bimolecular deactivation - quenching . Excited state of metal complexes: comparison with organic compounds, electronically excited state of metal complexes, charge transfer spectra.

Ligand Field Photochemistry:

Photosubstitution, photo-oxidation, photo-reduction, lability and selectivity, zero vibrational level of ground state and excited states, energy content of excited states, zero-zero spectroscopic energy, development of equations for redox potential of the excited states.

Redox Reaction by Excited Metal Complexes:

Energy transfer under the conditions of weak interactions and strong interaction-exciple formation , conditions of the excited states to be useful as redox reactant, excited electron transfer, metal complexes as attractive candidates(2,2'-bipyridine and 1,10-phenanthroline complexes), Redox behaviour of Ruthenium²⁺ , bipyridal complex, comparison with Fe(bipy)₃ . Application of redox process for catalytic purpose, transformation of low energy reactants into high energy products, chemical energy into light.

Suggested Readings:

1. Solid State Physics, N. W. Ashcroft and N. D. Mermin, Saunders College.
2. Handbook of Liquid Crystals, Kelkar and Hatz., Chemie Verlag.
3. Material science and Engineering, An Introduction, W. D. Callister, Wiley.
4. Principle of solid states, H. V. Keer, Wiley Eastern.
5. Concepts of Inorganic Photochemistry, a. W. Adamson and P. D. Fleischauer, Wiley.
6. Photochemistry of Coordination Compounds, V. Balzari and V. Carassiti, Academic Press.
7. Elements of Inorganic Photochemistry, G. J. Ferraudi, Wiley.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Semester -IIIrd

Paper-IV

CHI-304

Inorganic Special -II

80 Marks.

Inorganic Chains, Rings, Cages and Clusters:

Chains: Catenation, intercalation chemistry, isopolyanions and heteropolyanions.

Rings: Borazines, phosphazenes and other heterocyclic inorganic ring systems, homocyclic inorganic systems.

Cages: Phosphorus oxides and sulphides of phosphorus, Arsenic Sulphides, boranes, carboranes, metallocene carboranes.

Metal Clusters: Binuclear compounds, three atom clusters, four atoms tetrahedral clusters, five and six atom clusters.

Transition Metal Compounds with Bonds to Hydrogen:

Characterisation of hydride complexes, synthetic method, chemical behaviour of hydride compounds, Mononuclear poly-hydrides, Homoleptic polyhydrides anions, carbonyl hydrides and hydride anions: molecular hydrogen compounds. Metal hydrogen interaction with C-H groups, MH interactions, complexes of borohydrides and aluminohydride. Synthetic applications of metal hydrides.

Organometallics:

Metal-carbon, nature of M-C bond in alkali/alkaline earth metal complexes, Metal carbenes and carbynes Electron deficient compounds of Li, Be, Mg, B, Al, Ga In Electron deficient specification or organometallic compounds based upon their electrons.

2e Ligands: Olefinic and acetylenic complexes, chelating olefinic ligands, synthesis and structures.

3e Ligands: Allylic and η^3 -complexes of cyclopentadienes – synthesis and structures.

4e Ligands: Butadienes, cyclobutadiene, η^4 -complexes of cyclopentadiene, fulvalene, heterocyclic, pentadiene, cyclo-Pentadiene and cyclic dienes and polyenes (e.g. hexadiene, 1,3 cycloheptadiene). Boron containing 4e ligands compounds.

5e Ligands- η^5 complexes of cyclohexadienyl, cycloheptadienyl molecules, Complexes of carboranes, metallocarboranes-synthesis and structure: M.O. treatment of ferrocene.

6e Ligands- η^6 complexes of benzene and its derivatives M.O. treatment of η^6 complexes of cycloheptadiene and cyclo-octadiene.

Multidecker sandwich compounds, homogeneous hydrogenation of unsaturated compounds, reversible cis-dihydrocatalysis, monohydrido compounds, asymmetrical hydrogenation, Hydrosilation of unsaturated compounds, hydrocyanation of alkenes, alkane metathesis, Ziegler-Natta polymerisation of ethylene and propylene, water gas shift reaction, acetic acid synthesis by carbonyls. Oxopalladation reactions, heterogenous-homogenous catalysis.

Suggested Readings:

J. E. Huheey: Inorganic Chemistry, IIIrd Edition.

F. A. Cotton & G. Wilkinson: Advanced Inorganic Chemistry Vth Edition.

G. F. Gates, M. L. H. Green, P. Powel and K. Wade: Principles of Organometallic Chemistry.

K. P. Purcell and J. V. Kotz: Inorganic Chemistry.

Greenwood and Earnshaw: Chemistry of Elements.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

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Semester –IIIrd
Paper-V
CHI-305
Inorganic Special -III

M. Marks: 80

Bioinorganic Chemistry -I:

Energy sources for life, metalloporphyrins, photosynthesis and respiration chlorophyll structure, function and synthetic model, cytochromes, structure and function CN & CO poisoning. Ferredoxins and rubredoxin, bio-redox agents and mechanisms, Haemoglobin and myoglobin, structure and mechanism of function, Cooperativity, Enzymes. Vitamin B-12 Co-enzymes structure and function, synthetic model of enzyme action, inhibition and poisoning by ligands and metal ions xanthine oxidase, N₂ fixation.

Bioinorganic Chemistry -II:

The Bio-chemistry of Iron availability of iron, competition for iron, iron toxicity and nutrition, essential and trace elements in biological systems periodic survey of essential and trace elements, biological importance and relative abundance. Biochemistry of the non-metals-structural uses, antibiotics and related compounds, chelate therapy. Problems in biological systems-agriculture, gaseous air pollution, acid rain, nitrogen oxides, chloro-fluorocarbons and upper atmosphere, particulate pollution, mixing problems.

Chemistry of Lanthanides

Electronic structure, oxidation state and ionic radii, lanthanide contraction. Extraction and application of colour and spectra, magnetic properties, binary and ternary compounds, oxo-salts, compounds containing oxygen, nitrogen, sulfur and phosphorus ligands, cyclopentadienyl compounds, use of lanthanides as shift reagents.

Chemistry of Actinides:

General properties, oxidation state, chemistry of actinium, thorium, protactinium, uranium, similarities between later actinides and lanthanides. Trans-uranic elements, compounds containing O, N, S and P ligands, cyclopentadienyl compounds.

Suggested Readings:

W.W. Proterfield, Inorganic Chemistry: A Unified Approach.

F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 5th Edition.

J.E. Huheey: Inorganic Chemistry, III Ed.(Unit-I)

G.F. Coates, M.L.H.Green, P.Powel and K. Wade: Principles of Organometallic

Chemistry.

K.P. Purcell and J.V. Kotz: Inorganic Chemistry.

Greenwood and Earnshaw: Chemistry of Elements.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

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Semester -IIIrd
Paper III
CHO-303
Organic Special-I

Max. Marks: 80

Organometallic Reagents-I:

Principle, preparations, properties and application of the organometallic compounds of the following elements in organic synthesis with mechanistic details.

Group I and

Transition metals

Zn, Cd, Hg, Cu, Pd, compounds.

Organometallic Reagents-II:

Principle, preparations, properties and application of the organometallic compounds of the following elements in organic synthesis with mechanistic details.

Group II metals

Transition metals

Fe, Co, Rh, Cr and Ti

Other elements

Si, B, Al, Sb and Pb compounds.

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.

Oxidation with ruthenium tetroxide, iodobenzene diacetate and thallium(III) nitrate.

Reduction

Introduction. Different reductive processes.

Hydrocarbons – alkenes, alkenes and aromatic rings.

Carbonyl compounds - aldehydes, ketones, acids and their derivatives.

Epoxides, nitro, nitroso, azo and oxime groups.

Hydrogenolysis.

Catalysis

Phase Transfer Catalysis, Crown others, cryptates, cyclodextrins, cyclodextrin based enzyme models, calixarenes, ionophores, micelles and Wilkinson's catalyst.

Suggested Readings:

Designing Organic Synthesis, S.Warren, Wiley.

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

Modern Synthetic Reactions, H.O. House, W.A, Benzamin.

Advanced Organic Chemistry, Part B., F.A. Carey and R.J.Sundberg.
Plenum Press.
Organic Chemistry, Vol.2,I.L. Finar, ELBS.
Heterocyclic Chemistry, T.L. Gilchrist Longman Scientific Technical.
Comprehensive Heterocyclic Chemistry, A.R.Katritzky and C.W Rees,
eds., Pergaman Press.
Polycyclic Aromatic Hydrocarbons, E. Clar, Academic Press.
Natural Products: Chemistry and Biology Significance, J. Mann, R.S.
Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne,
Longman, Essex.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Semester -IIIrd
Paper – IV
CHO-304
Organic Special - II

Maximum Marks: 80

Disconnection Approach

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, chemoselectivity, reversal of polarity (Umpolung), amine synthesis.

Protective groups

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

One Group and Two Group C-C disconnections

Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of Wittig reagents, acetylenes and aliphatic nitro compounds in organic synthesis. Diel's Alder reaction, 1,3-difunctionalised compounds, α,β -unsaturated carbonyl compounds, 1,5-difunctionalised compounds. Michael addition and Robinson annelation.

Reagents in Organic Synthesis

Principle, preparation, properties and applications of the following in organic synthesis with mechanistic details: lithium diisopropylamide(LDA), dicyclohexylcarbodiimide (DCC), 1,3-dithiane (reactivity umpolung), trimethylsilyl iodide, tri-n-butyltin hydride, Woodward and Prevost hydroxylation, DDQ, phase transfer catalysts (Crown ethers and quaternary ammonium salts), Oxidation with ruthenium tetroxide, iodobenzene diacetate and thallium nitrate.

Rearrangements:

A detailed study of the following rearrangements: Demayanov, Favorskii, Arndt-Eistert synthesis, Neber, Baeyer-Villiger, Shapiro, Hoffman-Loffer-Fretag reaction, Chichibabin reaction.

Suggested Readings:

Designig Organic Synthesis, S.Warren, Wiley
Some Modern Methods of Organic Synthesis, W.Carruthers,
Cambridge Univ. Press.
Modern Synthetic Reactions, H.O. House, W.A.Benzamin.
Advanced Organic Chemistry Reactions, Mechanisms and Structures,
J. March, Wiley.
Advanced Organic Chemistry Part B.F.A. Carey and R.J.Sundberg.
Plenum Press.
Organic Chemistry, Vol.2, I.L. Finar, ELBS.
Polycyclic Aromatic Hydrocarbons, E. Clar, Academic Press.
Organic photochemistry, J.Coxan & B. Halton, Cambridge University
Press.
Introductory Photochemistry, A.Cox and T. Camp McGraw Hill.
The Conservation of Orbital Symmetry, R.B. Woodward and R.
Hoffmann, Verlag Chemie Academic Press.
Organic Reactions and Orbital Symmetry, T.L Gilchrist and R.C.
Storr, Cambridge University Press. Cambridge, 2nd Ed. 1979.
Organic photochemistry, chapman and Depuy
Organic Photochemistry, W.H. Horspool.
Photochemistry of excited states, J.D.Coyle.
Frontier orbitars and Organic chemical reactions , Wiley , New York
1976.
Pericyclic Reactions, S. M.Mukherji, Macmilan India.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Semester –IIIrd
Paper V
CHO-305
Organic Special-III

Marks: 80

Terpenoids and Carotenoids-I:

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

Structure determination, stereochemistry, general biosynthesis. Synthesis of the following representative molecules: citral, geraniol, α -terpeniol, menthol and β -carotene.

Carotenoids-II

Structure determination, stereochemistry, general biosynthesis. Synthesis of the following representative molecules: farnesol, zingiberene, santonin, phytol, abeitic acid.

Porphyryns:

Structural elucidation of chlorophyll, general structural features of haemoglobin (structure elucidation excluded).

Drug Design -I

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, design of agonists and antagonists.

Drug Design –II

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.

Suggested Readings:

- Natural Products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
- Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ed. Robert F.Dorge.
- Burger's Medicinal Chemistry and Drug Discovery, Vol-I Ed.M.D. Wolf, John, Wiley.
- Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
- Organic Chemistry, Vol-1, I.L. Finar, ELBS.
- Introduction to Medicinal Chemistry, A. Gringuage, Wiley, VCH.
- The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press.
- New Trends in Natural Products Chemistry, Attaur-Rahman and M. I. Choudhary, Harwood Academic Publishers.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

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Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

**M. Sc. Chemistry 3rd Semester
Inorganic Chemistry Practicals**

(CHI-306)

Marks 50

I Qualitative Analysis

(Ten unknown mixtures will be given containing four radicals out of which one must be an insoluble and one may be an acid radical and two metal ions).

- (a) Less common metal ions- Tl, Mo, W, Ti, Zr, Th, V, U (two metal ions in cationic/anionic forms)
- (b) Insolubles- oxides (Al_2O_3 , Cr_2O_3 , SnO_2 , TiO_2 , SiO_2),
sulphates (PbSO_4 , BaSO_4)
halides (AgCl , AgBr , AgI).
- (c) Acid radicals CO_3^{2-} , HCO_3^- , SO_3^{2-} , SO_4^{2-} , CH_3COO^- , S^{2-} , PO_4^{3-} , NO_3^- , NO_2^- , Cl^- , Br^- , I^- , $\text{C}_2\text{O}_4^{2-}$, etc.

II Preparations of Complexes

- a) Preparations of tetraminezinc (II) fluoborate $[\text{Zn}(\text{NH}_3)_4][\text{BF}_4]_2$
- b) Preparations of dinitrotetraminenickel(II) $[\text{Ni}(\text{NH}_3)_4(\text{NO}_2)_2]$
- c) Preparations of hexaiminenickel(II)chloride $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$
- d) Preparations of nitropentaminechromium (III) chloride $[\text{Cr}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$
- e) Preparations of tetrapyridinecopper(II) persulphate $[\text{Cu}(\text{C}_5\text{H}_5\text{N})_4]\text{S}_2\text{O}_8$
- f) Preparations of bis(ethylenediamine)copper(II) diiodocuprate (I)
 $[\text{Cu}\{\text{C}_2\text{H}_4(\text{NH}_2)_2\}_2][\text{CuI}_2]_2$

Book Suggested

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L.Jolly, Prentice Hall.
3. Inorganic Synthesis, Vol. 1-12, McGraw Hill.
4. Practical Inorganic Chemistry, Marr and Rocket.

M. Sc. Chemistry 3rd Semester
Physical Chemistry Practicals

(CHP-306)

Marks 50

I Potentiometry

Prepare and test the calomel electrode.

Titrate Mohr's salt against KMnO_4 potentiometrically and carry out the titration in reverse order.

II Chemical Kinetics

Determine the velocity constant of hydrolysis of ethyl acetate using sodium hydroxide solution.

III Conductometry

Study conductometric titration of (1) NH_4Cl / NaOH (2) CH_3COONa / HCl and comment on nature of graph.

Study conductometric titration of (1) MgSO_4 / $\text{Ba}(\text{OH})_2$ (2) BaCl_2 / K_2SO_4 and comment on nature of graph.

To study stepwise neutralization of polybasic acid i.e. oxalic acid, citric acid, succinic acid by conductometric titration and explain the variation in the graph..

To determine the relative strength of two acids using conductometer.

To determine the solubility of a sparingly soluble salt in water by conductance measurements.

To find CMC value of a given surfactant solution

IV pH – metry

To determine the hydrolysis constant of aniline hydro chloride

Find out the dissociation constant of weak acid.

V Colorimetry/Spectrophotometry

Determine the concentration of Crystal violet and Aurine in mixture of (Crystal violet + Aurine) solution.

To determine the absorption maxima of a compound using a UV/ Visible Spectrophotometer.

To determine the dissociation constant (K_a) of Methyl red using absorption Spectrophotometer.

VI Polarimetry

To determine the concentration of an optically active substance.

To determine the percentage of two optically active substances in a given mixture.

VII Refractometer

To determine the molar refractivity of CH_3OH , CH_3COOH , $\text{CH}_3\text{COOC}_2\text{H}_5$ and CCl_4 and calculate the refractive equivalent of C, H and Cl atoms.

Find out molar refractivity of benzene, toluene, propyl alcohol, butyl alcohol etc. and – CH_2 - group of homologous series.

VIII Solution Chemistry

Determination of Solubility by evaporation method.

Determination of solubility by gravimetric method.

Determination of transition temperature by thermometric method.

Books Suggested

1. Practical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Practical Physical Chemistry, B.P. Levitt and Findley'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.

M. Sc. Chemistry 3rd Semester
Organic Chemistry Practicals

(CHO-306)

Marks 50

I Qualitative Analysis

Analysis of an organic mixture containing two solid components using water, NaHCO₃, NaOH for separation and preparation of suitable derivatives.

II Organic Synthesis

Preparation of organic compounds involving two steps.

- i) Preparation of bezalacetophenone from acetophenone (Claisen-Schmidt reaction)
- ii) Preparation of cinnamic acid from malonic acid (Knoevenagel reaction)
- iii) Preparation of 2-carbethoxycyclopentanone from adipic acid (Dieckmann's condensation)
- iv) Preparation of benzilic acid from benzaldehyde.
- v) Preparation of methyl orange from aniline.
- vi) Preparation of benzanilide from benzophenone.
- vii) Preparation of phthalimide from phthalic anhydride.

Books Suggested

1. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

M. Sc. (Chemistry) Final

Second Year: There will be two semesters in second year. Examination will be held at the end of each semester.

Fourth Semester

Marks 550

Course Papers	(Theory)	Course Hours	Marks
Paper I (CHC-401)	Instrumental Methods	60	80+20
Paper II (CH-402) (CHP-402/CHI-402/CHO-402)	Physical/ Inorganic/Organic Special-I	60	80+20
Paper III(CH-403) (CHP-403/CHI-403/CHO-403)	Physical/Inorganic/Organic Special-II	60	80+20
Paper IV(CH-404) (CHP-404/CHI-404/CHO-404)	Physical/Inorganic/Organic Special-III	60	80+20
Paper V (CHS-405)	Seminar (Two Seminars of 25 marks each)		50
Practicals (CHI-406 & CHI-407)/	Inorganic Practical	90	
(CHP-406 & CHP-407)/	Physical Practical	90	50+50
(CHO-406 & CHO-407)	Organic Practical	90	

Total Marks= 550

Grand Total= 2200

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M. Sc. (Chemistry) Final

Semester IV

1a Paper I

CH-401

Instrumental Methods of Analysis

M. Marks: 80

Electro analytical Methods:

Electrolytic and galvanic cell, Cell components, D.C. & A.C current in a cell, Reversible and irreversible cells, Nature of electrode potentials. Description of standard hydrogen electrode, measurement of potentials, sign conventions. E_0 values and their calculations. Effect of concentration on cell potentials. Concept of Liquid Junction potential. Ohmic potential (IR drop). Polarization (overvoltage) phenomenon and its theories, Limitation to the use of standard electrode potentials.

Potentiometric Methods:

Reference electrodes (Calomel, Ag/AgCl, Tl/TlCl) Metallic indicator electrodes (first, second and third type). Metallic Redox indicator electrode: Membrane and ion – selective electrodes: Principle and design: Glass electrode, Gas sensing probes. Enzyme electrode: Principle and applications of potentiometric methods.

Voltammetry and Polarography:

General introduction, theoretical consideration of classical polarography, polarographic currents, effect of capillary characteristics on diffusion current, residual current, half wave potential. Effect of complex formation on polarographic waves and mixed anodic cathodic waves, oxygen waves, instrumentation, cell electrodes and their modifications, Application of polarography. Modified voltametric methods, viz; current sampled polarography, pulse polarography, stripping methods, amperometric titrations and their applications.

Electrogravimetry and Coulometry:

Current voltage relationship, electrolysis at constant applied voltage, constant current electrolysis, coulometric methods of analysis. Potentiostatic coulometry, amperostatic Coulometry, application of coulometric titrations.

Conductometric Methods:

Electrolytic conductance, relationships used in conductometry variation of equivalent conductance with concentration, measurement of conductance, conductometric titrations, applications to various types of titrations for detection of end points.

Turbidimetry, Refractometry and Polarimetry:

Nephelometry and turbidimetry, Theory of Nephelometry and turbidimetry, Instruments, applications of scattering methods, refractometry, measurement of refractive index. Specific and molar refraction, variables that affect refractive index

measurements, instruments for measuring refractive index, applications of refractometry, polarimetry, optically active compounds, variables that affect optical rotation, mechanism of optical rotation, polarimeters, applications of optical polarimetry.

Suggested Readings:

- D. A. Skoog and D. M. West: Principle of Instrumental Methods of Analysis Saunder College Publishing, New York.
- D. A Skoog and D.M West, F. J. Hollar: Fundamentals of Instrumental analysis.
- G. W.Ewing: Instrumental Methods of Analysis, 5th ed. McGraw Hill Book Co.
- H. H. Willard, L.L. Merritt & J.A. Dean: Instrumental Methods of Analysis, 6th ed., CBS Publishing.
- B. H. Vassos and G. W. Ewing: Electro analytical Chemistry.
- J. A Plamberk: Electro-Analytical Chemistry.
- H. A. Flaschka, A. J. Barnard and P. E. Strurrock, Analytical Chemistry.

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Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Semester -IV
Paper – II
CHP-402
Physical Special -I

Max Marks: 80

Electrodics:

Rate of charge- transfer reactions under zero field, under the influence of an electric field, the equilibrium exchange current density, the non-equilibrium drift-current density (Butler-Volmer) equation. High-field and low-field approximations, physical meaning of the symmetry factor (β), a preliminary to a second theory of β , a simple picture of the symmetry factor and its dependence on over potential. Polarizable and non-polarizable interfaces.

Fuel Cells and Batteries:

The maximum intrinsic efficiency, actual efficiency and current - potential relation in an electrochemical energy converter, factors influencing the electrochemical energy conversion, the power output of an electrochemical energy converter. Electrochemical electricity generators (fuel cells), brief idea about $H_2 - O_2$, hydrocarbon – air, and natural gas & CO – air fuel cells, Electricity storage: some important quantities in electricity storage (electricity storage density, energy density, power), desirable conditions for an ideal storer, storage of electricity using the lead-acid battery, dry cell, silver- zinc cell and Sodium- Sulfur cell.

Corrosion:

Electrochemistry of corrosion of metals, Factors affecting corrosion, electrochemical cell formation, polarization of metal electrode, concentration polarization, resistance polarization, anodic and cathodic polarization curves, anodic passivation, electrochemical measurement of corrosion current density, corrosion potential, passivation potential, mixed potential theory and Tafel slope.

Application of the current – potential laws of electrode – electrolyte interface to other type of charged interfaces i.e. semiconductors n-p junctions, the current across biological membranes, hot and cold emission of electrons from a metal into vacuum.

Suggested Readings:

1. An Introduction to Chemical Thermodynamics, R. P. Rastogi and R. R. Mishra, Vikas Publication.
2. Introduction to Statistical Thermodynamics, M. Dole.
3. Chemical Physics, J. C. Slater.
4. Theoretical Chemistry, S. Glasstone, Affiliated East-West press.

5. Modern Electrochemistry, J.O. M Bockris & A. K.N Reddy, Plenum Publishing Corp.
6. An Introduction to Electrochemistry, S. Glasstone, Affiliated East- West Press.
7. Corrosion Engineering, Fontana, Mc Graw Hill.
8. An introduction to metallic corrosion, Raj Narain.

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Semester -IVth
Paper III
CHP-403
Physical Special- II

Max Marks – 80

Chemistry of Surfactants-I:

Adsorption of surface active agents at S/L, L/G and L/L interfaces:

Mechanism of adsorption, adsorption isotherm, effects of adsorption from aqueous solution on the surface properties of solid adsorbent, adsorption from, non-aqueous solution, determination of surface areas of solids, Gibb's and BET adsorption equation and its utilization to calculate surface concentration and area per molecule.

Critical micelle concentration (cmc), methods of determining cmc, factors affecting value of cmc, micellar structure and shape, micellar aggregation, cmc in non-aqueous media, Thermodynamic parameters of micellization.

Effectiveness of adsorption at L/G and L/L interfaces, Szyskiwski, Langmuir and Frumkin equations. Derivation of thermodynamics parameters of adsorption at the L/G and L/L interfaces.

Chemistry of Surfactants-II:

Solubilization by solutions of Surfactants:

Solubilization in aqueous media, Locus of solubilization, factors determining the extent of solubilization, Solubilization in non-aqueous media, reduction of surface and interfaces tension by surfactants, wetting (spreading wetting, adhesional wetting, immersional wetting), modification of wetting by surfactants, general consideration hard surface wetting, textile wetting

Foaming and anti-foaming by aqueous solutions of Surfactants:

Film elasticity, theories of film elasticity, factors determining emulsion stability, theories of emulsion type qualitative theory, kinetic theory), micro emulsions, relationship of surfactant, chemical structure to emulsifying behavior, methods of selecting surfactants as emulsifying agent (HLB & PIT).

Suggested Readings:

Solid State Chemistry and its Applications, A.R. West, Plenum.
Principles of the Solid State, H.V. Keer, Wiley Eastern.
Solid State Chemistry, N.B. Hannay.
Solid State Chemistry, D. K. Chakrabarty, New age International.
Solid State Chemistry, W. E. Garner,
X-Ray Structure Determination, G.H. Stout and L. H. Jensen, McMillan.
The powder method, Azaroff.
Surfactants and Interfacial Phenomenon, Milton J. Rosen, John Wiley and Sons.
Emulsions: Theory and Practice, Paul Becher, American Chemical Society.
Handbook of Surfactants, M R Porter, Chapman and Hall.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Semester -IVth

**Paper IV
CHP-404**

Physical Special III

Max Marks 80

Commercial Polymers:

Polyethylene, polyvinyl chloride, polyamides, polyesters, polyesters, phenolic resins, epoxy resins and silicone polymers, Functional polymers – fire retarding polymers and electrically conducting polymers.

Thermodynamics of Biopolymer Solutions:

Thermodynamics of biopolymer solutions (entropy of mixing & liquid state model along with limitation), free volume theory, heat and free energy of mixing. Osmotic pressure membrane equilibrium, muscular contraction and energy generation in mechanochemical system.

Biopolymers and their Molecular Weights:

Evaluation of size, shape molecular weight and extent of hydration of biopolymers by various experimental techniques. Sedimentation equilibrium, hydrodynamic methods, diffusion, sedimentation velocity, viscosity, electrophoresis and rotational motions.

Diffraction Methods:

Light scattering, low angle X-ray scattering, X-ray diffraction and photo correlation spectroscopy. ORD and CD.

Suggested Readings:

1. Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.
2. Polymer Science, V.R.Gowariker, N.V. Viswanathan and J.Sreedhar, Wiley-Eastern.
3. Functional Monomers and Polymers, K. Takemoto, Y.Inaki and R.M Ottanbrite.
4. Contemporary Polymer chemistry, H.R Alcock and F.W. Lamb, Prentice Hall.
5. Physics and Chemistry of Polymers, J.M.G.Cowie, Blackie Academic and Professional.
6. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, H.Dugas and C.Penny, Springer-Verlag.
7. Macromolecules: Structure and Function, F. Wold, Prentice Hall.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

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Semester -IVth
Paper II
CHI-402
Inorganic Special -I

80 Marks.

Supramolecular Chemistry

Concepts and Language, molecular recognition: molecular receptor for different types of molecules including arisonic substrates, Design and synthesis of co-receptors.

Molecules and multiple recognition. Supramolecular reactivity and catalysis.

Transport process and carrier design, switching device. Some examples of self assembly in supramolecular chemistry.

Advanced Inorganic Materials-I:

Multiphase materials: Ferrous alloys, Fe – C phase transformation in ferrous alloys; stainless steel, non-ferrous alloys, their application and properties.

Glasses, Ceramics, Composites and Nanomaterials: glassy state, glass formers and modifiers, applications. Ceramics: structure, properties and clay products.

Advanced Inorganic Materials-II:

Refractories, characterizations, properties and their applications. Microscopic composites; dispersions; strengthened and particle reinforced, fibre reinforced composites, nanocrystalline phase, preparation procedures, special properties, applications.

Thin films and Langmuir - Blodgett films: Preparation techniques; evaporation /sputtering, chemical processes, MOCVD, sol-gel etc. Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications.

Polymeric materials: Molecular shape, structure and configuration, crystallinity, stress strain behaviour, thermal behaviour, polymer type and their application, conducting and ferro-electric polymers.

Suggested Readings:

Solid State Physics, N. W. Ashcroft and N. D. Mermin, Saunders College.
Handbook of Liquid Crystals, Kelkar and Hatz., Chemie Verlag.
Material science and Engineering, An Introduction, W. D. Callister, Wiley.
Principle of solid states, H. V. Keer, Wiley Eastern.
Concepts of Inorganic Photochemistry, a. W. Adamson and P. D. Fleischauer,
Wiley.
Photochemistry of Coordination Compounds, V. Balzari and V. Carassiti,
Academic Press.
Elements of Inorganic Photochemistry, G. J. Ferraudi, Wiley.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Semester -IV

Paper-III CHI-403

Inorganic Special -II

80 Marks.

Reaction Mechanisms of Transition Metal Complexes-I:

Introduction, Ligands replacement reactions. Classifications of mechanisms, Water exchange rates, formation of complexes aqueous ions, anation reactions, aquation and base hydrolysis, attack on ligands reactions of square complexes, mechanisms of Ligand displacement reactions, metal carbonyl reactions, reactions of binuclear carbonyl, associative reactions, species with 17 electrons, Electron Transfer Processes – outer and inner sphere.

Reaction Mechanisms of Transition Metal Complexes-I:

The Marcus theory, doubly bridged inner-sphere transfer and other electron transfer reactions, two electron transfer. Non-complementary reactions, Ligands exchange via electron exchange, reductions by hydrated electrons, stereochemical non-rigidity – stereochemically non-rigid coordination compounds, Trigonal bipyramidal molecules, systems with coordination number six or more, isomerization and racemization of tris chelate complexes, metal carbonyl scrambling cluster rotation with CO shells.

The Elements of the Second and Third Transition Series:

General comparisons between first, second and third transition series, general discussion of oxidation of zirconium and hafnium. Structures of ZrO_2 , ZrO_5 , $Zr_2Cl_6(PBu_3)_4$, $[Zr_4(OH)_8(H_2O)_{16}]^{8+}$, oxidation states of niobium and tantalum, structure of NbO , NbF_5 , $NbCl_5$ dincular, $NbOCl_3$, $NbCl_4$, structure of $[M_2, Cl_6L_3]$ species ($M = Nb$ and Ta . $L = Me_2S_5$ and $L =$ tetrahydroiophene), $Nb_2Cl_8(pme_3)_4$, structure of cluster $[M_6X_{12}]$ (where $M=Nb$ and Ta).

Molybdenum and Tungsten Group: Polymeric $Mo_2O_7^{2-}$, isopolyanion structure, heteropolymolybdate and tungstate ions, important trinuclear species of $Mo(IV)$ and $W(IV)$, triple and quadruple bond, M.O. diagram of M_2L_8 systems of d^4 metal ions, $[M_6X_8]^{4+}$ (where $M=Mo(II)$), structure of $[ReH^6_9, Re_3Cl_9]$ unit, multiple bounded dirhenium and ditechinitium compounds.

$[Re_2Cl_8]^{2-}$, $Re_2(Pet_3)_2$, $Re_2Cl_5(DTH)_2$, $[Re_2(O_2CR)_4]Cl_2$. Structure of ruthenium and osmium pentafluorides, qualitative MO picture of osmyl complexes. Structure of ∞ and β $PdCl_2$ and (mixed valence (II, IV), linear chain compounds platinum, trans effect.

Suggested Readings:

J.E.Huheey: Inorganic Chemistry, IIIrd Edition .

F.A. Cotton & G. Wilkinson: Advanced Inorganic Chemistry Vth Edition.

G.F.Gates, M.L.H. Green, P.Powel and K. Wade: Principles of Organometallic Chemistry.

K.P. Purcell and J.V. Kotz: Inorganic Chemistry .

Greenwood and Earnshaw: Chemistry of Elements.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Semester -IV
Paper-IV
CHI-404
Inorganic Special –III

M. Marks: 80

Oxidative-Addition and Migration (Insertion Reactions):

Acid base behaviour of metal atoms in complexes, Protonation and Lewis Base behaviour, acceptor properties of Lewis acidity of complexes, oxidative addition and reductive elimination, addition of specific molecules, Hydrogen addition, HX additions, Organic halides addition of some other molecules productive elimination, migration reaction promotion of alkyl migration insertion of CO. Into M.H. Bands other aspects of CO insertion reactions, transfer of other molecules, CO₂ SO₂ NO₂ RCM, Insertion of alkenes and C-C unsaturated compounds, Cleavage of C-H bonds; alkane activation.

Lower halide and chalcogenide clusters:

Octahedral metal halide and chalcogenide clusters (M₆X₈ and M₆X₁₂ types), Chevrel phases, triangular clusters and solid state extended arrays.

Compounds with M-M multiple bonds:

Major structural types, quadruple bonds, other bond orders in tetragonal context, relation of clusters to multiple bonds and one dimensional solids.

Transition Metal Complexes on Catalysis:

Reaction of carbon mono-oxide and hydrogen: Synthesis gas and water gas shift reaction reduction of carbon monoxide by hydrogen, hydroformylation of unsaturated compounds, Reductive carbonylation of alcohols and other compounds; carbonylation Reaction: Methanol and methyl acetate, Adipic ester. Synthesis and other carbonylation reactions, decarbonylation reactions. Catalytic addition of molecules to C-C multiple bonds homogeneous hydrogenation, hydrosilation of unsaturated compounds, polymerization, oligomerisation and metathesis reactions of alkenes and alkynes, Ziegler-Natta polymerization if ethylene and propylene oligomerisation and related reactions.

Reactions involving C-C bond Cleavage: Alkene and alkyne metathesis, other aspects of catalytic reactions, Cluster compounds in catalysis, supported homogenous and phase transfer catalysis , supported homogeneous and phase transfer catalysis, oxidation reaction: Oxidative carbonylations, Palladium catalysd oxidation of ethylene, Acrylonitrile synthesis, oxygen transfer from peroxo and oxo species, oxygen transfer from NO₂ groups.

Suggested Readings:

W.W. Proterfield, Inorganic Chemistry: A Unified Approach.
F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 5th Edition.
J.E. Huheey: Inorganic Chemistry, III Ed.(Unit-I)
G.F. Coates, M.L.H.Green, P.Powel and K. Wade: Principles of Organometallic Chemistry.
K.P. Purcell and J.V. Kotz: Inorganic Chemistry.
Greenwood and Earnshaw: Chemistry of Elements.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

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Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Semester –IVth
Paper II
CHO-402
Organic Special -I

Max. Marks: 80

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 labelling. Mechanism of Enzyme Action: Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion.

Examples of some typical enzyme mechanisms for chymotrypsin, carboxypeptidase-A and papain.

Co- Enzyme Chemistry

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological function of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD, NADP, FMN, FAD, lipoic acid and vitamin B₁₂. Mechanisms of reactions catalyzed by the above cofactors.

General Introduction, nomenclature and biological roles of prostaglandins.

Synthesis of Natural Products

Synthesis of the following natural products with special emphasis on stereochemistry. Mechanistic aspects and the choice of reagents involved therein.

Johnson's hydrochrysen approach towards the synthesis of Androsterone, Progesterone and Testosterone, Satette's stereospecific synthesis of Cortisone. Synthesis of Juvabione, Longifolene, Chlorophyll-a, Fredericamycin – A and enantioselective synthesis of Aphidicolin.

Heterocyclic compounds

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

Methods of synthesis and Reactions including mechanism of the following.

Five-Membered heterocycles: pyrazole, imidazole, oxazole, isooxazole, thiazole, isothiazole, six-membered heterocycles: pyrimidines and purines.

Metalloenes, Non-benzenoid Aromatics and Polycyclic Aromatic Compounds

General considerations, synthesis and reactions of representative compounds:

Ferrocene, Azulene, Tropone, Tropolone and Sydnones.

Synthesis of Benzo-1,2-anthracene, Chrysene, Benzo-3,4-phenanthrene and Benz[a]pyrene.

Suggested Readings:

Designig Organic Synthesis, S.Warren, Wiley.
Some Modern Methods of Organic Synthesis, W.Carruthers, Cambridge Univ. Press.
Modern Synthetic Reactions, H.O. House, W.A.Benzamin.
Advanced Organic Chemistry, Part B., F.A. Carey and R.J.Sundberg. Plenum Press.
Organic Chemistry, Vol.2,I.L. Finar, ELBS.
Heterocyclic Chemistry, T.L. Gilchrist Longman Scientific Technical.
Comprehensive Heterocyclic Chemistry, A.R.Katritzky and C.W Rees, eds., Pergaman Press.
Polycyclic Aromatic Hydrocarbons, E. Clar, Academic Press.
Natural Products: Chemistry and Biology Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

Semester -IVth
Paper – III
CHO-403
Organic Special -II

Maximum Marks: 80

Pericyclic Reactions-I:

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 method, FMO & PMO approach, Electrocyclic reaction – conrotatory and disrotatory motions. $4n$, $4n + 2$, allyl systems, cycloadditions-antarafacial and suprafacial additions, $4n$ and $4n+2$ systems, 2+2 addition of ketenes, 1,3- dipolar cycloadditions and chelotropic reactions.

Pericyclic Reactions-II:

Sigmatropic Rearrangements- suprafacial and antarafacial 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, aza-cope rearrangements. Introduction to Ene reactions. Simple problems on pericyclic reactions. Group transfers and eliminations.

Photochemistry-I and Aromaticity:

Excitation and excited states, Franck- Condon Principle, Jablonski diagram, energy transfer photosensitization, 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 photoreduction.

Aromaticity (aromatic, non-aromatic and antiaromatic) alternant and non-alternant hydrocarbons. Aromaticity in charged rings, homoaromaticity, pseudo-aromaticity, HMO and PMO for determining aromaticity of various π - electron systems, application of ¹H-NMR in determining aromatic character of annulenes.

Photochemistry-II:

Photochemistry of olefins and 1,3- Butadiene (cis, trans- isomerisation, dimerisation and cycloadditions) and cyclization reactions of conjugated olefins, di- π - methane rearrangement, enone and dienone rearrangements, photochemistry of aromatic compounds (substitution, isomerization, cyclization and cycloaddition reactions), Photo-Fries reactions of anilides, photolysis of nitrile and esters and Barton reaction.

Suggested Readings:

- Designing Organic Synthesis, S. Warren, Wiley
- Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
- Modern Synthetic Reactions, H.O. House, W. A, Benzamin.

Advanced Organic Chemistry Reactions, Mechanisms and Structures, J. March, Wiley.
Advanced Organic Chemistry Part B.F.A. Carey and R.J.Sundberg. Plenum Press.
Organic Chemistry, Vol.2, I. L. Finar, ELBS.
Polycyclic Aromatic Hydrocarbons, E. Clar, Academic Press.
Organic photochemistry, J. Coxan & B. Halton, Cambridge University Press.
Introductory Photochemistry, A.Cox and T. Camp Mc Graw Hill.
The Conservation of Orbital Symmetry, R.B. Woodward and R. Hoffmann, Verlag Chemie Academic Press.
Organic Reactions and Orbital Symmetry, T.L Gilchrist and R.C. Storr, Cambridge University Press. Cambridge, 2nd Ed. 1979.
Organic photochemistry, Chapman and Depuy
Organic Photochemistry, W.H. Horspool.
Photochemistry of excited states, J.D.Coyle.
Frontier orbitals and Organic Chemical Reactions , Wiley , New York 1976.
Pericyclic Reactions, S. M.Mukherji, Macmilan India.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

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Semester –IVth
Paper IV
CHO-404
Organic Special -IIIrd

Marks: 80

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

Antineoplastic agents: Mechlorethamine, mitocin, cyclophosphamide, chlorambucil, melphalan, aminopterin, 6-mercaptopurine and 6-chloropurine. Recent developments in cancer chemotherapy.

Antimalarials: Chloroquine, primaquine, chloroguanide, pyrimethamine, trimethoprim, dapsone and mefloquine.

Antipyretics: Morphine and related compounds (codeine and heroin), mepoeridine, methadone, dextropropoxyphen, aspirin, acetaminophen, antipyrine, aminopyrine and dipyrone.

Antifertility agents: Ovulation inhibitors and related hormonal contraceptives – norethindrone, norethynodrel, estradiol and mestranol.

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

Anti-inflammatory agents: Salicylic acid derivatives, endomethacin, phenylbutazone, ethoxyphenylbutazone, antipyrine, amino-antipyrine, aminopyrine, mefanamic acid, ibuprofen, diclofenac.

Cardiovascular Drugs: Calcium channel blockers and β - blockers: Sorbitrate, and verapamil.

AIDS and drugs against HIV: How HIV infects the system, structure and mode of action of important drugs against HIV – AZT, ddI, ddC, d4T and 3TC (synthesis only of AZT)

Antibiotics

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, amoxicillin, carbenicillin and carfecillin.

Cephalosporins – Discovery, structure elucidation and synthesis of cephalosporin –C, Oxytetracycline (synthesis excluded)

Alkaloids:

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

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

Suggested Readings:

1. Natural Products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
2. 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.D. Wolf, John, Wiley.
4. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
5. Organic Chemistry, Vol-1, I.L. Finar, ELBS.
6. Introduction to Medicinal Chemistry, A. Gringuage, Wiley, VCH.
7. The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press.
8. New Trends in Natural Products Chemistry, Atta-ur-Rahman and M. I. Choudhary, Harwood Academic Publishers.

Note: Section A (16 Marks) it will consist of one question having eight parts of two marks each. Candidates will be required to attend all the parts. Answer to any parts should not exceed half page.

Section B (40 marks) consists of eight questions. Candidate will be required to attempt five question each. Each question carries eight marks. Answer to any of the question should not exceed three pages.

Section C (24 Marks) It will consist of four question. Candidate will be required to attempt two questions. Each question carrying twelve marks. Answer to any question should not exceed six pages.)

M. Sc. Chemistry (4th Semester)

Practicals Inorganic Chemistry

CHI-406

Marks-50

Instrumental methods of Analysis

1. Spectrophotometry
 - a) Nickel, Molybdenum, Iron by extractive spectrophotometric method.
 - b) Iron-phenanthroline complex; Jobs method of continuous variation/mole ratio method.
 - c) Determination of pK value of an acid-base indicator.
2. Potentiometry
 - a) Determination of strength of HCl and CH_3COOH in a mixture using NaOH.
 - b) Titration of weak acid with strong base using quinhydrone and determination of dissociation constant of acid.
3. Conductometry
 - a) Conductometric titration of NH_4Cl vs NaOH, CH_3COONa vs HCl, ($CH_3COOH+HCl$) vs NaOH.
4. pH meter

Determination of strength of HCl, CH_3COOH etc.

Books Suggested:

1. Synthesis and characterization of Inorganic compounds. W.L.Jolly, Prentice Hall.
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.

M. Sc. Chemistry (4th Semester)

Practicals Inorganic Chemistry

CHI-407

Marks-50

Preparation

1. Preparation of hexaureachromium(III) chloride and estimation of Cl⁻ ions in the prepared complex.
2. Preparation of pure sample of nitrosylbisdiethylthiocarbamateiron(I) and estimation of Fe in the prepared complex.
3. Preparation of hexathioureaplumbous nitrate and estimation of Pb in the prepared complex.
4. Preparation of cobalt tetrathiocyanatomercurate(II) $\text{Co}[\text{Hg}(\text{SCN})_4]$ and estimation of Hg in the prepared complex.
5. Preparation of tetraminecopper (II) sulphate $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ and estimation of Cu in the prepared complex.
6. Preparation of dipyridinemercury (II) persulphate $[\text{Hg}(\text{C}_5\text{H}_5\text{N})_2]\text{S}_2\text{O}_8$ and estimation of Hg in the prepared complex.
7. Preparation of dichlorobis(hydroxylamine)zinc(II) $[\text{Zn}(\text{NH}_2\text{OH})_2\text{Cl}_2]$ and estimation of Zn in the prepared complex.
8. Preparation of aluminiumacetylacetonate $[\text{Al}(\text{C}_5\text{H}_7\text{O}_2)_3]$ and estimation of Al in the prepared complex.
9. Preparation of pentathioureadicuprous nitrate and estimation of Cu in the prepared complex.
10. Preparation of tetrapyridineferrouschloride and estimation of Fe in the prepared complex.

Books Recommended:

- 01) G. Marr and B. W. Rockett, Practical Inorganic Chemistry, Van Nostrand Reinhold Company, London, 1972.
- 02) Bull. Chem. Soc., Japan, 29, (1965)852.
- 03) Inorg. Chim. Acta., 23, 35 (1977).
- 04) J. Chem. Edu., 79, 581(1977).
- 05) Advances to Inorganic and Radiochemistry, Vol.7.
- 06) Inorganic Chemistry, 1966, Vol.5, 615.
- 07) J. Chem. Soc, 1962, 84, 3404.

M. Sc. Chemistry 4th Semester

Organic Chemistry Practicals

(CHO-406)

Marks 50

I Qualitative Analysis

Analysis of an organic mixture containing two solid components using HCl and ether for separation and preparation of suitable derivatives.

II Quantitative Analysis

Determination of the number of hydroxyl groups in organic compounds by acetylation method. Estimation of amines/phenols.

III Organic Synthesis

1. Preparation of Phenacetin from p- Aminophenol.
2. Preparation of S-Tribromobenzene from aniline.
3. Preparation of m-Nitroaniline from Benzene.
4. Preparation of 2,4-dinitrophenyl hydrazine from chlorobenzene.
5. Preparation of anthranilic acid from phthalic anhydride.
6. Preparation of benzanilide from benzophenone.
7. Preparation of phthalimide from phthalic anhydride.
8. Preparation of p-Bromo/Nitro acetanilide from aniline.

Books Suggested

1. Experiments in Organic Chemistry” Louis F. Fieser O. C. Heath and Company Boston, 1955.
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
3. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
4. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
5. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
6. Vogel’s Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
7. Organic Spectroscopy, by William Kemp. John Wiley & Sons.
8. A Guide to spectroscopy in Organic Chemistry’ by PAVY.

M. Sc. Chemistry 4th Semester
Organic Chemistry Practicals

(CHO-407)

Marks 50

I Organic Synthesis

Preparation of organic compounds involving one step.

Acetylation : Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.

Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.

Grignard reaction: Synthesis of triphenylmethanol from benzoic acid.

Aldol condensation: Dibenzal acetone from benzaldehyde.

Sandmeyer reaction: p-Chlorotoluene from p-toluidine.

Preparation of organic compounds involving two steps.

Preparation of Aspirin from Phenol.

Preparation of Phenacetin from P-Amino-Phenol.

Preparation of Methyl Orange from aniline.

Preparation of acridone from anthranilic acid.

II Spectral Analysis of Organic Compounds- IR and NMR

p-toluidine, Ethyl acetate, Phenol, Acetanilide, Cinnamaldehyde, Di-ethylamine, Anisaldehyde, Benzoic acid

Books Suggested

1. Experiments in Organic Chemistry” Louis F. Fieser O. C. Heath and Company Boston, 1955.
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
3. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
4. Systematic Qualitative Organic Analysis, H. Middleton, Edward Arnold.

**M. Sc. Chemistry 4th Semester
Physical Chemistry Practicals**

(CHP-406)

Marks 50

I Polarimetry

To determine the concentration of an optically active substance.

To determine the percentage of two optically active substances in a given mixture.

II Refractrometer

To determine the molar refrectivity of CH_3OH , CH_3COOH , $\text{CH}_3\text{COOC}_2\text{H}_5$ and CCl_4 and calculate the refractive equivalent of C, H and Cl atoms.

Find out molar refractivity of benzene, toluene, propyl alcohol, butyl alcohol etc. and $-\text{CH}_2-$ group of homologous series.

III Solution Chemistry

Determination of Solubility by evaporation method.

Determination of solubility by gravimetric method.

Determination of transition temperature by thermometric method.

IV Flame Photometry

To determine the concentration of various alkali metal ions in a given solution.

To determine the concentration of various transition metal ions in a given solution.

V Ultrasonic Interferometer

To find ultrasonic speed of given organic binary liquid mixtures of different composition.

To study the effect of temperature on ultrasonic speed of given organic mixture.

VI Potentiometry

Determination of temperature dependence of EMF of a cell.

Determination of strength of strong and weak acids in a given mixture using a potentiometer.

Potentiometric strong acid versus weak base titration.

Books Suggested

- 01) Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
- 02) Practical Physical Chemistry, B.P. Levitt and Findley's, Longman.
- 03) Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
- 04) Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
- 05) Experiments in Physical Chemistry, Shoemaker and Gailand McGraw Hill.

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Physical Chemistry Practicals**

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Marks 50

Turbiditymetry

To find the turbidity of given solution by using Nephthalo turbidity meter.

Phase Rule

To verify the phase rule for a given two component azeotropic mixtures.

To verify the phase rule for a given three component azeotropic mixtures.

Polarography/Amperometry

To find half wave potential of given metal ions using dropping mercury electrode.

Amperometric titration of given solution of inorganic ions.

Corrosion

To find corrosion rate of any metal or alloy in given acidic solution.

To study the effect of temperature on the corrosion rate.

Dipole Metry

To find dipole moment of given solution by using dipolemeter.

Books Suggested

- 06) Practical Chemistry, A.M. James and F.E. Prichard, Longman.
- 07) Practical Physical Chemistry, B.P. Levitt and Findley's, Longman.
- 08) Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
- 09) Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
- 10) Experiments in Physical Chemistry, Shoemaker and Gailand McGraw Hill.