Chaudhary Devi Lal University, Sirsa

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

M.Sc. 2nd Semester

Paper No.	Code	Nomenclature	Contact hours (L +P)	Credits	Max. Marks
Paper-XI	CHI(H)-201	Inorganic Chemistry-II	4+0 = 04	04	70+30
Paper-XII	CHP(H)-202	Physical Chemistry-II	4+0 = 04	04	70+30
Paper-XIII	CHO(H)-203	Organic Chemistry-II	4+0 = 04	04	70+30
Paper-XIV	CHS(S)-204	Spectroscopy-II	4+0 = 04	04	70+30
Paper-XV	CHA(S)-205	Analytical Techniques-II	4+0 = 04	04	70+30
Paper-XVI	CHE(H)-206	Environmental Chemistry	4+0 =04	04	70+30
Paper-XVII	CHI(H)-207	Inorganic Chemistry Practical-II	0+6 = 06	03	50
Paper-XVIII	CHP(H)-208	Physical Chemistry Practical-II	0+6 = 06	03	50
Paper-XIX	CHO(H)-209	Organic Chemistry Practical-II	0+6 = 06	03	50

Note:

- CH (H), CH (S) represents Hard core, Soft core papers in Chemistry.
- Each theory paper will include 20% marks as internal assessment as per University rules.
- Each practical examination will be of 06 hours and will be conducted in two sessions (Morning & Evening) of 03 hours each.
- Maximum marks of M.Sc. 2nd Semester will be 650. Theory 500 marks; Practical 150 marks)
- Practical marks will include 20% marks for viva-voce and 20% for record files.
- The payment to the internal as well as external examiners will be made on the basis of sessions.
- Total credits : 29
  Hard Core = 25; Soft Course = 04

Detailed Course Outlines
M.Sc. (2nd Sem.)
Paper-XI
CHI(H)-201
Inorganic Chemistry-II

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

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 neutron-neutron, proton-proton and neutron-proton, The magnitude of nuclear forces (short range), Qualitative idea of the stability of nucleas (n/p ratio). Shell and liquid drop models (qualitative ideas), Natural and artificial radioactivity, Disintegration series; Radioactive disintegration rate, Half -life and average life.

UNIT-II

Nuclear Chemistry-II

Nuclear binding energy, Mass defect, Einstein's mass energy relation, Calculation of mass defect and binding energy, Artificial transmutation, Nuclear reactions: Nuclear fissions, fusion and spellation, 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. Radioactive waste disposal.

UNIT-III

Non aqueous Solvents

Basic Introduction, role of solvents in chemical reactions, Physical properties of a solvent, types of solvents and their general characteristics. Kinetics and mechanism of coordination reactions in non-aqueous media, Electrode potential and its relation to spontaneity and application in the prediction of chemical reactions, Reaction in non-aqueous media with reference to H_2SO_4, BrF_3, CH_3COOH, HCN and N_2O_4. Reactions in molten salts.

UNIT-IV

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 structures, 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. P. Lever
Introduction to Magnetochemistry, A. Earnshaw
Chemical Application of group theory, F. A. Cotton
Introduction to Ligand Fields, B. N. Figgis
Principles of Inorganic Chemistry, Puri, Sharma and Kalia
Essentials of Nuclear Chemistry, H. J. Arinikar, 4th edition
Radiochemistry and Nuclear Chemistry, G. Choppin, J. Liljenzin and J. Rydberg

M.Sc. (2nd Sem.)
Paper-XII
CHP(H)-202
Physical Chemistry-II

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

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 (LS) coupling, Zeeman splitting.

UNIT-II

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.

UNIT-III

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.

UNIT-IV

Chemistry of Nanomaterials

Definition, Historical perspective, Consequence of nanoscale, Nanoparticle morphology, Introduction to synthesis and characterization techniques for nanomaterials and applications of nanomaterials.

Suggested Readings

A Text Book of Physical Chemistry, H. K. Moudgil, PHI Publication House, New Delhi
Quantum Chemistry, I. M. Levine, Prentice-Hall.
Introduction to Quantum Chemistry, A. K. Chandra, Tata Mc Graw Hill.
Chemical Thermodynamics, R. P. Rastogi, S. S. Mishra
Thermodynamics for Chemists, S. Glasstone
Introduction to Thermodynamics of Irreversible processes, Prigogine
Chemical Kinetics, Keith J. Laidler, McGraw Hill
Kinetics and Mechanisms, Arthur A. Frost,R. G. Pearson
Chemical Statistics and Kinetics of solutions, E. A. Huges
Quantum Chemistry, Donald A. Mcquarrie
Physical Chemistry: A Molecular approach, Donald A. Mcquarrie, John D. Simon

M.Sc. (2nd Sem.)
Paper-XIII
CHO(H)-203
Organic Chemistry-II

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT-I

Aliphatic Electrophilic Substitution

Bimolecular mechanisms: S_E2 and S_E1. The S_E1 mechanism, Electrophilic substitution accompanied by double bond shifts. Effect of substrates, Leaving group and solvent polarity on the reactivity.

Aliphatic Nucleophilic Substitution The SN^2, SN^1, SN^i, mixed SN^1 and SN^2 and SET Mechanisms; Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. The limiting cases of 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

UNIT-II

Nucleophilic Aromatic Substitution

The SN^{Ar}, SN^1, benzyne and $S_{RN}1$ mechanisms. Reactivity – effect of substrate structure, leaving group and attacking nucleophile.

Mechanism of nueleophilic substitution in aromatic systems via diazonium ions. Addition-elimination and elimination-addition machanism (involving arynes). Von-Richter rearrangement, Sommelet-Hauser, Smiles and Stevens rearrangements. General aspects of generation, structure, stability and reactivity of arynes.

Aromatic Electrophilic Substitution

Theoretical treatment of aromatic substitution reactions, The arenium ion mechanism, orientation and reactivity. The ortho/para ratio, ipso attack, Structure-reactivity relationship in mono substituted benzene ring, Orientation in other ring systems, Vilsmeier-Haack reaction, Bischler-Napieralski reaction, Pechmann reaction, Houben-Hoesch reaction. Diazonium coupling, Gattermann-Koch reaction

UNIT-III

Mechanism of Elimination Reactions

The E^1, E^1_{cB} and E^2 mechanism, Orientation Effects in elimination reactions, Saytzeff and Hoffman rules, Stereochemistry of E^2 elimination reaction and eclipsing effects in E^2 eliminations. Dehydration of alcohols, Elimination not involving C□H bonds, Pyrolytic eliminations.

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, Dienone-phenol rearrangement and Trans-annular rearrangements.

UNIT-IV

Addition to C-C multiple bond

Mechanism of addition of hydrogen halide, H_2O, halogens, HOX and mercuric salt to alkenes and alkynes.

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

Addition to Carbon-Hetero Multiple Bonds Mechanism of metal hydride reduction of carbonyl compounds, acids and esters. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates – Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin,Stobbe reactions, Reformatsky reaction, Michael addition reaction, Dieckman reaction, Robinson annulation reaction, Hydrolysis of esters and amides

Suggested Readings :

Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Jerry March
A guide Book to Mechanism in Organic Chemistry, Peter Sykes
Organic Chemistry, R. T. Morrison, R. N. Boyd
Reaction mechanism in Organic Chemistry, S. M. Mukherji, S. P. Singh
Organic Chemistry, Benjamin/Cummings, 2nd edition
Organic Chemistry, McMurry 2nd edition
Organic Chemistry, Solomons , 5th edition
Organic Chemistry, Vollhard, W. H. Freeman
Organic reaction Mechanism, V K Ahluwalia and R K Prasher, Narosa Publishing House.
Name Reactions: A Collection of Detailed Mechanisms and Synthetic Applications by Jie Jack Li from Springer
The Art of Writing Reasonable Organic Reaction Mechanisms by Robert B. Grossman from Springer.

M.Sc. Chemistry (2nd Sem.)
Paper-XIV
CHS(S)-204
Spectroscopy-II

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

Ultraviolet and Visible Spectroscopy

The energy of electronic excitation, Measurement techniques, Beer-lambert law, Molar extinction coefficient. The Frank-Codon principle. Different types of transition in UV spectrum of organic functional groups and their relative energies, Chromophore, Auxochromes, Factors affecting extinction coefficient (ε_{max}). Effect of steric hindrance to coplanarity, Solvent effects. Absorption spectra of charge transfer complexes. Applications of UV-Vis spectroscopy.

UNIT-II

Rotational (microwave) Spectroscopy

Rotational energies of linear molecules, 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).

UNIT-III

Vibrational (infrared) Spectroscopy

Harmonic and anharmonic Oscillators, vibrational energies of diatomic molecules, Absorption of radiations by molecular vibration. 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. Vibrations in polyatomic molecules, Effects giving rise to absorption bands. Group vibrations and limitations of group vibration concept.

UNIT-IV

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, Eelection rules, Rule of mutual exclusion. Factors affecting absorption frequencies. Interpretation and finger printing regions.

Suggested Readings

Organic Spectroscopy, W. Kemp, ELBS, London.
Spectrometric Identification of Organic compounds, R. M. Silverstein, G. C. Bassler
Molecular Spectroscopy, H. S. Randhawa
Structural Methods in Inorganic Chemistry, E. A. V. Ebsworth, D. W. H. Rankin, S. Cradock
Physical Methods in Chemistry, R. S Drago
Fundamentals of Molecular Spectroscopy, C. N. Banwell
Electron Spin Resonance: Elementary Theory and Practical Applications, J. E. Wertz, J. R Boulton, Chapman and Hall (p.49-65)
Infrared and Raman Spectra of Inorganic and co-ordination compounds, K. Nakamoto

M. Sc. Previous (2nd Sem.)
Paper-XV
CHA(S)-205
Analytical Techniques-II

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

Thermal Methods

Principle, instrumentation of TGA, DTA, and DSC. Effect of heat on Materials, Chemical decomposition and T. G. Curves, Analysis of T.G. curve to show nature decomposition reactions, the product and qualities of compounds expelled, T.G. in controlled atmosphere, applications. DTA, instrumentation and Methodology, applications. DSC, theory, instrumentation and applications. Thermometric titrations method and applications.

UNIT-II

Imaging Techniques

An introduction to microscopy, the transmission and scanning electron microscope, electron optics, TEM specimens preparation and imaging system, kinematics of scattering by atomic nucleus, electron electron scattering, dynamics of scattering, electron diffraction pattern, operating principle of SEM, penetration of electron in solids, secondary electron images backscattered electron images, SEM operating conditions and specimen preparation, electron beam lithography.

UNIT-III

Chromatographic Techniques

Theory, instrumentation and applications of: Exclusion chromatography, gel permeation, retention behavior, inorganic molecular sieves, determination of molecular weight of polymers. Super Critical fluid Chromatography, Inverse gas chromatography, Affinity Chromatography

UNIT-IV

Analysis of Metal, Alloys, Soil and Fertilizers

Foundry materials, analysis of coal, ferroalloys, and special steels, slags, fluxes, brass and bronze. Method of soil analysis, soil fertility its determination, determination of inorganic constituents of plant materials, Chemical analysis as measure of soil fertility, analysis of fertilizers.

Suggested readings:

Physical principles of electron microscopy, an introduction to TEM, SEM and AEM, Ray F. Egerton.
Principles of instrumental analysis, D. A. Skoog, D. M. West, R. J. Holler and T. A. Nieman.
Instrumental methods of analysis, 7th edition, H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle.
Concepts in analytical Chemistry, S. M. Khopkar.
Extraction chromatography, T. Braun and G. Ghersene, Elsevier.
Super critical fluid extraction, L. Taylor, Elsevier.
Analytical agriculture chemistry, Chopra and Kanwar, Kalyani publishers.
Commercial methods of analysis, Snell and Biffen.

M. Sc. (2nd Sem.)
Paper XVI
CHE(H)-206
Environmental Chemistry

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

The Environment an Introduction

Introduction, Components, Chemical and physical characteristics of the atmosphere. Environment pollution, classification of pollutants.

Natural and Anthropogenic air pollution, Sources and types of air pollutants, Carbon oxides, Sulfur and Nitrogen compounds, Hydrocarbons and their derivatives like vinyl chloride, benzene particulate matter.

Health effect of pollutants such as carbon monoxide, Sulfur oxides, Nitrogen oxides particulate matter, Ozone, Lead, health effects of hazardous air pollutants such as Be, Hg, Asbestos.

UNIT-II

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.

UNIT-III

Soil Pollution

Definition of soil, components, its function and formation. Sources of pollution: Chemical Pesticides, Disposal of industrial and domestic solid wastes on soils, contamination with toxic inorganic compounds. Prevention of soil pollution by 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.

UNIT-IV

Toxicology

Definition of toxicology, its history, scope and literature, Dose-response relationship. Absorption, Distribution and excretion of toxic materials. Toxicity by metal ions, (like Pb, Hg, Al, Ni, As), Organic toxicants such as halogenated hydrocarbons, pesticides and solvents, Chemical carcinogens.

Suggested Readings

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

M. Sc. (2nd Sem.)-Practicals
Inorganic Chemistry Practicals-II
CHI(H)-207

Max Marks : 50

Preparation of Complexes

1. Preparation of Chloropentaaminecobalt(III) chloride and its conversion into nitro and nitrite isomers (IR study).
2. Preparation of *cis* and *trans* $[Co(en)_2Cl_2]Cl$ (UV-Vis and IR Study).
3. Preparation of *bis*-(acetylacetonato)copper(II) (UV-Vis, EPR Spectroscopic studies).
4. Preparation of Mercury tetraisothiocyanatocobaltate(II) $Hg[Co(NCS)_4]$. Magnetic susceptibility and IR study.
5. Preparation of Sodium hexanitritocobaltate(III), $Na_3[Co(NO_2)_6]$, and its IR interpretation.
6. Preparation and resolution of *tris*-(ethylenediamine) cobalt(III) ion. Measurement of optical rotation of these resolved complexes.
7. Preparation of Potassium dioxalatocuprate(II) dihydrate $K_2[Cu(C_2O_4)_2].2H_2O$. (Magnetic susceptibility, ESR, IR and UV-Vis studies).
8. Preparation of *cis* and *trans* Potassium dioxalatodiaquochromate(III). Interpretation of their IR and electronic absorption spectral data.
9. Preparation of Iron(II) oxalate and Potassium trioxaltoferrate(III), $K_3[Fe(C_2O_4)_3]$, Interpretation of their magnetic and EPR. data.
10. Preparation of Ammonium tetrathiocynatodiammine chromate(III). $NH_4[Cr(SCN)_4(NH_3)_2]$.
11. Preparation of tris (thiourea) copper (I) sulphate $[Cu\{SC(NH_2)_2\}_3]_2SO_4.2H_2O$.
12. Preparation of Vanadyl acetylacetonate, $[VO(C_5H_7O_2)_2]$.
13. Preparation of *cis* and *trans* isomers of *bis*-glycinato copper(II) and distinguish them on the basis of IR spectroscopy.
14. Preparation of macrocyclic ligand 5,7,7,12,14,14-hexamethy1-1,4,8,11-tetrazacylotetradeca-4,11-diene dihydrogeniodide, and its complexes with Ni(II).

Suggested Readings

Inorganic Synthesis, Book Series Vol 5, Wiley
Practical Inorganic Chemistry, G. Marr, B. W. Rockett
Bull. Chem. Soc., Japan 29, (1956) 852.
J. Chem. Soc 84, (1962) 3404.
P. H. Merrell, F. L. Urbach, M. Arnold, *J. Chem. Edu.* 54(9), (1977) 580.
Practical Inorganic Chemistry : Preparations, reactions and instrumental methods, G. Pass, H. Sutcliffe, springer Science

M. Sc. (2nd Sem.)-Practicals
Physical Chemistry Practicals -II
CHP(H)-208)

Max marks = 50

Refractometry

(i) Determination of refractive index of simple organic liquids.
(ii) Variation of refractive index with composition for a mixture of two organic liquids.
(iii) To determine the molar refrectivity of CH_3OH, CH_3COOH, $CH_3COOC_2H_5$ and CCl_4 and calculate the refractive equivalent of C, H and Cl atoms.
(iv) Find out molar refractivity of benzene, toluene, propyl alcohol, butyl alcohol *etc.* and $-CH_2-$ group of homologous series.

Chemical Kinetics

(v) 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.
(vi) Determination of the rate constant of an ester catalyzed by an acid or a base.
(vii) Study of a second order reaction.
(viii) Determine the velocity constant of hydrolysis of ethyl acetate using sodium hydroxide solution.

Solution Chemistry

(ix) To determine the solubility of an inorganic salt like KCl, NaCl, KNO3,NaNO3, K2SO4 etc in water at different temperature and hence to obtain the solubility curve.
(x) To determine the heat of solution of given substance like oxalic acid and benzoic acid by solubility method.

pH Metery

(xi) To determine the strength of strong acid versus strong base using a pH meter.
(xii) To determine the strength of weak acid versus strong base using a pH meter.
(xiii) Determination of the strength of strong and weak acids in a given mixture using a pH meter.

Potentiometery

(xiv) To determine the strength of strong acid versus strong base using a potentiometer.
(xv) To determine the strength of weak acid versus strong base using a potentiometer.
(xvi) Determination of the strength of strong and weak acids in a given mixture using a potentiometer.
(xvii) To prepare and test the standard reference electrode i.e. calomel electrode or silver-silver chloride electrode.
(xviii) Titrate Mohr's salt against $KMnO_4$ potentiometrically and carry out the titration in reverse order.

Thermochemistry

(xix) To determine the heat of neutralization of sulphuric acid using Dewar's vacuum flask as the calorimeter.
(xx) To determine the heat of ionization of a weak base i.e. NH_4OH using calorimeter.

Suggested Readings

Zindley's Practical Physical Chemistry, B. P. Levitt, Longman.
Experimental Physical Chemistry, R. C. Das, B. Behara, Tata McGraw Hill.
Practical Physical Chemistry, A. M. James, F. E. Prichard, Longman.
Practical Physical Chemistry, S. R. Palit, S. K. De, Science Book agency.
Experiments in Physical Chemistry, Shoemaker and Gailand, McGraw Hill.
Practical Physical Chemistry, B. Viswanathan, P. S. Raghavan

M.Sc. (2nd Sem.)-Practicals
Organic Chemistry Practicals -II
CHO(H)-209

Max Marks = 50

1. **Qualitative Analysis:**

Analysis of an organic mixture containing two solid components using HCl / NaOH and checking purity of individual component using TLC. IR spectra to be used for functional group identification.

2. **Organic synthesis:**

Two Step Preparations:

1. Sym-tribromobenzene from aniline
2. 2,4-dinitrophenylhydrazine from chlorobenzene
3. 2,5-dihydroxy acetophenone from hydroquinone
4. Benzanilide from Benzophenone

Note-1. Department can opt any other similar two step preparation depending upon the material available.

2. Purification after first step should preferably be done by using Recrystallization or Column chromatography to ensure purity by TLC.

3. Viva-voce (10 marks)
4. Note book/Practical file (10 marks)

Suggested Readings

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

Systematic Qualitative Organic Analysis, H. Middleton, Edward Arnold (Publishers) Ltd., London 1959.

A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, A. I. Vogel

Experiments in Organic Chemistry, L. 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, D. T. Plummer, Tata McGraw Hill Publishing Company, Ltd., N Delhi, 1988.

Practical Organic Chemistry, Mann and Saunders.

Organic Analytical Chemistry, Jag Mohan

M. Sc. 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.

M.Sc. 3rd Semester

Paper No.	Code	Nomenclature	Contact hours (L+P)	Credits	Max. Marks
Paper-XX	CHI(H)-301	Inorganic Special-I	4+0 = 04	04	70+30
Paper-XXI	CHP(H)-301	Physical Special-I	4+0 = 04	04	70+30
Paper-XXII	CHO(H)-301	Organic Special-I	4+0 = 04	04	70+30
Paper-XXIII	CHI(H)-302	Inorganic Special-II	4+0 = 04	04	70+30
Paper-XXIV	CHP(H)-302	Physical Special-II	4+0 = 04	04	70+30
Paper-XXV	CHO(H)-302	Organic Special-II	4+0 = 04	04	70+30
Paper-XXVI	CHI(H)-303	Inorganic Special-III	4+0 = 04	04	70+30
Paper-XXVII	CHP(H)-303	Physical Special-III	4+0 = 04	04	70+30
Paper-XXVIII	CHO(H)-303	Organic Special-III	4+0 = 04	04	70+30
Paper-XXIX	CHI(E)-304	Inorganic Chemistry General -I	4+0 = 04	04	70+30
Paper-XXX	CHP(E)-304	Physical Chemistry General -I	4+0 = 04	04	70+30
Paper-XXXI	CHO(E)-304	Organic Chemistry General -I	4+0 = 04	04	70+30
Paper-XXXII	CHC(H)-305	Computer for Chemistry	2+4 = 06	04	70+30
Paper-XXXIII	CH(OE) -306	Open Elective Paper-II* (Chemistry in Every day Life)	4+0 = 04	04	70+30
Paper-XXXIV	CHI(H)-307	Inorganic Special Practical	0+06 = 06	03	50
Paper-XXXV	CHP(H)-307	Physical Special Practical	0+06 = 06	03	50
Paper-XXXVI	CHO(H)-307	Organic Special Practical	0+06= 06	03	50
Paper -XXXVII	CHS-308	Two Seminars	2+0= 02	02	25+25

Note:

- CH (H) & CH (E) represents Hard core & Elective papers respectively in Chemistry.
- Hard core papers are mandatory for M.Sc. 3rd Semester students.
- Candidate has to opt three Hard core from the same series i.e. "301" or "302" or "303"
- CHO(E)-306 will be qualifying only.
- Maximum marks of M.Sc. 3rd Sem will be 600 (Theory 500; Practical 50; Seminar 50)
- Each theory paper will include 30% marks as internal assessment as per University rules.
- Each practical examination will be of 06 hours and will be conducted in two sessions (Morning & Evening) of 03 hours each.
- Practical marks will include 20% marks for viva-voce and 20% for record files.
- The payment to the internal as well as external examiners will be made on the basis of sessions.
- Total Credits = 29
  Hard core = 21 and Elective = 08

Detailed Course Outlines
M. Sc. (3rd Sem.)
Paper XXXII
CHC(H)-305
Computer for Chemistry

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

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.

UNIT-II

Programming for Problems related to Chemistry-I

Development of small computer codes in C language involving simple formulae in chemistry, such as vander Waals equation, pH titration, kinetics and radioactive decay.

UNIT-III

Programming for Problems related to Chemistry-II

Evaluation of lattice energy and ionic radii from experimental data. Linear simultaneous equations to solve secular equations within the Huckel theory.

UNIT-IV

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

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

M. Sc. (3rd Sem.)
Paper -XXI
CHP(H)-301
Physical Special-I

Max Marks: 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

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-Einstien statics, Statistics of a photon gas, Fermi-Dirac statistics and comparison of three statistics.

UNIT-II

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, Seckure-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.

UNIT-III

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 and Stern model.

UNIT-IV

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

A Text Book of Physical Chemistry, H. K. Moudgil, PHI Publication House, New Delhi
An Introduction to Chemical Thermodynamics, R. P. Rastogi, R. R. Mishra
Introduction to Statistical Thermodaynamics, M. Dole.
Chemical Physics, J. C. Slater
Theoretical Chemistry, S. Glasstone
Modern Electrochemistry, J. O. M Bockris, A. K. N Reddy, Plenum Publishing Corp.
An Introduction to Electrochemistry, S Glasstone

M. Sc. (3rd Sem.)
Paper XXIV
CHP(H)-302
Physical Special-II

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

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, Vaçancies: Schottky and Frenkel defects, Thermodynamics of Schottky and Frenkel defect formation, Colour centres, non-stoichiometry defects.

UNIT-II

Solid State Chemistry-II

Classification of solids, Lattice energy, Evaluation of Madelung constant (NaCl), Calculation of repulsive potential exponent: Lattice heat capacity. Einstein and Debye model of lattice heat capacity, Debye T^3 law.

UNIT-III

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, Charge transfer complex organic metals, New superconductors.

UNIT-IV

Diffraction Methods:

Lattice, Unit cell, Bragg's Law, Reciprocal lattice, Structure determination by X-ray diffraction, Powder method in detail, Structure of NaCl and KCl. 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

A Text Book of Physical Chemistry, H. K. Moudgil, PHI Publication House, New Delhi
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, L. H. Jensen, McMillan
The powder method, Azaroff.
Physical Chemistry, Puri, Sharma and Pathania

M. Sc. (3rd Sem.)
Paper XXVII
CHP(H)-303
Physical Special-III

Max Marks 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

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.

UNIT-II

Polymer Characterization

The practical significance of molecular weight. Measurement of molecular weights: End-group, Osmotic and Ultracentrifugation methods. Analysis and testing of polymers: Chemical analysis of polymers, Spectroscopic methods and Microscopy. Thermal analysis and physical testing: Tensile strength, Fatigue, Impact, Tear resistance and Hardness & Abrasion resistance.

UNIT-III

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 Tm, Melting points of homogeneous series, Effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature Tg, Relationship between Tm and Tg, Effects of molecular weight, Diluents, Chemical structure, Chain topology, Branching and cross linking.

UNIT-IV

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

A Text Book of Physical Chemistry, H. K. Moudgil, PHI Publication House, New Delhi
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, 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.
Polymer Chemistry, M. P. Stevens

M. Sc. (3rd Sem.)
Paper XX
CHI(H)-301
Inorganic Special-I

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

Photo Inorganic Chemistry

Basis of Photochemistry: Absorption, Excitation, Photochemical laws, Quantum yield, Electronically excited states, lifetime measurements. Flash photolysis, Stop flow techniques. Energy dissipation by radiative and non radiative processes, Absorption spectra, Franck codon principle, Photochemical stages: Primary and Secondary processes.

UNIT-II

Excited States of Metal Complexes

Excited states, Dipole moment, Acid-base strength, reactivity, Photochemical kinetics, Calculations of rates of radiative processes. Bimolecular deactivation: quenching. Electronically excited state of metal complexes, Comparison with organic compounds, Charge transfer spectra.

UNIT-III

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, Metal complex sensitizers.

UNIT-IV

Redox Reaction by Excited Metal Complexes

Energy transfer under the conditions of weak interactions and strong interaction: Exciplex formation, Conditions of the excited states to be useful as redox reactant, Excited electron transfer, Redox behaviour of Ru(II) 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

Solid State Physics, N. W. Ashcroft, N. D. Mermin
Handbook of Liquid Crystals, H. Kelker, R. Hatz
Material Science and Engineering: An Introduction, W. D. Callister, D. G. Rethwisch.
Principles of Solid State, H. V. Keer
Concepts of Inorganic Photochemistry, A. W. Adamson, P. D. Fleischauer
Photochemistry of Coordination Compounds, V. Balzani, V. Carassiti
Elements of Inorganic Photochemistry, G. J. Ferraudi

M.Sc. (3rd Sem.)
Paper-XXIII
CHI(H)-302
Inorganic Special-II

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

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: 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.

UNIT-II

Transition Metal Compounds with bonds to Hydrogen

Characterization of hydride complexes, Synthetic methods, 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, M□H interactions, Complexes of boroydrides and aluminohydride. Synthetic applications of metal hydrides, Monohydrido compounds.

UNIT-III

Organometallics-I

Nature of M□C bond in alkali/alkaline earth metal complexes, Metal carbenes and carbines. Electron deficient compounds of Li, Be, Mg, B, Al, Ga and In. Electron deficient specification of 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.

UNIT-IV

Organometallics-II

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

5e Ligands-η^5 complexes of cyclohexadienyl and cyclohepatadienyl molecules, Complexes of carboranes, Metallocarboranes: Synthesis and structure, M.O. treatment of ferrocene.

6e Ligands-η^6 complexes of benezene and its derivatives, M.O. treatment of η^6 complexes of cycloheptadiene and cyclooctadiene, Multidecker sandwich compounds.

Suggested Readings

Inorganic Chemistry, J. E. Huheey, 3rd edition
Advanced Inorganic Chemistry, F. A. Cotton, G. Wilkinson 5th Edition.
Principles of Organometallic Chemistry, G. F. Coates, M. L. H. Green, P. Powel and K. Wade
Inorganic Chemistry, K. P. Purcell, J. V. Kotz
Chemistry of Elements, N. N. Greenwood, A. Earnshaw

M. Sc. (3rd Sem.)
Paper-XXVI
CHI(H)-303
Inorganic Special-III

M. Marks: 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT I

Bioinorganic Chemistry-I

Energy sources for life, Metalloporphyrins, Photosynthesis and respiration, Chlorophyll: Structure, function and synthetic model, Cytochromes: Structure and function, CN and CO poisoning. *Ferredoxins* and *Rubredoxin*, Bio-redox agents and mechanisms, Haemoglobin and myoglobin: Structure and mechanism of function, Cooperativity. Vitamin B_{12}, Enzymes, Co-enzymes: Structure and functions, Synthetic model of enzyme action, Inhibition and poisoning by ligands and metal ions, *Xanthine oxidase*, Nitrogen fixation.

UNIT-II

Bioinorganic Chemistry-II

Biochemistry 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, Chlorofluorocarbons and upper atmosphere, Particulate pollution, mixing problems.

UNIT-III

Chemistry of Lanthanides

Electronic structure, Oxidatiopn state and ionic radii, Lanthanide contraction. Extraction and application, Colour and spectra, Magnetic properties, Binary and Ternary compounds, Oxosalts, Compounds containing oxygen, nitrogen, sulfur and phosphorus ligands, Cyclopentadienyl compounds, Use of lanthanides as shift reagents.

UNIT-IV

Chemistry of Actinides

General properties, Oxidation state, Chemistry of actinium, thorium, protactinium, uranium, Similarities between later actinides and lanthanides. Trans-uranic elements, Compounds containing oxygen, nitrogen, sulfur and phosphorus ligands, Cyclopentadienyl compounds.

Suggested Readings

Inorganic Chemistry: A Unified Approach, W.W. Porterfield
Advanced Inorganic Chemistry, F. A. Cotton, G. Wilkinson 5th Edition.
Inorganic Chemistry, 3rd edition J. E. Huheey
Principles of Organometallic Chemistry, G. F. Coates, M. L. H. Green, P. Powel, K. Wade
Inorganic Chemistry, K. P. Purcell, J.V. Kotz
Chemistry of Elements, N. N. Greenwood, A. Earnshaw

M. Sc. (3rd Sem.)
Paper-XXII
CHO(H)-301
Organic Special-I

Max. Marks: 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

Organometallic Reagents:Preparation, properties and applications of following reagents in organic synthesis with mechanistic details: n-Butyllithium, Grignard reagent, Organo chromium(III) compounds, Dialkyl copper lithium, Pentacarbonyl iron, Tetracarbonyl nickel, octacarbonyl dicobalt, Alkene Palladium (II) complexes, Tri-n-butyl tin hydride, Trimethyl silyl iodide.

UNIT - II

General Reagents: Principle, preparation, properties and applications of the following in

organic synthesis with mechanistic details: Dicyclohexylcarbodiimide (DCC), 1,3-dithianes, Polyphosphoric acid, diazomethane, Boron Trifluoride, Trifluoro acetic acid, cuprous chloride,

N-bromosuccinamide, Lithium diisopropylamide (LDA) Woodward and Prevost hydroxylation, DDQ.

UNIT - III

Oxidation: Introduction to Different oxidative processes:Hydrocarbons- Alkenes,aromatic rings, saturated C-H groups (activated and unactivated) , alcohols, Diols, Aldehydes, Ketones, Carboxylic acids, amines, hydrazines and sulfides.

Oxidation with ruthenium tetraoxide, Iodobenzene diacetate and thallium(III) nitrate.

Reduction: Introduction to Different reductive processes: Akenes, alkynes and aromatic rings, carbonyl compounds, aldehydes, ketones, acids and their derivatives.
Epoxides, nitro, nitroso, azo and oxime groups.Hydrogenolysis.

UNIT - IV

Rearrangements: A detailed study of following rearrangements: Demjanov, Benzil- Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofman, Curtius, Lossen, Schmidt, Baeyer-Villiger ,Mitsunabu and Shapiro 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, Part B., F. A. Carey, R. J. Sundberg
Organic Chemistry, Vol.2, I. L. Finar, ELBS.
Heterocylic Chemistry, T. L. Gilchrist
Comprehensive Heterocyclic Chemistry, A. R. Katritzky, C. W Rees
Polycyclic Aromatic Hydrocarbons, E. Clar, Academic Press.
Natural Products: Chemistry and Biology Significance, J. Mann, R. S. Davidson, J. B. Hobbs, D.V. Banthrope, J.B. Harborne, Longman, Essex.
Principles of Organic Synthesis, R. O. C. Normon, J. M. Coxon

M. Sc. (3rd Sem.)
Paper-XXV
CHO(H)-302
Organic Special-II

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

Disconnection Approach

An introduction of synthons and synthetic equivalents, General principles of the disconnection approach, Functional group interconversions, 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.

UNIT-II

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.

UNIT – III

Enzymes

Introduction and historical perspective, Chemical and biological catalysis. Remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature, classification, extraction and purification. Fischer's lock and key model 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

Coenzymes, Prosthetic groups, Apoenzymes. Structure and biological function of coenzyme-A, thiamine pyrophosphate, pyridoxal phosphate, NAD, NADP, FMN, FAD, lipoic acid and vitamin B_{12}.

UNIT - IV

Biotechnological Applications of Enzymes Large-scale production and purification of enzymes, Elementary discussion on techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes.

Kinds of Reactions catalyzed by Enzymes: Oxidation – reduction, hydrolytic reactions, addition and elimination reactions, Formation of C-C bond (aldol Reactions).

Suggested Readings :

Designig Organic Synthesis, S. Warren, Wiley
Organic Chemistry, J. Clayden, N. Geeves, S. Warren
Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press
Advanced Organic Chemistry Part B. F. A. Carey, R. J. Sundberg
Organic Chemistry, Vol.2, I. L. Finar, ELBS
Principles of Biochemistry, A.L. Lehninger, Worth Publishers
Bio-organic Chemistry by Vinay Prabha Sharma from Pragati Edition
Chemistry of Natural Products Vol-1 & 2 by O P Aggarwal from Krishna Prakashan.

M. Sc. (3rd Sem.)
Paper-XXVIII
CHO(H)-303
Organic Special-III

Max Marks: 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

Drug Design-I

Classification and discovery of new drugs, History and development of chemotherapeutic agents, Therapeutic index, LD_{50} and ED_{50}, 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.

UNIT-II

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.

UNIT – III

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

Anti-inflammatory agents: Salicylic acid derivatives, Endomethacin, Antipyrine, Amino-antipyrine, Aminopyrine, Mefanimic 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).

UNIT – IV

Porphyrins

Structural elucidation and synthesis of chlorophyll, General structural features of Haemoglobin (structure elucidation excluded).

Plant Pigments: Occurance, nomenclature and general methods of structure determination: Isolation and synthesis: Quercetin, Quercetin-3-glucoside, Vitexin, Cyanine, Diadzein, Biosynthesis of Flavonoids.

Suggested Readings

Natural Products: Chemistry and Biological Significance, J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthrope, J. B. Harborne, Longman, Essex.
Text book of Organic Medicinal and Pharmaceutical Chemistry, R. F.Dorge.
Medicinal Chemistry and Drug Discovery, Vol-I, M. D. Wolf, John, Wiley.
Pharmacological Basis of Therapeutics, Goodman and Gilman's MeGraw-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, A. Rahman, M. I. Choudhary, Harwood Academic Publishers.
An Introduction to Medicinal Chemistry, G. L. Patrick

M. Sc. Final (3rd Sem.)
Paper-XXX
CHI(E)-304
Inorganic Chemistry General -I

Max. Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

Photo Inorganic Chemistry

Basics of Photochemistry: Absorption, Excitation, Photochemical laws, Quantum yield, Electronically excited states, lifetime measurements. Flash photolysis, Stop flow techniques. Energy dissipation by radiative and non radiative processes, Absorption spectra, Franck codon principle, Photochemical stages: Primary and Secondary processes.

UNIT-II

Organometallic Compounds of Transition Elements

Two electron ligands: Olefinic and Acetylenic complexes, Chelating olefinic ligands: Synthesis and structures. Three electron ligands: Allylic and η^3-complexes of cyclopentadienes: Synthesis and structures. Four electron ligands: Butadienes, cyclobutadiene, η^4-complexes of cyclopentadiene, fulvalene, heterocyclic pentadiene, Cyclo-pentadiene and cyclic dienes and polyenes (e.g. hexadiene, 1,3 cycloheptadine). Five electron ligands-η^5 complexes of cyclohexadienyl and cyclohepatadienyl molecules, M.O. treatment of ferrocene, Six electron ligands-η^6 complexes of benezene and its derivatives, M.O. treatment of η^6 complexes of cycloheptadiene and cyclooctadiene. Multidecker sandwich compounds.

UNIT – III

Organometallic Compounds in Catalysis

Homogeneous hydrogenation of unsaturated compounds, Asymmetrical hydrogenation, Hydrosilation of unsaturated compounds, Hydrocyanation of alkenes, Alkene metathesis, Ziegler-Natta polymerisation of ethylene and propylene, Water gas shift reaction, Acetic acid synthesis by carbonyls. Oxopalladation reactions, Heterogenous-homogenous catalysis. Hydroformylation of unsaturated compounds.

UNIT – IV

Chemistry of Lanthanides

Electronic structure, Oxidatiopn state and ionic radii, Lanthanide contraction. Extraction and application, Colour and spectra, Magnetic properties, Binary and Ternary compounds, Oxosalts, Compounds containing oxygen, nitrogen, sulfur and phosphorus ligands, Cyclopentadienyl compounds, Use of lanthanides as shift reagents.

Suggested readings:

Concepts of Inorganic Photochemistry, A. W. Adamson, P. D. Fleischauer
Photochemistry of Coordination Compounds, V. Balzani, V. Carassiti
Elements of Inorganic Photochemistry, G. J. Ferraudi
Advanced Inorganic Chemistry, F. A. Cotton, G. Wilkinson 5th Edition.
Principles of Organometallic Chemistry, G. F. Coates, M. L. H. Green, P. Powel and K. Wade
Chemistry of Elements, N. N. Greenwood, A. Earnshaw

M. Sc. Final (3rd Sem)
Paper-XXIX
CHP(E)-304
Physical Chemistry General -I

Max. Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

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.

UNIT-II

Solid State Chemistry

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 and Frenkel defects, Thermodynamics of Schottky and Frenkel defect formation, Colour centres, non-stoichiometry defects.

UNIT – III

Electrochemistry

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 and Stern model.

UNIT – IV

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-Einstien statics, Statistics of a photon gas, Fermi-Dirac statistics and comparison of three statistics.

Suggested readings:

A Text Book of Physical Chemistry, H. K. Moudgil, PHI Publication House, New Delhi
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, 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.
Polymer Chemistry, M. P. Stevens

M.Sc. Final (3rd Sem.)
Paper-XXXI
CHO(E)-304
Organic Chemistry General -I

Max. Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Unit -1

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

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, d4T (synthesis only of AZT).

Unit -2

Rearrangements: A detailed study of following rearrangements: Benzil- Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofman, Curtius, Lossen, Baeyer-Villiger.

Unit-3

General Reagents: Principle, preparation, properties and applications of the following in organic synthesis with mechanistic details: diborane, Boron Trifluoride, Trifluoro acetic acid, cuprous chloride, N-bromosuccinamide, Lithium diisopropylamide (LDA) Woodward and Prevost hydroxylation, Potassium permagnate and potassium dichromate

Unit-4

Principle, Preparations, properties and applications of the following in organic synthesis with mechanistic details.
Organo Sulphur and Organo Palladium

Suggested Readings

Text book of Organic Medicinal and Pharmaceutical Chemistry, R. F.Dorge.
Medicinal Chemistry and Drug Discovery, Vol-I, M. D. Wolf, John, Wiley.
Organic Chemistry, Vol-1, I. L. Finar, ELBS.
Introduction to Medicinal Chemistry, A. Gringuage, Wiley, VCH.
Modern Synthetic Reactions, H. O. House, W. A. Benzamin
Principles of Organic Synthesis, R. Norman and J. M. Coxon

M. Sc. (3rd Sem.)
Open Elective Paper-II (Paper XXXIII)
CHO(E)-306

Max Marks : 70

Chemistry in Everyday life

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

Polymers : Classification of polymers, mechanism of polymerization, some commonly used polymers and their application (Synthetic rubber, natural rubber, Teflon, PMMA), High density and low density polymer.

UNIT-II

Soaps & Detergents : Chemical composition, constitution and cleaning action of the soap and detergents. Difference between soaps and detergents.

UNIT – III

Dyes & Pigments : An introduction of dyes and pigments. Colour theory of dyes.

Food Additives : Artificial sweetners, preservatives, colour additives, rancidity.

UNIT – IV

Electrochemistry : Cells (primary and secondary), composition of cells, cell recations, Batteries (Pb-Acid battery), composition of batteries, reactions of the battery, fuel cells, solar cells.

Suggested Readings :

A Text Book of Physical Chemistry, H. K. Moudgil, PHI Publication House, New Delhi
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, 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.
Organic Chemistry, Vol-1, I. L. Finar, ELBS.
Bio-organic chemistry by Vinay Prabha Sharma from Pragati Prakshan.

M. Sc. (3rd Sem.)-Practicals
Inorganic Special Practical
CHI(H)-307

Max Marks : 50

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 ($PbSO_4$, $BaSO_4$) and 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^-, $C_2O_4^{2-}$ *etc*

Preparations of Complexes

a) Preparations of tetraminezinc(II) flouroborate $[Zn(NH_3)_4][BF_4]_2$

b) Preparations of dinitrotetraminenickel(II) $[Ni(NH_3)_4(NO_2)_2]$

c) Preparations of hexaimnenickel(II) chloride $[Ni(NH_3)_6]Cl_2$

d) Preparations of nitropentaminechromium(III) chloride $[Cr(NH_3)_5(NO_2)]Cl_2$

e) Bis-(tetraethylammonium) tetrachlorocuprate (II)

f) Preparations of *bis*-(ethylenediamine)copper(II) diiodocuprate (I)
$[Cu\{C_2H_4(NH_2)_2\}_2][CuI_2]_2$

Suggested Readings

Vogel's Textbook of Quantitative Analysis, revised edition, J. Bassett, R. C. Denney, G. H. Jeffery, J. Mendham, ELBS.
Synthesis and Characterization of Inorganic Compounds, W. L. Jolly
Inorganic Synthesis, Vol. 5 & 9, McGraw Hill.
Practical Inorganic Chemistry, G. Marr, B. W. Rockett.
Experimental inorganic, physical chemistry, M. A. Malati, Woodhead Publishing (1999)

M. Sc. (3rd Sem.)-Practicals
Physical Special Practical (CHP(H)-307)

Max Marks : 50

Conductometry

1) Determination of the equivalent conductance of strong electrolytes such as HCl, KCl, KNO_3, $AgNO_3$ and NaCl and the validity of Onsager equation.
2) Determination of the solubility of lead sulfate and silver halides.
3) Conductometric titration of Strong acid *vs.* strong base using conductivity meter.
4) Conductometric titration of weak acid *vs.* strong base using conductivity meter.
5) Conductometric titration of Strong acid *vs.* weak base using conductivity meter.
6) Conductometric titration of weak acid *vs.* weak base using conductivity meter.

pH Metry

7) Acid base titration of a non-aqueous media using pH meter.
8) Determination of dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.

Colorimetry/Spectrophotometry

9) Determine the concentration of Crystal violet and Aurine in mixture of (Crystal violet + Aurine) solution.
10) To determine the absorption maxima of a compound using a UV-Visible spectrophotometer.
11) To determine the dissociation constant (K_a) of Methyl red using absorption spectrophotmeter.
12) Verification of Lambert's-Beer law using solutions such as I_2 in CCl_4, and $K_2Cr_2O_7$, $CuSO_4$ and $KMnO_4$ in water.

Polarimetery

13) To determine the concentration of an optically active substance.
14) To determine the percentage of two optically active substances in a given mixture.

Solution Chemistry

15) Determination of Solubility by evaporation method.
16) Determination of Solubility by gravimetric method.
17) Determination of transition temperature by thermometric method.

Suggested Readings

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

M. Sc. (3rd Sem.)-Practicals
Organic Special Practical
CHO(H)-307

Max Marks : 50

Multi-step Synthesis of Organic Compounds and Isolation of Organic Compounds from Natural Sources

(a) **Multi-step synthesis: -**

1. Benzanilide from benzene
2. 6-Nitro-4-methyl-7-hydroxy coumarin from ethyl acetate
3. Acetylaminocinnamic acid from glycine
4. Acridone from anthranilic acid
5. Preparation of bezalacetophenone from acetophenone (Claisen-Schmidt reaction)
6. Preparation of cinnamic acid from malonic acid (Knoevenagel reaction)
7. Preparation of benzilic acid from benzaldehyde.
8. Preparation of phthalimide from phthalic anhydride.
9. 5-Acetoxy-1,2-benzoxathiole-2 -one from hydroquinone
10. 2' - Hydroxy - 4 - methoxyphenyl styryl ketone from resorcinol
11. p-nitrobenzanilide from Benzophenone

(b) **Isolation** :

(i) Caffeine from tea leaves
(ii) Lactose and casein from milk
(iii) Cystine from human hair
(iv) D (+) Glucose from cane sugar
(v) Ascorbic acid from fruit juice

2. Viva-Voce (10 marks)
3. Note Book (10 marks)

Note-1. Department can opt any other similar multi step preparation depending upon the material available.

Suggested Readings

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

M.Sc. Chemistry 4th Sem.

Paper No.	Code	Nomenclature	Contact hours (L+ P)	Credits	Max. Marks
Paper-XXXVIII	CHI(H)-401	Inorganic Special-IV	4+0 = 04	04	70+30
Paper-XXXIX	CHP(H)-401	Physical Special-IV	4+0 = 04	04	70+30
Paper-XL	CHO(H)-401	Organic Special-IV	4+0 = 04	04	70+30
Paper-XLI	CHI(H)-402	Inorganic Special-V	4+0 = 04	04	70+30
Paper-XLII	CHP(H)-402	Physical Special-V	4+0 = 04	04	70+30
Paper-XLIII	CHO(H)-402	Organic Special-V	4+0 = 04	04	70+30
Paper-XLIV	CHI(H)-403	Inorganic Special-VI	4+0 = 04	04	70+30
Paper-XLV	CHP(H)-403	Physical Special-VI	4+0 = 04	04	70+30
Paper-XLVI	CHO(H)-403	Organic Special-VI	4+0 = 04	04	70+30
Paper-XLVII	CHIM(S)-405	Instrumental methods in Chemistry	4+0 = 04	04	70+30
Paper-XLVIII	CHIC(S)-406	Industrial Chemistry	4+0 = 04	04	70+30
Paper-XLIX	CHP(E)-404	Physical Chemistry General -II	4+0 = 04	04	70+30
Paper-L	CHI(E)-404	Inorganic Chemistry General -II	4+0 = 04	04	70+30
Paper-LI	CHO(E)-404	Organic Chemistry General -II	4+0 = 04	04	70+30
Paper-LII	CHI(H)-407	Inorganic Special Practical-I	0+09 = 09	04	50
Paper-LIII	CHP(H)-407	Physical Special Practical-I	0+09 = 09	04	50
Paper-LIV	CHO(H)-407	Organic Special Practical-I	0+09 = 09	04	50
Paper-LV	CHI(H)-408	Inorganic Special Practical-II	0+09 =09	04	50
Paper-XLIV	CHP(H)-408	Physical Special Practical-II	0+09 = 09	04	50
Paper-XLV	CHO(H)-408	Organic Special Practical-II	0+09 = 09	04	50

Note:

- CH (H) & CH(S), represents Hard core & Soft core papers respectively in Chemistry.
- Hard core papers are mandatory for M.Sc. 4th Semester students.
- Candidate has to opt three Hard core & one Soft core papers from the same series i.e. "401" or "402" or "403" and "405"
- Maximum marks of M.Sc. 4th Semester will be 600 (Theory 500; Practical 100)
- Each theory paper will include 30% marks as internal assessment as per University rules.
- Each practical examination will be of 06 hours and will be conducted in two sessions (Morning & Evening) of 03 hours each.
- Practical marks will include 20% marks for Viva-Voce and 20% for record files.
- The payment to the internal as well as external examiners will be made on the basis of sessions.
- Credits : 28, Hard core = 20, Soft core = 04, Elective = 04

M. Sc. (4th Sem.)
Paper-XLVII
CHIM(S)-405
Instrumental Methods of Analysis

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

Electro Analytical & Potentiometric 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_o 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.

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.

UNIT-II

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.

UNIT – III

Electrogravimetry and Coulometry & Conductometric Methods

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

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.

UNIT – IV

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

A Text Book of Physical Chemistry, H. K. Moudgil
Principle of Instrumental Methods of Analysis, D. A. Skoog, D. M. West, Saunder College Publishing, New York

M. Sc. (4th Sem.)

Paper-XLVIII

CHIC(S)-406

Max Marks : 70

INDUSTRIAL CHEMISTRY

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Unit -I

Introduction

Inorganic Chemicals : Sulphuric acid, phosphoric acid, lime, soda ash, titanium dioxide, sodium chloride and chloralkali. Industrially important polymers: polyethylene, polypropylene, polyvinyl chloride, polyester, nylon, fluoropolymers, acetal resins.

Unit -II

Blends and Additives

Blends, antioxidants, UV stabilizers, antistatic agents, peroxides, lubricants, fire retardants, heat stabilizers, plasticizers. Agricultural Chemicals : Fertilizers, insecticides, herbicides, fungicides.

Unit -III

Petrochemicals

Crude oil and natural gas, refinery operations, energy consumption, lower olefins and acetylenes. cracking processes, synthesis gas, ammonia and methanol production, acetic acid and acetic anhydride production, C_1 products : Formic acid, hydrogen cyanide, chlomethanes. C_2 products : ethanol, acetaldehyde, ethylene oxide.

Unit -IV

Industrial Pollution

Source of Pollution: Air pollution-various pollutants, Water pollution-Organic/inorganic pollutants, Noise pollution, Pesticide pollution, Radiation pollution. Control and treatment of pollution and waste from industrial sites.

Suggested Readings:

An introduction to Industrial Chemistry, A. Heaton, 3rd edition Springer Science.
Fundamental of Industrial Chemistry : J. A. Tyrell, Wiley.
Air quality, T. Godish, 5th ed, CRC Press.
Analytical agricultural Chemistry, Kanwar and Chopra.

M. Sc. (4th Sem.)
Paper-XXXIX
CHP(H)-401
Physical Special-IV

Max Marks: 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

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 simple picture of the symmetry factor and its dependence on over potential. Polarizable and non-polarizable interfaces.

UNIT-II

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 fuel cell, Hydrocarbon-air fuel cells, and Natural gas, CO-air fuel cells, Electricity storage: Some important quantities in electricity storage (like electricity storage density, energy density and power), Desirable conditions for an ideal storer. Storage of electricity using the lead-acid battery, Dry cell, Silver-Zinc cell and Sodium-Sulfur cell.

UNIT – III

Corrosion

Electrochemistry of corrosion of metals, Factors affecting corrosion, Electrochemical cell formation, Polarization of metal electrode *i.e.* Concentration, Resistance and Activation polarization. Anodic and cathodic polarization curves (Evan's diagram). Electrochemical measurement of corrosion current density, corrosion potential and mixed potential theory and Tafel slope. Anodic passivation and passivation potential. Passivity theory.

UNIT – IV

Current Potential Laws

Application of the current-potential laws, Comparison of electrolytic interface to other type of charged interfaces *i.e.* semiconductors *p-n* junctions. The current across biological membranes. Hot and cold emission of electrons from a metal into vacuum.

Suggested Readings

A Text Book of Physical Chemistry, H. K. Moudgil, PHI Publication House, New Delhi
An Introduction to Chemical Thermodynamics, R. P. Rastogi, R. R. Mishra
Introduction to Statistical Thermodaynamics, M. Dole
Chemical Physics, J. C. Slater
Theoretical Chemistry, S. Glasstone
Modern Electrochemistry, J. O. M. Bockris, A. K. N. Reddy
An Introduction to Electrochemistry, S. Glasstone
Corrosion Engineering, Fontana, Mc Graw Hill.
An introduction to metallic corrosion, Raj Narain.

M. Sc. (4th Sem.)
Paper-XLII
CHP(H)-402
Physical Special-V

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

Chemistry of Surfactants-I

Adsorption of surface active agents at Solid/Liquid, Liquid/Gas and Liquid/Liquid 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 surface area per molecule.

UNIT-II

Chemistry of Surfactants-II

Critical micelle concentration (CMC), Methods of determining CMC, Factors affecting CMC. Micellar structure and shape, Micellar aggregation. CMC in non-aqueous media. Thermodynamic parameters of micellization.

Effectiveness of adsorption at Liquid/Gas and Liquid/Liquid interfaces, Szyszkiwski, Langmuir and Frumkin adsorption equations. Derivation of thermodynamics parameters of adsorption at the Liquid/Gas and Liquid/Liquid interfaces.

UNIT – III

Chemistry of Surfactants-III

Solubilization by solutions of Surfactants: Solubilization in aqueous media, Locus of solubilization, Factors determinig the extent of solubilization, Solubilization in non-aqueous media, Reduction of surface and interfacial tension by surfactants. Wetting (spreading, adhesional and immersional wetting), Modification of wetting by surfactants. General consideration, Hard surface wetting and textile wetting.

UNIT – IV

Foaming and Anti-foaming by Aqueous Solutions of Surfactants

Film elasticity: Its theories and factors. Factors determining emulsion stability. Theories of emulsion: Its types, qualitative theory and kinetic theory. Micro emulsions. Relationship of surfactant, Chemical structure to emulsifying behavior, Methods of selecting surfactants as emulsifying agent (HLB and PIT theory).

Suggested Readings

A Text Book of Physical Chemistry, H. K. Moudgil, PHI Publication House, New Delhi
Solid State Chemistry and its Applications, A. R.West
Principles of the Solid State, H. V. Keer
Solid State Chemistry, N. B. Hannay
Solid State Chemistry, D. K. Chakrabarty
Solid State Chemistry, W. E. Garner
Surfactants and Interfacial Phenomenon, Milton J. Rosen
Emulsions: Theory and Practice, Paul Becher, American Chemical Society

M. Sc. (4th Sem.)
Paper-XLI
CHI(H)-402

Inorganic Special-V

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

Reaction mechanisms of Transition Metal Complexes-I

Introduction, Ligands replacement reactions, Classifications of mechanisms, Water exchange rates, Formation of complex aqueous ions, Anation reactions, Aquation and Base hydrolysis, attack on ligands, Reactions of square planar complexes, Mechanisms of ligand displacement reactions, *Trans* Effect, Metal carbonyl reactions, Reactions of binuclear carbonyl, Associative reactions, Species with 17 electrons, Electron Transfer Processes-outer and inner sphere.

UNIT-II

Reaction mechanisms of Transition Metal Complexes-II

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, Trigional bipyramidal molecules, Systems with coordination number six or more, Isomerization and Racemization of *tris* chelate complexes, Metal carbonyl scramling, Cluster rotation with CO shells.

UNIT – III

The elements of the Second and Third Transition series -I

General comparisons between first, second and third transition series. General discussion of oxidation state 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, $NbCl_5$ dinculear, $NbOCl_3$, $NbCl_4$, Structure of $[M_2Cl_6L_3]$ species (M = Nb and Ta. L = Me_2S_5 and L = tetrahydrohiophene), $Nb_2Cl_8(pme_3)_4$, Structure of cluster $[M_6X_{12}]$ (where M=Nb and Ta).

UNIT – IV

Elements of 2nd & 3rd Transition series -II: 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 $[ReH_9^{6-}$, $Re_3Cl_9]$ unit, Multiple bonded dirhenium and ditechnitium 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 M.O. picture of osmyl complexes. Structure of α and β $PdCl_2$ and Mixed valence (II, IV) compounds, Linear chain compounds of platinum.

Suggested Readings

Inorganic Chemistry, J. E. Huheey 3rd Edition
Advanced Inorganic Chemistry, F. A. Cotton, G. Wilkinson: 5th Edition
Principles of Organometallic Chemistry, G. F. Coates, M. L. H. Green, P. Powel, K. Wade
Inorganic Chemistry, K. P. Purcell, J.V. Kotz
Chemistry of Elements, Greenwood and Earnshaw

M. Sc. (4th Sem.)
Paper-XLIV
CHI(H)-403

Inorganic Special-VI

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

Oxidative Addition and Migration (Insertion Reactions)

Acid base behaviour of metal atoms in complexes, Protonation and lewis base behavior. 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, Reductive elimination; Migration reaction, Promotion of alkyl migration, Insertion of CO into M□H bonds, Other aspects of CO insertion reactions, transfer to other molecules: CO_2, SO_2, NO, RNC. Insertion of alkenes and C□C' unsaturated compounds, Cleavage of C□H bonds, Alkane activation.

UNIT-II

Lower halide and Chalcogenide Clusters

Octahedral metal halide and chalcogenide clusters (M_6X_8 and M_6X_{12} types), Chevrel phases, Triangular clusters and solid state extended arrays.

UNIT – III

Transition Metal Complexes in Catalysis

Reaction of carbon monooxide 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 carbon carbon(C□C) multiple bonds, Homogeneous hydrogenation, Hydrosilation of unsaturated compounds, Polymerization, oligomerisation and metathesis reactions of alkenes and alkynes. Ziegler-Natta polymerization of ethylene and propylene, oligomerisation and related reactions. Hydrocynation of alkenes, acetic acid synthesis.

UNIT – IV

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, Oxidation reaction: Oxidative carbonylations, Palladium catalysd oxidation of ethylene, Acrylonitrile synthesis, oxygen transfer from peroxo and oxo species, oxygen transfer from NO_2 groups.

Suggested Readings

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

M. Sc. (4th Sem.)
Paper-XL
CHO(H)-401
Organic Special-IV

Max. Marks: 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

Heterocyclic compounds
Systematic (Hantzsch-Widman) classification and nomenclature for monocylic and fused ring systems.Criteria of aromaticity, Tautomerism.
Five membered Heterocycles: Synthesis and reaction including mechanism of the following: Imidazole, Thiazole, Oxazole, Isooxazole,Isothiazole

UNIT - II

Six membered Heterocycles with two heteroatoms: Detailed study of Pyrimidines and Purines. Structural elucidation of uric acid and caffeine
Nucleosides and Nucleotides: Structure of Nucleosides and Nucleotides, General synthesis of Nucleotides and polynucleotides

UNIT – III

Ylides : General methods of formation, General study of reactions with their mechanisms of Nitrogen (Ammonium, Immonium, Diazonium and Nitrile), Phosphorous and Sulphur ylides and their applications.
Metallocenes, non-benzenoid aromatics and polycyclic aromatic compounds
General considerations, synthesis and reactions of representative compounds: Ferrocene, Azulene, Tropones, Tropolones and Sydnones.
Synthesis of Benzo-1,2-anthracene, Chrysene, Benzo-3,4-phenanthrene and Benz[a] pyrene.

UNIT – IV

Synthetic Drugs: Relation between physiological action and chemical constitution .
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 Dipyrrone.

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, R. J. Sundberg
Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
Heterocylic Chemistry, T. L. Gilchrist
Comprehensive Heterocyclic Chemistry, A. R. Katritzky, C.W. Rees
Polycyclic Aromatic Hydrocarbons, E. Clar, Academic Press.
Natural Products: Chemistry and Biology Significance, J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthrope, J. B.

M. Sc. (4th Sem.)
Paper-XLIII
CHO(H)-402
Organic Special-V

Maximum Marks: 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT – I

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 and PMO approach, Electrocylic reaction: conrotatory and disrotatory motions. 4n, 4n +2, systems, Cycloadditions: antarafacial and suparafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3-Dipolar cycloadditions and Cheliotropic reactions.

UNIT – II

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.

UNIT – III

Photochemistry-I

Photochemical Reactions: Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, Franck-Condon Principle, Jablonski diagram, Energy transfer Photsensitization, Quenching, Quantum efficiency and quantum yield, actinometry.

Photochemistry of Carbonyl Compounds: Intramolecular reactions of carbonyl compounds. saturated, cyclic, acyclic, and unsaturated compounds. Cyclo hexa dienones.

Norrish type I and type II changes, Paterno-Buchi reaction and photoreduction.

UNIT – IV

Photochemistry-II

Photochemistry of Aromatic Compounds: Isomerisations,cyclization, additions and substitutions reactions.

Miscellaneous Photochemical Reactions: Photo-Fries reactions of anilides, Photolysis of nitrile and esters, Barton reaction.

Singlet molecular oxygen reactions. Photodegradation of polymers.

Intermolecular cycloaddition reactions –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.

Suggested Readings :

Organic photochemistry, J. Coxan, B. Halton, Cambridge University Press
Introductory Photochemistry, A. Cox, T. Camp Mc Graw Hill
The Conservation of Orbital Symmetry, R. B. Woodward, R. Hoffmann, Verlag Chemie Academic Press
Organic Reactions and Orbital Symmetry, T. L Gilchrist, 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

M. Sc. (4th Sem.)
Paper-XLVI
CHO(H)-403

Organic Special-VI

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT - I

Terpenoids: Classification , nomenclature, occurrence and general method of structural determination , Isoprene rule, Stucture determination, stereochemistry and synthesis of Citral, Farnesol, Zingibrene, Santonin, Geraniol, α-terpeniol, and Abietic acid, Biogenetic pathways and biosynthesis.

Carotenoids

General method of structure elucidation and synthesis of α -carotene, β-carotene, lycopene, γ - carotene. Biosynthesis of carotenoids

UNIT - II

Alkaloids: Classification, occurrence, general methods of isolation and structure elucidation. Structure, Stereochemistry, synthesis and biosynthesis of following: Papaverine, Nicotine, Quinine, morphine, lysergic acid and Reserpine (Definition, Nomenclature and physiological action, role of alkaloids in plants.

UNIT – III

Steroid: Occurrence, General method of isolation, Diel's Hydrocarbon, Structure elucidation and synthesis of Cholesterol, Bile acids, Testosterone, Progesterone, Esterone and synthetic non-steroidal estrogens, androsterone, oestrogens.

UNIT – IV

Antibiotics: Penicillins and semi-synthetic penicillins: Synthesis, Structure elucidation and Medicinal uses of Pencillin, chloramphenicol, Streptomycin and Tetracyclins, Problems of sensitivity to acids, β-lactamases and narrow spectrum of activity of penicillin G, solving these problems leading to the development of penicillin V, oxacillin, cloxacillin, ampicillin, amoxicillin and carbenicillin.

Prostaglandins: Classification, Physiological effects and synthesis of PGE2 and PGF2 α.

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, MeGraw-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, Atta-ur-Rahman and M. I. Choudhary, Harwood Academic Publishers.

M. Sc. Final (4th Sem.)

Paper-L

CHI(E)-404

Inorganic Chemistry General -II

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

UNIT - I

Supramolecular Chemistry

Concepts and Language, Molecular recognition, Molecular receptor for different types of molecules including anionic substrates, Design and synthesis of co-receptors molecules and multiple recognition. Supramolecular reactivity and catalysis. Transport process and carrier design, Switching devices. Some examples of self assembly in supramolecular chemistry.

UNIT - II

Reaction mechanisms of Transition Metal Complexes

Introduction, Ligands replacement reactions, Classifications of mechanisms, Water exchange rates. Anation reactions, Aquation and Base hydrolysis, Reactions of square planar complexes. Mechanisms of ligand displacement reactions, *Trans* Effect, Electron Transfer Processes-outer and inner sphere. The Marcus theory, Doubly bridged inner-sphere transfer and other electron transfer reactions, Two electron transfer. Non-complementary reactions.

UNIT – III

The elements of the Second and Third Transition Series

General comparisons between first, second and third transition series, General discussion of oxidation state 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, $NbCl_5$ dinculear, $NbOCl_3$, $NbCl_4$, Structure of $[M_2Cl_6L_3]$ species (M = Nb and Ta. L = Me_2S_5 and L - tetrahydrohiophene), $Nb_2Cl_8(PMe_3)_4$, Structure of cluster $[M_6X_{12}]$ (where M=Nb and Ta).

UNIT – IV

Compounds with M□M Multiple Bonds

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

Suggested readings:

Supramolecular chemistry : concepts and perspectives, J. M. Lehn
Inorganic Chemistry, K. P. Purcell, J.V. Kotz
Inorganic Chemistry, J. E. Huheey 3rd Edition
Advanced Inorganic Chemistry, F. A. Cotton, G. Wilkinson: 5th Edition
Multiple bonds between metal atoms, F. A. Cotton, C. A. Murillo, R. A. Walton

M. Sc. Final (4th Sem.)
Paper-XLIX
CHP(E)-404
Physical Chemistry General -II

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Unit -1

Chemistry of Surfactants-I

Adsorption of surface active agents at Solid/Liquid, Liquid/Gas and Liquid/Liquid 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 surface area per molecule.

Unit -2

Chemistry of Surfactants-II

Critical micelle concentration (CMC), Methods of determining CMC, Factors affecting CMC, Micellar structure and shape, Micellar aggregation. CMC in non-aqueous media. Thermodynamic parameters of micellization.

Effectiveness of adsorption at Liquid/Gas and Liquid/Liquid interfaces, Szyszkiwski, Langmuir and Frumkin adsorption equations. Derivation of thermodynamics parameters of adsorption at the Liquid/Gas and Liquid/Liquid interfaces.

Unit -3

Corrosion

Electrochemistry of corrosion of metals, Factors affecting corrosion. Electrochemical cell formation, Polarization of metal electrode *i.e.* Concentration, Resistance and Activation polarization. Anodic and cathodic polarization curves (Evan's diagram). Electrochemical measurement of corrosion current density, corrosion potential and mixed potential theory and Tafel slope. Anodic passivation and passivation potential. Passivity theory.

Unit -4

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 fuel cell, Hydrocarbon-air fuel cells, and Natural gas, CO-air fuel cells, Electricity storage: Some important quantities in electricity storage (like electricity storage density, energy density and power), Desirable conditions for an ideal storer, Storage of electricity using the lead-acid battery, Dry cell, Silver-Zinc cell and Sodium-Sulfur cell.

Suggested Readings

A Text Book of Physical Chemistry, H. K. Moudgil, PHI Publication House, New Delhi
An Introduction to Chemical Thermodynamics, R. P. Rastogi, R. R. Mishra
Introduction to Statistical Thermodynamics, M. Dole

M. Sc. Final (4th Sem.)
Paper-LI
CHO(E)-404
Organic Chemistry General -II

Max Marks : 70

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further examiner will set two questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Unit -1

Ylides: General methods of formation, General study of reactions with their mechanisms of Nitrogen (Ammonium, Immonium, Diazonium and Nitrile), Phosphorous and Sulphur ylides and their applications.

Unit -2

Pericyclic reactions:
Molecular orbital symmetry, Frontier orbital of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system, Classification of pericyclic reactions, Woodward-Hoffmann correlation diagram method of Electrocylic reaction: conrotatory and disrotatory motions in 4n, 4n +2 systems, Cycloadditions: antarafacial and suparafacial additions, 4n and 4n+2 systems,

Unit -3

Photochemistry : Norrish type I and type II changes, Paterno-Buchi reaction

Unit -4

Synthesis of Testosterone and Progesterone and Androsterone from Cholesterol

Suggested Readings :

Organic photochemistry, J. Coxan, B. Halton, Cambridge University Press
Pericyclic Reactions, S. M. Mukherji
Aspects of Organic Photochemistry by Horspool, W. M.
Organic Chemistry, Vol-2, I.L. Finar, ELBS.
Modern Synthetic Reactions, H.O. House, W. A, Benzamin.

M. Sc. (4th Sem.)-Practicals
Inorganic Special Practical -I
CHI(H)-407

Max Marks : 50

Instrumental methods of Analysis

1. **Spectrophotometry**

a) Nickel, Molybdenum, Iron by extractive spectrophotometric method.
b) Iron-phenanthroline complex; Jobs method of continous 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) Conductrometric titration of NH_4Cl vs NaOH, CH_3COONa vs HCl, (CH_3COOH+HCl) vs NaOH.

4. **pH metery**

Determination of strength of HCl, CH_3COOH, *etc.*

Suggested Readings

Synthesis and characterization of Inorganic compounds, W. L. Jolly, Prentice Hall
Synthesis and physical studies of Inorganic compounds, C. F. Bell, Pergamon Press
A Text book of Quantitative Analysis. A. I. Vogel, ELBS, London

M. Sc. (4th Semester)-Practicals
Inorganic Special Practical-II
CHI(H)-408

Max Marks : 50

Preparations

1. Preparation of hexaureachromium(III) chloride and estimation of Cl^- ions in the prepared complex.
2. Preparation of pure sample of nitrosyl-*bis*-diethylthiocarbamatoiron(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) $Co[Hg(SCN)_4]$ and estimation of Hg in the prepared complex.
5. Preparation of tetraminecopper (II) sulphate $[Cu(NH_3)_4]SO_4$ and estimation of Cu in the prepared complex.
6. Preparation of copper (I) tetraiodomercurate (II), Cu_2HgI_4 and estimation of Hg in the prepared complex.
7. Preparation of dichloro-*bis*-(hydroxylamine)zinc(II) $[Zn(NH_2OH)_2Cl_2]$ and estimation of Zn in the prepared complex.
8. Preparation of aluminiumacetylacetonate $[Al(C_5H_7O_2)_3]$ and estimation of Al in the prepared complex.
9. Preparation of pentathioureadicuprous nitrate and estimation of Cu in the prepared complex.
10. Preparation of bis(aniline)dichlorocobalt(II) and estimation of Co in the prepared complex.

Suggested Readings

Inorganic Synthesis, Book Series Vol 1-15, Wiley
Practical Inorganic Chemistry, G. Marr, B. W. Rockett
Bull. Chem. Soc., Japan 29, (1956) 852.
J. Chem. Soc 84, (1962) 3404.

M.Sc. (4th Sem.)-Practicals
Organic Special Practical-I
CHO(H)-407

Max Marks : 50

Quantitative Analysis

1. **Titrimetric Method**

(a) Determination of percentage or number of hydroxyl groups in organic compound by acetylation method.
(b) Estimation of Amines/phenols using bromate-bromide solution/or acetylation method.
(c) Determination of iodine and saponification values of oil samples.
(d) Determination of concentration of Glucose/or Sucrose in the given solution (Fehling solution method)

2. **Spectrophotometric (UV/VIS) Estimations**

(a) Caffeine
(b) Cholesterol
(c) Amino acids
(d) Proteins
(e) Carbohydrates
(f) Ascorbic acid

3. Viva-Voce (10 marks)
4. Note Book (10 marks)

Note- Department can opt any other similar experiment depending upon the material available.

Suggested Readings

Experiments in Organic Chemistry, Lousis F. Fieser, O. C. Heath and Company Boston, 1955
Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson, M. Miller, Prentice Hall
Macroscale and Microscale Organic Experiments, K. L. Williamson, D.C. Heath
Systematic Qualitative Organic Analysis, H. Middleton, A. Arnold
Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, A. Arnold
Vogel's Textbook of Practical Organic Chemistry, A. R. Tatchell John Wiley
An Introduction to Practical Biochemistry, D. T. Plummer, Tata McGraw Hill Publishing Company, Ltd., N. Delhi, 1988.

M. Sc. (4th Sem.)-Practicals
Organic Special Practical-II
CHO(H)-408

Max Marks: 50

1. **Qualitative Analysis**
Separation of components of a binary mixture (Solid-liquid, liquid-liquid) and Identification of the components by chemical and spectroscopic methods (IR, UV, NMR & Mass) followed by preparation of their derivatives.

Note: Two sets to be given in the examination.

2. Viva-Voce (10 Marks)
3. Note Book (10 Marks)

Note-1. Department can opt any other similar three steps preparation depending upon the material available

Suggested Readings

Experiments in Organic Chemistry, Lousis F. Fieser O. C. Heath and Company Boston, 1955
Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson, M. Miller, Prentice Hall
Macroscale and Microscale Organic Experiments, K. L. Williamson, D.C. Heath
Systematic Qualitative Organic Analysis, H. Middleton, A. Arnold

M. Sc. (4th Sem.)-Practicals
Physical Special Practical-I (CHP(H)-407)

Max Marks : 50

Ultrasonic Interferometer

1) To find ultrasonic speed of given organic binary liquid mixtures of different composition.
2) To study the effect of temperature on ultrasonic speed of given organic mixture.

Potentiometry

3) Determination of temperature dependence of EMF of a cell.
4) To determine the thermodynamic parameter for a reaction from emf measurement.
5) To determine the formal potential of a redox couple, $Fe(CN)_6^{3-}/Fe(CN)_6^{4-}$ in different media.
6) To determine the pH of a series of buffer solution by potentiometric method.
7) To determine the solubility product of AgCl and to determine instability constant of $Ag(NH_3)_2^+$ complex.
8) To determine the activity of hydrogen ion in acid medium using hydrogen electrode, hence to determine the ionic product of water and hydrolysis constant of sodium acetate.
9) To determine the degree of hydrolysis and hydrolysis constant of aniline, HCl by potentiometry.
10) To determine the concentration of a reductant or an oxidant i.e. Ferrous ammonium sulphate and Ceric sulphate by a potentiometric redox titration.
11) To determine the amount of KI and KCl present in a mixture by potentiometric titration.

Equilibrium and Dissociation Constant

12) To determine the equilibrium constant of an esterification reaction between acetic acid and ethanol.
13) To determine the equilibrium constant of the following reversible reaction:
$2\ Ag^+ + CaSO_4 \rightleftharpoons Ag_2SO_4\ (s) + Ca^{2}$

Magnetic Moment and Magnetic Susceptibility

14) To determine the magnetic susceptibility of Mohr's salt at room temperature and hence the magnetic moment by using Gouy balance.

Suggested Readings

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

M. Sc. (4th Sem.)-Practicals

Physical Special Practical-II (CHP(H)-408)

Max Marks : 50

Turbiditymetry

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

Phase Rule

2) To verify the phase rule for a given two component Azeotropic mixtures.
3) To verify the phase rule for a given three component Azeotropic mixtures.
4) To determine the transition temperature of given salt hydrate like Sodium sulphate, Strontium sulphate or Sodium thiosulphate.
5) To determine the critical solution temperature of phenol water system.

Corrosion

6) To find corrosion rate of any metal or alloy in given acidic solution.
7) To study the effect of temperature on the corrosion rate.

Dipole Metry

8) To find dipole moment of given liquid such as Chlorobenzene, Chloroform, Nitrobenzene etc. by using dipole meter.

Conductometry

9) Study of conductometric titration of NH_4Cl versus NaOH solution and comment on nature of graph.
10) Study of conductometric titration of CH_3COONa versus HCl and comment on nature of graph.
11) Study conductometric titration of $MgSO_4$ versus $Ba(OH)_2$ and comment on nature of graph.
12) Study conductometric titration of $BaCl_2$ and K_2SO_4 and comment on nature of graph.
13) 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.
14) To determine the relative strength of two acids using conductometer.
15) To determine the solubility of a sparingly soluble salt in water by conductance measurements.
16) To find CMC value of a given surfactant solution.

pH metry

17) To determine the thermodynamic parameter for a reaction from pH measurement.
18) To prepare a series of buffer solution and to check resist in its pH value by pH meter method.
19) To determine the degree of hydrolysis and hydrolysis constant of aniline. HCl by pH metrically.
20) To determine the concentration of a reductant or an oxidant i.e. Ferrous ammonium sulphate and Ceric sulphate by a pH meteric titration.
21) To determine the amount of KI and KCl present in a mixture by pH metric titration.
22) To determine the strength of polybasic acid with the help of pH meter.

Suggested Readings

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