SCHEME OF STUDIES & EXAMINATIONS

M.Sc. in Chemistry (Four-Semester Course)

(Effective from Session 2012-2013)

DEPARTMENT OF CHEMISTRY

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE &TECHNOLOGY

MURTHAL (SONEPAT) HARYANA – 131039

Contents

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE &TECHNOLOGY
MURTHAL (SONEPAT) HARYANA – 131039
DEPARTMENT OF CHEMISTRY

SCHEME OF STUDIES & EXAMINATIONS
M.Sc. in Chemistry (Four-Semester Course)
(Effective from Session 2012-2013)

Semester – I

Paper No.	Paper Title	Teaching Scheme			Examination Scheme			Duration of Exam (Hours)	Credit
		L	T	P	Sessional Marks	External Marks	Total		
CH-501 B	Inorganic Chemistry-I (Essential Inorganic Chemistry)	4	0	0	50	100	150	3	4
CH-503 B	Organic Chemistry-I (Structure & Mechanism in Organic Chemistry-1)	4	0	0	50	100	150	3	4
CH-505 B	Physical Chemistry-I (Thermodynamics and Electrochemistry)	4	0	0	50	100	150	3	4
CH-507 B or CH-509 B	Mathematics for Chemists or Biology for Chemists	3 3	0 3	0 0	30 30	70 70	100 100	3 3	3 3
CH-511 B	Inorganic Chemistry Lab-I	0	0	8	50	100	150	8	4
CH-513 B	Organic Chemistry Lab-I	0	0	8	50	100	150	8	4
CH-515 B	Physical Chemistry Lab-I	0	0	8	50	100	150	8	4
Total		15	0	24	330	670	1000		27

Note:

1. **Credit requirement for completion of this semester: 27. Credit requirement for completion of programme: 106 (Grade D or above)**

2. **The students who have studied biology at UG level will study paper no. CH-507 B and those who have studied mathematics at UG level will study paper no. CH-509 B.**

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE &TECHNOLOGY
MURTHAL (SONEPAT) HARYANA – 131039
DEPARTMENT OF CHEMISTRY

SCHEME OF STUDIES & EXAMINATIONS
M.Sc. in Chemistry (Four-Semester Course)
(Effective from Session 2012-2013)

Semester – II

Paper No.	Paper Title	Teaching Scheme			Examination Scheme			Duration of Exam (Hours)	Credit
		L	T	P	Sessional Marks	External Marks	Total		
CH-502 B	Inorganic Chemistry-II (Coordination Chemistry)	4	0	0	50	100	150	3	4
CH-504 B	Organic Chemistry-II (Structure & Mechanism in Organic Chemistry-2)	4	0	0	50	100	150	3	4
CH-506 B	Physical Chemistry-II (Kinetics, Quantum Mechanics and Spectroscopy)	4	0	0	50	100	150	3	4
CH-508 B	Computer for Chemists	3	0	0	30	70	100	3	3
CH-510 B	Inorganic Chemistry Lab-II	0	0	8	50	100	150	8	4
CH-512 B	Organic Chemistry Lab-II	0	0	8	50	100	150	8	4
CH-514 B	Physical Chemistry Lab-II	0	0	8	50	100	150	8	4
Total		15	0	24	330	670	1000		27

Note:

1. **Credit requirement for completion of this semester: 27. Credit requirement for completion of programme: 106 (Grade D or above)**
2. **Sessional Marks for the CH-508 B (Computer for Chemists) course will be based on the computer application of the course contents.**

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE &TECHNOLOGY
MURTHAL (SONEPAT) HARYANA – 131039
DEPARTMENT OF CHEMISTRY

SCHEME OF STUDIES & EXAMINATIONS
M.Sc. in Chemistry (Four-Semester Course)
(Effective from Session 2013-14)

Semester – III (Inorganic Chemistry)

Paper No.	Paper Title	Teaching Scheme			Examination Scheme			Duration of Exam (Hours)	Credit
		L	T	P	Sessional Marks	External Marks	Total		
CH-601 B	Inorganic Special - I (Spectroscopic Techniques)	4	0	0	50	100	150	3	4
CH-603 B	Inorganic Special - II (Group Theory and Vibrational Spectroscopy)	4	0	0	50	100	150	3	4
CH-605 B	Inorganic Special – III (Bio-Inorganic Chemistry)	4	0	0	50	100	150	3	4
	Elective – I	4	0	0	50	100	150	3	4
CH-607 B	Inorganic Chemistry Lab-III	0	0	8	50	100	150	8	4
CH-609 B	Inorganic Chemistry Lab-IV	0	0	8	50	100	150	8	4
CH-611 B	Seminar-I (Inorganic Chemistry)	2	0	0	50		50		2
Total		18	0	16	350	600	950		26

Note:

1. **Credit requirement for completion of this semester: 26. Credit requirement for completion of programme: 106 (Grade D or above)**
2. **The candidate will opt Elective-I paper from the following list:**

Paper No.	Paper Title
CH-651 B	Inorganic Chemistry Elective-I (Nuclear and Electroanalytical Chemistry)
CH-653 B	Organic Chemistry Elective-I (Polymer Chemistry)
CH-655 B	Physical Chemistry Elective-I (Semiconductors and Nanomaterials)

The Elective-I paper will be offered subject to the availability of the expert teacher and / or the minimum students strength of 1/3 rd of the total intake of the programme. Final decision in this regard shall lie with the Chairperson of the department.

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE &TECHNOLOGY
MURTHAL (SONEPAT) HARYANA – 131039
DEPARTMENT OF CHEMISTRY

SCHEME OF STUDIES & EXAMINATIONS
M.Sc. in Chemistry (Four-Semester Course)
(Effective from Session 2013-14)

Semester – III (Organic Chemistry)

Paper No.	Paper Title	Teaching Scheme			Examination Scheme			Duration of Exam	Credit
		L	T	P	Sessional Marks	External Marks	Total	(Hours)	
CH-613 B	Organic Chemistry Special-I (Organic Spectroscopy)	4	0	0	50	100	150	3	4
CH-615 B	Organic Chemistry Special-II (Natural Products-1)	4	0	0	50	100	150	3	4
CH-617 B	Organic Chemistry Special-III (Heterocyclic Chemistry)	4	0	0	50	100	150	3	4
	Elective – I	4	0	0	50	100	150	3	4
CH-619 B	Organic Chemistry Lab-III	0	0	8	50	100	150	8	4
CH-621 B	Organic Chemistry Lab-IV	0	0	8	50	100	150	8	4
CH-623 B	Seminar-I (Organic Chemistry)	2	0	0	50		50		2
Total		18	0	16	350	600	950		26

Note:

1. **Credit requirement for completion of this semester: 26. Credit requirement for completion of programme: 106 (Grade D or above)**
2. **The candidate will opt Elective-I paper from the following list:**

Paper No.	Paper Title
CH-651 B	Inorganic Chemistry Elective-I (Nuclear and Electroanalytical Chemistry)
CH-653 B	Organic Chemistry Elective-I (Polymer Chemistry)
CH-655 B	Physical Chemistry Elective-I (Semiconductors and Nanomaterials)

The Elective-I paper will be offered subject to the availability of the expert teacher and / or the minimum students strength of 1/3 rd of the total intake of the programme. Final decision in this regard shall lie with the Chairperson of the department.

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE &TECHNOLOGY
MURTHAL (SONEPAT) HARYANA – 131039
DEPARTMENT OF CHEMISTRY

SCHEME OF STUDIES & EXAMINATIONS
M.Sc. in Chemistry (Four-Semester Course)
(Effective from Session 2013-14)

Semester – III (Physical Chemistry)

Paper No.	Paper Title	Teaching Scheme			Examination Scheme			Duration of Exam (Hours)	Credit
		L	T	P	Sessional Marks	External Marks	Total		
CH-625 B	Physical Chemistry Special-I (Electrochemistry and Solid State Chemistry)	4	0	0	50	100	150	3	4
CH-627 B	Physical Chemistry Special-II (Quantum Chemistry)	4	0	0	50	100	150	3	4
CH-629 B	Physical Chemistry Special-III (Molecular Spectroscopy)	4	0	0	50	100	150	3	4
	Elective – I	4	0	0	50	100	150	3	4
CH-631 B	Physical Chemistry Lab-III	0	0	8	50	100	150	8	4
CH-633 B	Physical Chemistry Lab-IV	0	0	8	50	100	150	8	4
CH-635 B	Seminar-I (Physical Chemistry)	2	0	0	50		50		2
Total		18	0	16	350	600	950		26

Note:

1. **Credit requirement for completion of this semester: 26. Credit requirement for completion of programme: 106 (Grade D or above)**
2. **The candidate will opt Elective-I paper from the following list:**

Paper No.	Paper Title
CH-651 B	Inorganic Chemistry Elective-I (Nuclear and Electroanalytical Chemistry)
CH-653 B	Organic Chemistry Elective-I (Polymer Chemistry)
CH-655 B	Physical Chemistry Elective-I (Semiconductors and Nanomaterials)

The Elective-I paper will be offered subject to the availability of the expert teacher and / or the minimum students strength of 1/3 rd of the total intake of the programme. Final decision in this regard shall lie with the Chairperson of the department.

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE &TECHNOLOGY
MURTHAL (SONEPAT) HARYANA – 131039
DEPARTMENT OF CHEMISTRY

SCHEME OF STUDIES & EXAMINATIONS
M.Sc. in Chemistry (Two Year Course)
(Effective from Session 2013-14)

Semester – IV (Inorganic Chemistry)

Paper No.	Paper Title	Teaching Scheme			Examination Scheme			Duration of Exam (Hours)	Credit
		L	T	P	Sessional Marks	External Marks	Total		
CH-602 B	Inorganic Special - IV (Organometallic Chemistry)	4	0	0	50	100	150	03	4
CH-604 B	Inorganic Special - V (Inorganic Solids, Polymer and Cluster Compounds)	4	0	0	50	100	150	03	4
CH-606 B	Inorganic Special – VI (Inorganic Medicinal Chemistry)	4	0	0	50	100	150	03	4
	Elective-II	4	0	0	50	100	150	03	4
CH-608 B	Inorganic Chemistry Lab-V	0	0	8	50	100	150	8	4
CH-610 B	Inorganic Chemistry Lab-VI	0	0	8	50	100	150	8	4
CH-612 B	Seminar-II (Inorganic Chemistry)	2	0	0	50		50		2
Total		18	0	16	350	600	950		26

Note:

1. **Credit requirement for completion of this semester: 26. Credit requirement for completion of programme: 106 (Grade D or above)**
2. **The candidate will opt Elective -II paper from the following list:**

Paper No.	Paper Title
CH-652 B	Inorganic Chemistry Elective-II (Materials and Nano-Technology)
CH-654 B	Organic Chemistry Elective-II (Medicinal Chemistry)
CH-656 B	Physical Chemistry Elective-II (Photochemistry and Industrial Catalysis)

The Elective- II paper will be offered subject to the availability of the expert teacher and / or the minimum students strength of 1/3 rd of the total intake of the programme. Final decision in this regard shall lie with the Chairperson of the department.

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE &TECHNOLOGY
MURTHAL (SONEPAT) HARYANA – 131039
DEPARTMENT OF CHEMISTRY

SCHEME OF STUDIES & EXAMINATIONS
M.Sc. in Chemistry (Four-Semester Course)
(Effective from Session 2013-14)

Semester – IV (Organic Chemistry)

Paper No.	Paper Title	Teaching Scheme			Examination Scheme			Duration of Exam (Hours)	Credit
		L	T	P	Sessional Marks	External Marks	Total		
CH-614 B	Organic Chemistry Special-IV (Photochemistry & Pericyclic Reactions)	4	0	0	50	100	150	3	4
CH-616 B	Organic Chemistry Special-V (Natural Products-2)	4	0	0	50	100	150	3	4
CH-618 B	Organic Chemistry Special-VI (Reactions & Reagents)	4	0	0	50	100	150	3	4
	Elective-II	4	0	0	50	100	150	3	4
CH-620 B	Organic Chemistry Lab-V	0	0	8	50	100	150	8	4
CH-622 B	Organic Chemistry Lab-VI	0	0	8	50	100	150	8	4
CH-624 B	Seminar-II (Organic Chemistry)	2	0	0	50		50		2
Total		18	0	16	350	600	950		26

Note:

1. **Credit requirement for completion of this semester: 26. Credit requirement for completion of programme: 106 (Grade D or above)**
2. **The candidate will opt Elective -II paper from the following list:**

Paper No.	Paper Title
CH-652 B	Inorganic Chemistry Elective-II (Materials and Nano-Technology)
CH-654 B	Organic Chemistry Elective-II (Medicinal Chemistry)
CH-656 B	Physical Chemistry Elective-II (Photochemistry and Industrial Catalysis)

The Elective- II paper will be offered subject to the availability of the expert teacher and / or the minimum students strength of 1/3 rd of the total intake of the programme. Final decision in this regard shall lie with the Chairperson of the department.

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MURTHAL (SONEPAT) HARYANA – 131039
DEPARTMENT OF CHEMISTRY

SCHEME OF STUDIES & EXAMINATIONS
M.Sc. in Chemistry (Four-Semester Course)
(Effective from Session 2013-14)

Semester – IV (Physical Chemistry)

Paper No.	Paper Title	Teaching Scheme			Examination Scheme			Duration of Exam (Hours)	Credit
		L	T	P	Sessional Marks	External Marks	Total		
CH-626 B	Physical Chemistry Special –IV (Statistical Thermodynamics)	4	0	0	50	100	150	3	4
CH-628 B	Physical Chemistry Special –V (Electrochemistry and Quantum Chemistry)	4	0	0	50	100	150	3	4
CH-630 B	Physical Chemistry Special –VI (Kinetics, Surface and Polymer Chemistry)	4	0	0	50	100	150	3	4
	Elective – II	4	0	0	50	100	150	3	4
CH-632 B	Physical Chemistry Lab-V	0	0	8	50	100	150	8	4
CH-634 B	Physical Chemistry Lab-VI	0	0	8	50	100	150	8	4
CH-636 B	Seminar-II (Physical Chemistry)	2	0	0	50		50		2
Total		18	0	16	350	600	950		26

Note:

1. **Credit requirement for completion of this semester: 26. Credit requirement for completion of programme: 106 (Grade D or above)**
2. **The candidate will opt Elective -II paper from the following list:**

Paper No.	Paper Title
CH-652 B	Inorganic Chemistry Elective-II (Materials and Nano-Technology)
CH-654 B	Organic Chemistry Elective-II (Medicinal Chemistry)
CH-656 B	Physical Chemistry Elective-II (Photochemistry and Industrial Catalysis)

The Elective- II paper will be offered subject to the availability of the expert teacher and / or the minimum students strength of 1/3 rd of the total intake of the programme. Final decision in this regard shall lie with the Chairperson of the department.

M.Sc. Chemistry I-Semester
Inorganic Chemistry-I (Essential Inorganic Chemistry)

Paper No. CH-501 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Theories of Bonding in Co-ordination Complexes: Valence bond theory and limitations, Crystal field theory splitting of d-orbitals in cubic, octahedral, tetragonal, tetrahedral and square planar ligand environments. Structural consequences of splitting of d-orbitals, Jahn Teller theorem, trends in ionic radii, lattice energy and heat of ligation. Structure of spinels. MOT with σ and π bonding. **(15 Hrs)**

UNIT-II

Lanthanides

Extraction & applications, colour and spectra, magnetic properties, Binary & Ternary compounds, oxo salts, compound containing oxygen, nitrogen, sulphur & phosphorus ligands, cyclopentadienyl compounds, Low oxidation state compounds, Lanthanide contraction, Use of lanthanide compounds as shift reagents.

Actinides

General properties, oxidation states, Dioxoions, chemistry of Actinium, Thorium, Protactinium, Uranium, Compounds containing oxygen, nitrogen, sulphur, phosphorus ligands, uranyl & cyclopentadienyl compounds, Transuranic elements, Later actinide elements. **(15 Hrs)**

UNIT-III

Chemistry of non-transition elements– I

General discussion on the properties of the non-transition elements.Synthesis, properties and structure of their halides and oxides.Polymorphism of carbon, phosphorus and sulphur.Sulphur-nitrogen compounds, peroxo compounds of boron, carbon and sulphur, oxy acids of nitrogen, phosphorus, sulphur and halogens. **(15 Hrs)**

UNIT-IV

Chemistry of non-transition elements– II

Synthesis, properties and structure of boranes, carboranes, borazines, silicates, phosphazenes,Interhalogens, pseudohalides and compounds of noble gas.

Non-aqueous Solvents:Solvent system definition, Reactions in non-aqueous media with respect to liquid H_2SO_4, NH_3, SO_2, BrF_3, N_2O_4, HF, thionyl chloride and phosphoryl chloride. Mechanism of coordination reactions in non-aqueous media. **(15 Hrs)**

Books Suggested

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huheey, HarperCollins.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
4. Magnetochemistry, R.L. Carlin, Springer Verlog.
5. Magnetochemistry, A. Earnshaw.
6. Inorganic chemistry, G. Wulf'sburg.
7. Introduction to ligand fields, B.N. Figgis, Wiley Eastern-IIed.

M. Sc. Chemistry I-Semester
Organic Chemistry -I (Structure & Mechanism in Organic Chemistry-1)

Paper No. CH-503 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Nature of Bonding in Organic Molecules

Delocalized chemical bonding- conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes, tautomerism, Aromaticity - Benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Hückel's rule, energy level of π–molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity. Bonds weaker than covalent bond, crown ether complexes, phase transfer catalyst, cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes. **(15 Hrs)**

UNIT-II

Stereochemistry

Nomenclature systems D&L, R&S and E&Z, CIP rules. Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, asymmetric synthesis (basic principle). Methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes); Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus. **(15 Hrs)**

UNIT-III

Reaction Mechanism: Structure and Reactivity

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects. Generation, structure, stability and reactivity of carbocations, carbanions free radicals, carbenes and nitrenes ; Hard and soft acid and bases; Effect of structure on reactivity – resonance and field effects, steric effect. The Hammett equation and linear free energy relationship, substituent and reaction constants. **(15 Hrs)**

UNIT-IV

Chromatographic Techniques –

Types of chromatography, Principle, Instrumentation and applications of Thin layer Chromatography, Column Chromatography, High Performance Liquid Chromatography

(including concept of theoretical plates & reverse HPLC) Gas Chromatography, Counter current distribution and electrophoresis. **(15 Hrs)**

Books Suggested

1. Advanced Organic Chemistry, F.A. Carey and R.J. Sundburg, Plenum.
2. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
3. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
4. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.
5. Structure and Mechanism in Organic Chemistry, C.K. Ingold, CBC Publisher & Distributors, 1995.
6. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
7. Stereochemistry of Organic Compounds, E. L. Eliel and S. H. Wilen, Wiley Interscience.
8. Basic stereochemistry of organic molecules, S Sengupta, Book Syndicate Pvt. Ltd., Kolkata
9. Advanced Organic Chemistry: Reaction Mechanism, Reinhard Bruckner, Harcourt 9India) Pvt. Ltd.
10. Organic reaction Mechanism, V K Ahluwalia and R K Prasher, Narosa Publishing House.
11. Instrumental methods of analysis by B. K. Sharma
12. Instrumental methods of analysis by Willard Merritt, Deen

M.Sc. Chemistry I-Semester
Physical Chemistry-I (Thermodynamics and Electrochemistry)

Paper No. CH-505B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Thermodynamics-I: Brief resume of First and Second law of thermodynamics. Entropy changes in reversible and irreversible processes; variation of entropy with temperature, pressure and volume, entropy concept as a measure of unavailable energy and criteria for the spontaneity of reaction; free energy functions and their significance, criteria for spontaneity of a process; partial molar quantities (free energy, volume, heat concept), Gibb's-Duhem equation. **(15 Hrs)**

UNIT-II

Thermodynamics-II: Classius-Clayperon equation; law of mass action and its thermodynamic derivation. Third law of thermodynamics (Nernest heat theorem, determination of absolute entropy, unattainability of absolute zero) and its limitation. Phase diagram for two completely miscible components systems. Eutectic systems, Calculation of eutectic point, systems forming solid compounds A_x B_y with congruent and incongruent melting points, phase diagram and thermodynamic treatment of solid solutions. **(15 Hrs)**

UNIT-III

Electrochemistry I: Ion-Ion Interactions -The Debye -Huckel theory of ion-ion interactions: potential and excess charge density as a function of distance from the central ion, Debye Huckel reciprocal length, ionic cloud and its contribution to the total potential, Debye-Huckel limiting law of activity coefficients and its limitations, ion-size effect on potential, ion-size parameter and the theoretical mean - activity coefficient in the case of ionic clouds with finite-sized ions.
Debye-Huckel-Onsager treatment for aqueous solutions and its limitations Debye-Huckel-Onsager theory for non-aqueous solutions, the solvent effect on the mobality at infinite dilution, equivalent conductivity (λ) vs. concentration $c^{1/2}$ as a function of the solvent, effect of ion association upon conductivity (Debye-Huckel-Bjerrum equation). **(15 Hrs)**

UNIT-IV

Electrochemistry II: Ion Transport in solutions – Ionic movement under the influence of an electric field , mobility of ions, ionic drift velocity and its relation with current density, Einstein relation between the absolute mobility and diffusion coefficient, the Stokes- Einstein relation , the Nernst -Einstein equation, Waldens rule, the Rate-Process approach to ionic migration , the Rate process equation for equivalent conductivity, total driving force for ionic transport, Nernst - Planck Flux equation, ionic drift and diffusion potential , the Onsager phenomenological equations. The basic equation for the diffusion, Planck-Henderson equation for the diffusion potential. **(15 Hrs)**

Books Suggested

1. Physical Chemistry, P.W. Atkins, Oxford University Press.
2. Physical Chemistry, G.W. Castellan, Narosa. Publishers, New Delhi
3. Thermodynamics for Chemists, S. Glasstone, Affiliated East-West Press.
4. Chemical Thermodynamics, I.M. Klotz and R.M. Rosenberg, Benzamin.
5. An Introduction to Chemical Thermodynamics, R.P. Rastogi and R.R. Misra, Vikas Pub.
6. Electrochemistry, S. Glasstone
7. Modern Electrochemistry vol.1 and vol II J.O.M.Bockris and A.K.N.Reddy, Plenum.
8. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Pub.
9. Advanced Physical Chemistry, Gurtu &Gurtu, A Pragati Edition.

M.Sc. Chemistry I-Semester
Mathematics for Chemists

Paper No. CH-507B **Credits: 03**
03 Hrs /week **External Marks: 70**
Total: 45 Hrs **Sessional Marks: 30**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of nine questions, three from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Vector: Examples of scalar and vectors, definitions of vectors in two, three spaces, representation and simple properties of vectors, addition and subtraction of vectors, vector addition by the method of triangles, resolution of vectors into rectangular components, addition of vectors by components, addition of vectors by components, multiplication and differentiation of vectors. Scalar and vector product. **(4Hrs)**

Matrices and Determinants: Definition of matrix, types of matrices, viz. row matrix, column matrix, null matrix, square matrix, diagonal matrix, addition, subtraction and multiplication by a number, matrix multiplication. Transpose and adjoint of matrix, elementary transformation. Definition of determinant, properties of determinants, evaluation of determinants. Illustration or applications to group theory, problems from chemistry. **(8 Hrs)**

Elements of Algebraic and Trigonometric Functions

The binomial expansion, some example from chemistry, sines, cosines and tangents, trigonometric identities. **(3 Hrs)**

UNIT-II

Differential and Integral Calculus: Theory, rules of differentiation, powers, added and subtracted functions, constants, products, quotients, functions of a function, logarithmic differentiation, parametric functions. Algebraic simplification, differentiation of implicit functions, graphical significance of differentiation, rate of change of slope, successive differentiation. Examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution. Exact and inexact differential with their application to thermodynamic principles. Integral theory, basic rules of integration, integration by parts, partial fraction, and substitution. **(15 Hrs)**

UNIT-III

Graphical Representation of Equations: Rectangular coordinates, straight lines, slope and intercept of the equation, slope and point equation, two point equation, parallel lines, points of intersection, distance between two points, change of origin. **(3 Hrs)**

Partial Differentiation: The fundamental theorem, geometrical significance of partial differentiation, special cases of fundamental theorem, successive partial differentiation. Integral transforms (Fourier and Laplace). Reduction formulae, application to chemical problems. **(6 Hrs)**

Differential Equation: Simple differential equations, separable variables, homogeneous equations, exact equations, linear equations, equation of the first and second order, partial differential equation, application to physico-chemical problems. **(6 Hrs)**

Books Suggested

1. Mathematical Methods for Science Students, G. Stephemen, ELBS.
2. The Chemistry Mathematics Book, E. Stener, Oxford University Press.
3. Mathematics for Chemistry, Doggett and Sucliffe, Longman.
4. Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill.
5. Chemical Mathematics, D.M. Hirst, Longman.
6. Applied Mathematics for Physical Chemistry, J.R. Barrante, Prentice Hall.
7. Basic Mathematics for Chemists, Tebbutt, Wiley.
8. Differential equation, Schaum series, Tata McGraw Hill.
9. Elements of Partial Differential Equation, I.N.Sneddom, Tata McGraw Hill..
10. Advanced Engg. Mathematics, E Kreyszig, John Wiely & sons.
11. Mathematical Techniques, Jordan &Smith, Oxford University Press.

M.Sc. Chemistry I-Semester
Biology for Chemists

Paper No. CH-509 B **Credits: 03**
03 Hrs /week **External Marks: 70**
Total: 45 Hrs **Sessional Marks: 30**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of nine questions, three from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT - I

Cell Structure and Functions

Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes - catabolism and anabolism. ATP - the biological energy currency. **(4 Hrs)**

Carbohydrates

Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides - cellulose and chitin. Storage polysaccharides - starch and glycogen.

Structure and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid.

Carbohydrate metabolism - Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway. **(11 Hrs)**

UNIT - II

Lipids

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

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

Lipid metabolism - β-oxidation of fatty acids. **(8 Hrs)**

Proteins

Chemical and enzymatic hydrolysis of proteins to peptides, Secondary structure of proteins, forces responsible for holding of secondary structures. α-helix, β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein- folding and domain structure. Quaternary structure. **(7 Hrs)**

UNIT - III

Nucleic Acids and Genetic Code

Structure of nucleotides, nucleosides, DNA (Watson-Crick model) RNA structure and conformation, Replication of DNA, transcription, translation of genetic material, genetic code, universality of the code, codon, anticodon pairing, RNA, protein biosynthesis (initiation, elongation, termination and processing of the peptide chain). **(15 Hrs)**

Books Suggested

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

M.Sc. Chemistry I-Semester
Inorganic Chemistry Lab. - I

Paper No. CH-511 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. **Qualitative Analysis** **(40 Marks)**
   a) Less common metal ions- Tl, Se, Te, Mo, W, Ti, Zr, U&V
   b) Insolubles- Oxides (WO_3, Silica, Alumina); Sulphates (Lead Sulphate, Barium Sulphate Strontium Sulphate and Calcium Sulphate); Halides (Calcium fluoride and silver halides)
   (2 less common metal ions and 1 insoluble to be given)

2. **Water Analysis** **(30 Marks)**

   a. Determination of dissolved oxygen in a water sample.
   b. Determination of the amount of bleaching powder required to disinfect a water sample by Horrock's test.
   c. Determination of biochemical oxygen demand of a waste water sample.

3. **Viva-Voce** **(15 marks)**

4. **Note book/Practical file** **(15 marks)**

Books Suggested:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis, revised, G. Svehla, Longman.
3. Practical Inorganic Chemistry, Marr and Rocket.Applied Chemistry by O.P. Virmani and A.K. Narula, New Age International.

M.Sc. Chemistry I-Semester
Organic Chemistry Lab. - I

Paper No. CH-513 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Qualitative Analysis (40marks)

Separation and identification of compounds of binary mixture using water/$NaHCO_3$ and preparation of their suitable derivatives.

2. Organic Synthesis (30 marks)

Two step preparations

1. p-nitroacetanilide from aniline
2. p-bromoacetanilide from aniline
3. Anthranilic acid from phthalic anhydride
4. Eosin from phthalic anhydride

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 (15 marks)

4. Note book/Practical file (15 marks)

Books Suggested

1. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
6. Advanced practical chemistry, Jagdamba, Yadav and shrivastava, Pragati Prakasan
7. Advanced organic practical chemistry, J.N.Gurtu and R. Kappor, S. Chand
8. Advanced practical organic chemistry, N.K. Vishnoi, Vikas Publishing House

M.Sc. Chemistry I-Semester
Physical Chemistry Lab. - I

Paper No. CH-515 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Conductometry
(i) Determination of cell constant
(ii) NaOH vs. HCl titration.
(iii) NaOH vs. Oxalic acid titration

2. Potentiometry
(i) NaOH vs. HCl titration.
(ii) NaOH vs.Oxalic acid titration.

3. pH metry
(i) NaOH vs. HCl titration.
(ii) NaOH vs. Oxalic acid titration.

4. Thermochemistry
Determination of heat of neutralisation
(i) NaOH vs. HCl.
(ii) NaOH vs. CH_3COOH.
(iii) NaOH vs. Oxalic acid.

5. Chemical Kinetics
(i) To study kinetics of hydrolysis of an ester in the presence of acid

6. Refractometry
(i) Determination of molar refractivity of the given liquid.

7. Surface Tension
(i) To determine interfacial tension of the two immiscible liquids.

8. Adsorption
(i) Study the adsorption of Oxalic acid and Acetic acid on charcoal from aqueous solution

Experiments **(70 Marks)**
Viva-Voce **(15 marks)**
Note Book/Practical file **(15 marks)**

Books Suggested

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B. Levitt and Findley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Garland McGraw Hill.
6. Senior Practical Physical Chemistry, B.D. Khosla.
7. Advanced Practical Physical Chemistry, J. B. Yadav

M.Sc. Chemistry II-Semester
Inorganic Chemistry –II (Coordination Chemistry)

Paper No. CH-502 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Electronic Spectra of Transition Metal Complexes
Spectroscopic ground states, correlation and spin-orbit coupling in free ions for 1^{st} series of transition metals, Orgel and Tanabe-Sugano diagrams for transition metal complexes ($d^1 – d^9$ states) calculation of Dq, B and ß parameters, charge transfer spectra of complexes(both metal to ligand and ligand to metal). **(15Hrs)**

UNIT-II

Magnetic Properties of transition metal complexes
Elementary theory of magneto - chemistry, Guoy's method for determination of magnetic susceptibility, calculation of magnetic moments, magnetic properties of free ions, orbital contribution, effect of ligand-field, application of magneto-chemistry in structure determination, magnetic exchange coupling and spin state cross over. **(15 Hrs)**

UNIT-III

Reaction Mechanism of Transition Metal Complexes - I
Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions. **(15 Hrs)**

UNIT-IV

Reaction Mechanism of Transition Metal Complexes - II
Substitution reaction in square planar complexes, the trans effect, mechanism of the substitution reactions. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, inner sphere type reactions. **(8 Hrs)**

Metal-Ligand Equilibria in Solution
Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. **(7 Hrs)**

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huheey, HarperCollins.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
4. Magnetochemistry, R.L. Carlin, Springer Verlog.
5. Magnetochemistry, A. Earnshaw.
6. Inorganic chemistry, G. Wulf'sburg.
7. Introduction to ligand fields, B.N. Figgis, Wiley Eastern-IIed.

M.Sc. Chemistry II-Semester
Organic Chemistry–II (Structure & Mechanism in Organic Chemistry-2)

Paper No. CH-504 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Aliphatic Electrophilic Substitution

Bimolecular mechanisms – S_E2 and S_Ei. The S_E1 mechanism, Effect of substrates, leaving group and the solvent polarity on the reactivity.

Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity. The ortho/para ratio, ipso attack, orientation in other ring systems. Diazonium coupling, Vilsmeir reaction, Gattermann-Koch reaction. **(15 Hrs)**

UNIT-II

Aliphatic Nucleophilic Substitution

The S_N2, S_N1, S_Ni, mixed S_N1 and S_N2 and SET Mechanisms; neighbouring group participation by π and σ bonds; Classical and nonclassical carbocations, phenonium ions, norbornyl system, Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, ambident nuleophile, regioselectivity.

Aromatic Nucleophilic Substitution

The S_NAr, S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity – effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser, and Smiles rearrangements. **(15 Hrs)**

UNIT-III

Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction.

Elimination Reactions: Type of elimination reactions, E_1, E_2 and E_{cb} Mechanisms.

(15 Hrs)

UNIT-IV

Addition to Carbon-Carbon Multiple Bonds

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 and Stobbe reactions. Hydrolysis of esters and amides.

(15 Hrs)

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundburg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
5. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
6. Advanced Organic Chemistry: Reaction Mechanism, Reinhard Bruckner, Harcourt (India) Pvt. Ltd.
7. Organic reaction Mechanism, V K Ahluwalia and R K Prasher, Narosa Publishing House.
8. Organic Chemistry Vol -1 by Aditi Sangal from Krishna Publishers.
9. Organic reactions and their mechanisms by P S Kalsi New Age International Publishers.
10. Name Reactions Strategic Applications of Named Reactions in Organic Synthesis by Laszlo Kurti (Author), Barbara Czako from Elsevier.
11. Name Reactions and Reagents in Organic Synthesis by Bradford P. Mundy, Michael G. Ellerd and Frank G. Favaloro Jr. from Wiley.
12. Name Reactions: A Collection of Detailed Mechanisms and Synthetic Applications by Jie Jack Li from Springer.
13. The Art of Writing Reasonable Organic Reaction Mechanisms by Robert B. Grossman from Springer.

M.Sc. Chemistry II-Semester
Physical Chemistry –II (Kinetics, Quantum Mechanics and Spectroscopy)

Paper No. CH-506 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Quantum Mechanics: Postulates of Quantum Mechanics; formulation of Schrodinger wave equation; Max-Born interpretation of Ψ and the Heisenberg's uncertainty principle; Quantum mechanical operators and their commutation relation, Hermitian operators, (elementary ideas, quantum mechanical operator for linear momentum and angular momentum as Hermitian operator). The average value of the square of Hermitian operators; commuting operators and uncertainty principle(x & p; E &t); Schrodinger wave equation for a particle in one and three dimensional box; evaluation of average position, average momentum and determination of uncertainty in position and momentum and hence Heisenberg's uncertainty principle, pictorial representation of the wave equation of a particle in one dimensional box and its influence on the kinetic energy of the particle in each successive quantum level, lowest energy of the particle. **(15 Hrs)**

UNIT-II

Chemical Dynamics I: Effect of temperature on reaction rates, Rate law for opposing reactions of Ist order and IInd order, Rate law for consecutive Ist order reactions, Collision theory of reaction rates and its limitations, steric factor, Activated complex theory, Ionic reactions: single and double sphere models, influence of solvent and ionic strength, the comparison of collision and activated complex theory. **(15 Hrs)**

UNIT-III

Chemical Dynamics II: Chain reactions: hydrogen - bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane. Photochemical reactions (hydrogen - bromine & hydrogen-chlorine reactions). General treatment of chain reactions (ortho -para hydrogen conversion and hydrogen - bromine reactions), apparent activation energy of chain reactions, chain length, Rice-Herzfeld mechanism of organic molecules, decomposition(acetaldehyde) Branching chain reactions and explosions (H_2 - O_2 reaction). Kinetics of (one intermediate) enzymatic reaction : Michaelis - Menton treatment, evaluation of Michaelis's constant for enzyme-substrate binding by Lineweaver - Burk plot, by Dixon and by Eadie-Hofstae methods. Competitive and non-competitive inhibition. **(15 Hrs)**

UNIT-IV

Spectroscopy: Electromagnetic radiation, interaction of electromagnetic radiation with matter, regions of the Spectrum, the width and intensity of spectral transitions. Resolving power**.**

Rotational spectra: The rotation molecules, rotational spectra of diatomic molecules, the spectrum of non-rigid rotator, the effect of isotopic substitutions, rotational spectra of linear and symmetric top polyatomic molecules

Vibrational and Vibrational – Rotational Spectra: The vibrating diatomic molecule; simple harmonic vibrations, anharmonicity of vibrations, the diatomic vibrating rotator, the interaction of rotations and vibrations, the vibrations of polyatomic molecules, analysis by infrared technique.

Electronics Spectra: Electronic spectra of diatomic molecules, vibrational course structure, and rotational fine structure of electronic band, the Frank-Condon principle, intensity of vibrational-electronic band, dissociation energy, organic charge transfer complexes, the Fortrat diagram.

(15 Hrs)

Books Suggested

1. Physical Chemistry, P.W. Atkins, Oxford University Press.
2. Physical Chemistry, G.W. Castellan, Narosa. Publishers, New Delhi
3. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Pub.
4. Introductory Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
5. Quantum Chemistry, I.M. Levine, Prentice Hall.
6. Quantum Mechanics, M.L. Strause, Prentice – Hall
7. Quantum Chemistry, J. P. Lowe & K. Peterson, Academic Press (2005).
8. Theoretical Chemistry, Samual Glasstone Affiliated East-West Press.
9. Molecular Quantum Mechanics, P.W. Atkins & R.S. Friedman, 3rd Ed. Oxford University Press (1997).
10. Chemical Kinetics Methods, C. Kalidas, New Age International
11. Chemical Kinetics, K.J. Laidler, McGraw Hill.
12. Modern Spectroscopy, J.M. Hollas, John Wiley.
13. Chemical Applications of Group Theory, F.A. Cotton.
14. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
15. Basic Principles of Spectroscopy, G.M. Barrow, McGraw Hill.
16. Fundamentals of molecular spectroscopy, C. N. Banwell, Tata Macgraw Hill.
17. Physical Methods in Chemistry, R.S. Drago, Saunders College.

M.Sc. Chemistry II-Semester
Computer for Chemists

Paper No. CH-508 B **Credits: 03**
03 Hrs /week **External Marks: 70**
Total: 45 Hrs **Sessional Marks: 30**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of nine questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Computer Fundamentals: Functional components of a digital computer, concepts of hardware and software, binary, octal & hexadecimal number systems. Binary arithmetic, input/output and storage devices, overview of functions of operating system, types of operating systems, features of windows operating system.

MS Office: Word, Excel, Power Point, Equation, Math type.

Chem Office: Structure of molecules like proteins, DNA, RNA, Sugar, amino acids, heterocyclic compounds, chemical reactions (single step, two step & multistep) using Chemdraw.

Programming Fundamentals: Algorithms, flowcharts, linear and binary search algorithms, bubble sort algorithms. Matrix transpose, matrix addition and matrix multiplication algorithms and their applications. **(15 Hrs)**

UNIT-II

Programming in C: Character set, constants and variables, reserved words, data types, expressions, scanf and print statements, operators and their hierarchy, conditional, unconditional and loop control structures. One-dimensional and two-dimensional arrays. Functions.

(15 Hrs)

UNIT-III

Computer Application in Chemistry: Developing programs in C involving simple formulae in chemistry such as van der Waals equation, pH titration, kinetics, radio active decay, evaluation of lattice energy and ionic radii from experimental data. Linear simultaneous equation to solve secular equations within the Huckel theory. Elementary structural features such as bond lengths, bond angles, dihedral angles etc. of molecules extracted from a database such as Cambridge database. **(15 Hrs)**

Books Suggested

1. Introduction to Computer Science, P.K. Sinha
2. Let Us C, Yashwant Kanetker
3. Computational Chemistry, A.C. Norris.

M.Sc. Chemistry II-Semester
Inorganic Chemistry Lab. - II

Paper No. CH-510 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. **Quantitative Analysis** **(35 Marks)**
   a) Separation and determination of two metal ions such as Ag- Cu, Cu- Ni, Cu- Zn, Ni- Zn, Cu-Fe etc. involving volumetric and gravimetric methods.

   b) Determination of Ferrous, Oxalate, Nitrite etc. by Cerimetry **(15 Marks)**
2. Preparations (**20 Marks)**
   i. $V(acac)_3$
   ii. $Na[Cr(NH_3)_2(SCN)_4]$
   iii. $Mn(acac)_3$
   iv. Prussian Blue/Turnbull's Blue
   v. $Hg[Co(NCS)_4]$

3. Viva-voce **(15 marks)**

4. Note book/Practical file **(15 marks)**

Books Suggested:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis, revised, G. Svehla, Longman.
3. Practical Inorganic Chemistry, Marr and Rocket.

M.Sc. Chemistry II-Semester
Organic Chemistry Lab. - II

Paper No. CH-512 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Qualitative Analysis **(40 marks)**

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 **(30marks)**

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 **(15 marks)**

4. Note book/Practical file **(15 marks)**

Books Suggested

1. Experiments in Organic Chemistry" Lousis F. Fieser O.C. Heath and Company Boston, 1955.
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
3. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
4. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
5. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
6. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
7. Organic Spectroscopy, by William Kemp. John Wiley & Sons.
8. A Guide to spectroscopy in Organic Chemistry' by PAVY.
9. Advanced practical chemistry, Jagdamba, Yadav and shrivastava, Pragati Prakasan
10. Advanced organic practical chemistry, J.N.Gurtu and R. Kappor, S. Chand
11. Advanced practical organic chemistry, N.K. Vishnoi, Vikas Publishing House.

M.Sc. Chemistry II-Semester
Physical Chemistry Lab- II

Paper No. CH-514 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Conductometry
(i) NaOH vs. CH_3COOH titration.
(ii) $AgNO_3$ vs. KCl titration.
(iii) $Ba(NO_3)_2$ vs. Na_2SO_4 titration.

2. Potentiometry
(i) NaOH vs. CH_3COOH titration
(ii) $AgNO_3$ vs. KCl titration.
(iii) $KMnO_4$ vs. Mohr's Salt/$FeSO_4$ titrations

3. pH metry
(i) NaOH vs. CH_3COOH titration.

4. Thermochemistry
(i) Determination of Heat of solution and Heat of hydration of $BaCl_2$ and $CuSO_4$

5. Chemical Kinetics
(i) To compare the relative strength of acids (HCl and H_2SO_4)
(ii) To determine the temperature coefficient for the Ist order reaction.

6. Refractometry
(i) To determine percentage composition of liquids in the given binary mixture.

7. Distribution Law
(i) Determination of partition coefficient of benzoic acid between benzene and water
(ii) Determination of partition coefficient of iodine between carbon tetrachloride & water
(iii) Determination of equilibrium constant for $I_2 + I = I_3$

Experiments **(70 Marks)**
Viva-Voce **(15 marks)**
Note Book/Practical file **(15 marks)**

Books Suggested

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B. Levitt and Findley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Garland McGraw Hill.
6. Senior Practical Physical Chemistry, B.D. Khosla
7. Advanced Practical Physical Chemistry, J. B. Yadav

M.Sc. Chemistry III-Semester
Inorganic Special –I (Spectroscopic Techniques)

Paper No. CH-601 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT – I

Atomic Absorption Spectroscopy: Principle, instrumentation, applications, sensitivity and detection limits, interferences in AAS and their elimination.
Atomic Emission Spectroscopy: Principle, instrumentation and applications**,** Inductively Coupled Plasma (ICP), advantages over AES w.r.t. detection limit. **(15 Hrs)**

UNIT – II

Electron Spin Resonance Spectroscopy: Principle, Presentation of the spectrum, hyperfine coupling, hyperfine splitting in various structures, Factors affecting magnitude of g, zero field splitting and Kramer's degeneracy, Applications to transition metal complexes having one and more than one unpaired electron, applications to inorganic free radicals, study of electron exchange reactions. (**15 Hrs)**

UNIT-III

Mossbauer Spectroscopy: Basic Principles, spectral display, isomer shift, factors affecting the magnitude of isomer shift, quadrupole and magnetic hyperfine interaction, applications of technique to the study of bonding and structure of Fe^{2+}, Fe^{3+} ; Sn^{2+} and Sn^{4+} compounds; detection of oxidation states, nature of M-L bond. **(8 Hrs)**

Mass Spectrometry: Principle, representation, interaction of molecule with high energy electrons, Ionisation (EI, CI, MALDI, FAB) and Detection Techniques (magnet sector, quadrupole and TOF), interpretation of mass spectrum, effect of isotopes on appearance of mass spectrum; applications- finger print application, molecular weight determination, evaluation of heat of sublimation of high melting solids. **(7 Hrs)**

UNIT- IV

Electronic Spectroscopy:
UV-visible molecular absorption spectrometry (principle, instrumentation and applications), Frank-Condon Principle, Molecular luminescence spectroscopy (fluorescence, phosphorescence, chemiluminescence). **(15 Hrs)**

Books Suggested

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L. Ho, Wiley Interscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry, R.S. Drago, Saunders College.
5. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
6. Basic Principles of Spectroscopy, G.M. Barrow, McGraw Hill.
7. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
8. Fundamental of Instrumental Analysis, Skoog and West.
9. E. A. V. Ebsworth, D. W. H. Rankin and S. Cradock, Structural Methods in Inorganic Chemistry, 1st Edn.(1987), Blackwell Scientific Publications, Oxford, London.
10. Application of X-ray crystallography, L.S.Dent Glasser, ELBS.
11. Fundamentals of molecular spectroscopy, C. N. Banwell, Tata Macgraw Hill.
12. Basic Concept of Analytical Chemistry, S.M. Khopkar
13. Atomic Absorption Spectroscopy, J.W. Robinson
14. Analytical Chemistry, G.D. Christian

M.Sc. Chemistry III-Semester
Inorganic Chemistry Special –II (Group Theory and Vibrational Spectroscopy)

Paper No. CH-603 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

Unit – I

Molecular Symmetry: Symmetry elements and symmetry operations in molecules, matrix representation of symmetry operation, multiplication tables, point groups, Derivation of character tables (non-degenerate such as C_{2v}, C_{2h}), construction of representation using vectors and atomic orbital as basis- Representation generated by Cartesian coordinates positioned on the atoms of a molecule. **(15 Hrs)**

Unit – II

Molecular Vibration: The symmetry of normal vibrations, determining the symmetry types of the normal modes, cartesian coordinate and internal coordinate methods, selection rules for fundamental vibrational transitions (IR and Raman), illustrative examples. **(15 Hrs)**

Unit – III

Chemical Bonding: construction of hybrid orbitals (BF_3, CH_4, $PC1_5$ etc.), σ and π bonding, transformation properties of atomic orbitals, Symmetry species of hybrid orbitals, Illustrative examples from different geometries. **(15 Hrs)**

Unit – IV

Vibrational Spectroscopy: Principle of IR and Raman spectroscopies; applications of vibrational spectroscopy in investigating (i) symmetry and shapes of simple AB_2, AB_3,AB_4.AB_5 and AB_6 molecules on the basis of spectral data, (ii) mode of bonding of ambidentate ligands (thiocyanate, nitrate, etc) ethylenediamine and diketonate complexes, Principle and application of resonance Raman Spectroscopy particularly for the study of active sites of metalloproteins. **(15 Hrs)**

Books Suggested

1. F. A. Cotton, Chemical Applications of Group Theory, 3 Edn. (1999), John Wiley & Sons, New York.
2. G. L. Miessler and D. A. Tarr, Inorganic Chemistry, 2nd Edn. (1999), Prentice Hall International Inc., London.
3. K. Veera Reddy, Symmetry and Spectroscopy of Molecules, (1999) New Age International Pvt. Ltd., New Delhi.
4. A. Vincent, Molecular Symmetry and Group Theory, John Wiley & Sons (1977)

M.Sc. Chemistry III-Semester
Inorganic Chemistry Special –III (Bio-Inorganic Chemistry)

Paper No. CH-605 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT – I

Metal Ions in Biological Systems: General survey of essential and trace metals, Disturbing factors in metabolic process and causes of diseases, different classes of drugs. **(5 Hrs)**
Alkali and alkaline earth metals in biological systems: Ionophores, active transport of cations across membranes, sodium pump, Calcium pump, Calcium carriers, role of carriers in muscle contraction, blood clotting and hormones. **(7 Hrs)**
Interaction of metal ions with Nucleotides: metal ions in nucleotide systems, effect of metal ions on nucleic acids. **(3 Hrs)**

UNIT – II

Oxygen carriers: Porphyrins, metalloporphyrins, Hemoproteins, structure and functions of hemoglobin and myoglobin, synthetic oxygen carrier model systems **(6 Hrs)**
Nitrogen fixation: Biological nitrogen fixation, Nitrogenase, model for nitrogenase, metal-N_2 complexes, photosynthesis and chlorophyll. **(6 Hrs)**
Metal transport and storage: Transferrin, Ferritin, Siderophores **(3 Hrs)**

UNIT - III

Metalloenzymes- I

Zinc Enzymes – Carboxypeptidase & Carbonic anhydrase

Copper Enzymes – Superoxide dismutase, blue copper- proteins

Nickel Enzyme - Urease

UNIT – IV

Metalloenzymes- II

Coenzymes – Vitamins B_{12}

Iron Enzymes – Catalase, peroxidase, Cytochromes (cytochrome c, cytochrome c oxidase and cytochrome P- 450), non-heme iron-containing protein. **(15 Hrs)**

Books suggested

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentne, University Science Books.
3. Lippard, S. J. & Berg, J. M. Principles of Bioinorganic Chemistry Univ. Science Books (1994).
4. Lippard, S. J. Progress in Inorganic Chemistry Vols. 18 and 38, Wiley-Interscience (1991).
5. Enzo Alessio (Ed.), Bioinorganic Medicinal Chemistry, Wiley-VCH Verlag (2011).

M.Sc. Chemistry III-Semester
Inorganic Chemistry Lab. - III

Paper No. CH-607 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Preparation of selected Inorganic compounds/complexes and their characterization using techniques/methods such as elemental analysis, conductance measurement, molecular weight determination, magnetic susceptibility measurements, infrared, UV, visible, Mossbauer and ESR spectra etc. Handling of air and moisture sensitive compounds.

a. Chromous Acetate
b. $Hg[Co(SCN)_4]$
c. $Ni(dmg)_2$
d. $[Cu(NH_3)_4]SO_4.H_2O$
e. $[Ni(NH_3)_6]Cl$
f. $K_3[Fe(C_2O_4)_3]$

2. Viva-voce **(15 marks)**

3. Note book/Practical File **(15 marks)**

Books Suggested:

1. Synthesis and Characterization of Inorganic Compounds. W.L. Jolly, Prentice Hall.
2. Synthesis and Physical studies of Inorganic compounds C.F. Bell, Pergamon Press.
3. A Textbook of Quantitative Analysis. A.I. Vogel, ELBS, London.

M.Sc. Chemistry III Semester
Inorganic Chemistry Lab. – IV

Paper No. CH-609 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Instrumental Techniques **(70 Marks)**
   a. Estimation of metal ions by atomic absorption spectrophotometry and Flame Photometry (Li, Ca etc.)
   b. Spectrophotometric determination of Fe, Ni, Mn Cr, V and Nitrate and phosphate etc.
   c. Determination of pK value of an indicator Spectrophotometrically.
   d. Study of Complexation (Stoichiometry and stability constant) between Fe-thiocynate, Fe-Phenanthroline and Cu- ethylenediamine by Job's method/ slope ratio method.
   e. Polarographic determination of metal ions such as Mg, Tl, Zn, Cd etc.(including mixtures). Amperometric titrations.

2. Viva-Voce **(15 Marks)**
3. Record file **(15 Marks)**

Books Suggested:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis, revised, G. Svehla, Longman.
3. Practical Inorganic Chemistry, Marr and Rocket.
4. Applied Chemistry by O.P. Virmani and A.K. Narula, New Age International.

M.Sc. Chemistry III-Semester
Seminar-I (Inorganic Chemistry)

Paper No. CH-611 **Credits: 02**
02 Hrs /week **Max. Marks: 50**

Student will be required to give seminar on the topic allotted. Each group will consist of five students for the purpose of allocation of work load to the faculty.

M.Sc. Chemistry III-Semester
Organic Chemistry Special – I (Organic Spectroscopy)

Paper No. CH-613 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT - I

Ultraviolet and Visible Spectroscopy:

Introduction – Electronic energy levels, electronic transitions and selection rules. The origin, general appearance and designation of UV bands, absorption laws and measurement of absorption intensity, chromophores, auxochromes, bathochromic shift, hypsocromic shift, hypochromic effect, hyperchromic effect. The ultraviolet spectrometer-. Wood-ward and Fieser's rules for calculating ultraviolet absorption maxima for substituted dienes and conjugated dienes, unsaturated carbonyl compounds and aromatic carbonyl compounds. Application of UV spectroscopy to problems in organic chemistry. **(15 Hrs)**

UNIT - II

Infrared Spectroscopy:

Introduction – basic theory and instrumentation including FT IR infrared spectrum. Functional group and finger print regions. Absorption of infrared radiation and molecular vibrations. Fundamental vibrations and overtones. Intensity and position of infrared absorption bands, bands resulting from combination or difference of vibrational frequencies or by the interaction of overtones (or combination bands) with the fundamental vibrations (fermi resonance). Frequency of vibrations of a diatomic molecule, spectral features of major functional groups: alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams, conjugated carbonyl compounds and amines. Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. Applications of IR spectroscopy. **(15 Hrs)**

UNIT -III

Nuclear Magnetic Resonance Spectroscopy:

Introduction – spin active nuclei behave as spinning nuclear magnets, orientation of spinning nuclear magnets in a uniform magnetic field and energy description of NMR phenomenon, Continuous wave (CW) NMR spectrometer and Fourier transform (FT) NMR spectrometer. Phenomenon of resonance and relaxation, chemical shift , chemical shift parameters and internal standards, factors affecting the chemical shift: shielding and deshielding of a nucleus, substitution effects leading to empirical co-relations for proton chemical shifts, anisotropic effect, effect of changing solvents, effect of hydrogen bonding, influence of chirality on the chemical shifts of enantiomers and intermolecular Vander Walls deshielding, spin spin coupling, multiplicity of splitting and relative intensity of lines in a multiplet, integration, mechanism of

coupling-one bond coupling (^{1}J), two bond coupling (^{2}J) three bond coupling (^{3}J) including Karplus relationship. Techniques for simplification of complex spectra: solvent effects, Lanthanide shift reagents, spin decoupling (double resonance), Fourier Transform technique, Nuclear Overhauser effect (NOE). Effect of sensitivity of ^{13}C NMR compared to ^{1}H NMR, comparison of ^{13}C NMR and ^{1}H NMR, elementary discussion on natural abundance, chemical shifts and splitting in Carbon, nitrogen, fluorine and phosphorous NMR. Simplification of ^{13}C spectra by process of decoupling, off resonance decoupling. **(15 Hrs)**

UNIT -IV

Mass Spectroscopy:

Introduction – basic theory, instrumentation, process of introducing the sample into mass spectrometer. Methods of generation of positively charged ions, electron ionization method, chemical ionization, FD and fast atom bombardment (FAB) techniques. Mass spectrum, base peak, molecular and parent ion, Mass to charge ratio (M/Z), relative intensity, fragment ions, even electron rule, nitrogen rule, meta stable ions, McLafferty rearrangement and ortho effect. Determination of molecular weight and molecular formula using mass spectrometry

Optical Rotatory Dispersion (ORD) and Circular Dichroism (CD):
Definition, halo-keto rule, octant rule for ketones, Cotton effect and Cotton curves, deduction of absolute configuration. **(15 Hrs)**

Books suggested

1. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill, John Wiley.
2. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
3. Application of Spectroscopy of Organic Compounds, J.R. Dyer, Prentice Hall.
4. Spectroscopic Methods in Organic Chemistry, D.H. Williams, I. Fleming, Tata McGraw-Hill.
5. Organic Chemistry, William Kemp, John Wiley.
6. Organic Spectroscopy, Jag Mohan, Narosa Publishers, New Delhi
7. Introduction to spectroscopy by Donald L. pavia, Brooks cole 4th edition.

M.Sc. Chemistry III-Semester
Organic Chemistry Special – II (Natural Products-1)

Paper No. CH-615 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT - I

Carotenoids:

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

Vitamins

Structure and synthesis of vitamins A, B_1, B_2, B_6, C, nicotinic acid, pantothenic acid and Biotin **(15 Hrs)**

UNIT-II

Plant pigments:

Occurrence, general chemical and spectroscopic methods for structure determination.

Structure elucidation and synthesis of Flavone, chrysin, Flavonol, Quercetin, Diadazin, Xanthone, Euxanthone, Cyanidin chloride, Malvidin chloride, Hirsudin chloride. Biosynthesis of flavonoids: Acetate pathway and shikimic acid pathways.

Porphyrins:

Structural and spectral properties of porphyrins and Haemin. Structure of chlorophyll and Haemoglobin (without synthesis). **(15 Hrs)**

UNIT – III

Enzymes

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity. Nomenclature and classification (suitable examples of reactions). Fischer's lock & key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling. Enzyme reversible and irreversible inhibition. Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion.

Co-enzymes: Chemistry of Co-enzymes; Co-I, Co-II, Co-A, Co-carboxylase, FMN and FAD.

(15 Hrs)

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.

Kind of reaction catalyzed by enzymes: Oxidation – reduction, hydrolytic reactions, addition and elimination reactions, Formation of C-C bond (aldol Reactions). **(15 Hrs)**

Books suggested

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Principles pf Organic Synthesis, R. Norman and J. M. Coxon,Blakie, Academic and Professional.
3. Fundamental of Photochemistry, K.K. RohtagiMukherjee,Wiley Eastern.
4. Medicinal chemistry, 4th Edition, A. Burger, Wiley Interscience.
5. Text Book of organic medicinal and Pharmaceutical chemistry, 8th Edition, R.F. Boerge, Ed. Wilson and Gisvelds, J.B. Lippincott Co.
6. Natural Products, their chemistry and biological significance. J. Mann, R. S. Davidson,
7. J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longmann, Essex, 1994.Medicinal Biochemistry, N. V. Bhagavan, Academic Press, Elsevier.
8. Natural Product Synthesis II: Targets, Methods, Concepts. Topics in Current Chemistry, 24thEd. Edited by Johann Mulzer (Universität Wien). Springer: Berlin, Heidelberg, New York.2005.
9. Natural Products from Plants 2nd ed., Cseke: National Scientific Book Agency, Delhi.
10. Biotransformations in Organic Chemistry 5th Edition by Kurt Faber from Springer.
11. Bio-organic Chemistry by Vinay Prabha Sharma from Pragati Edition.
12. Chemistry of Natural Products Vol-1 & 2 by O P Aggarwal from Krishna Prakashan.

M. Sc. Chemistry III-Semester
Organic Chemistry Special – III (Heterocyclic Chemistry)

Paper No. CH-617 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT – I

Heterocyclic Compounds: General behaviour, Classification & Nomenclature, Criteria of aromaticity.
Five membered Heterocycles: Synthesis and reactions of 1, 3-Azoles: Imidazole, Thiazole and Oxazole **(15 Hrs)**

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. **(15 Hrs)**

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. **(15 Hrs)**

UNIT - IV

Protecting Group Chemistry:

Role of Protective groups in organic synthesis, Protection of Hydroxy group (1,2 and 1,3 diols), Phenols (Esters& ethers), Protection of amino group (carbamates) and Protection of carbonyl group (acetal and ketal) **(15 Hrs)**

Books Suggested

1. Carey, F.A. & Sundberg, R. J. Advanced Organic Chemistry, Parts A & B, Plenum: U.S.
2. (2004).
3. Carruthers, W. Modern Methods of Organic Synthesis Cambridge University Press (1971).
4. Acheson, R. M. Introduction to the Chemistry of Heterocyclic Compounds John Wiley & Sons (1976).
5. Finar, I. L. & Finar, A. L. Organic Chemistry Vol. 2, Addison-Wesley (1998).
6. Finar, I. L. Organic Chemistry Vol. 1, Longman (1998).
7. Protective groups in organic synthesis by Greene and Wuts from John Wiley & sons.
8. Chemistry of natural products Vol 1 and 2 by O P Aggarwal from Goel Publication.
9. Heterocyclic Chemistry Vol 1, 2, & 3 by Gupta, Kumar & Gupta from Springer.

M.Sc. Chemistry III-Semester

Organic Chemistry Lab. –III

Paper No. CH-619 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

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

(a) Multi-step synthesis: - **(40 marks)**

(i) Benzanilide from benzene
(ii) 6-Nitro-4-methyl-7-hydroxy coumarin from ethyl acetate
(iii) α-Acetylaminocinnamic acid from glycine
(iv) Acridone from anthranilic acid

(b) Isolation **(30 marks)**

(i) Caffeine from tea leaves
(ii) Lactose and casein from milk
(iii) Cystine from human hair

2. Viva-Voce **(15 marks)**

3. Note Book **(15 marks)**

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

Books Suggested

1. Experiments in Organic Chemistry" Lousis F. Fieser O.C. Heath and Company Boston, 1955.
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
3. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
4. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
5. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
6. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
7. Organic Analytical Chemistry, Jag Mohan, Narosa Publishers, New Delhi
8. Advanced Practical organic Chemistry N.K. Vishnoi, Vikas Publishing House.

M.Sc. Chemistry III-Semester
Organic Chemistry Lab. – IV

Paper No. CH-621 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

Quantitative Analysis

1. Titrimetric Method **(35 Marks)**

(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

2. Spectrophotometric (UV/VIS) Estimations **(35 Marks)**

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

3. Viva-Voce **(15 marks)**

4. Note Book **(15 marks)**

Note-1. Department can opt any other similar experiment depending upon the material available.

Books Suggested

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

M.Sc. Chemistry III-Semester
Seminar-I (Organic Chemistry)

Paper No. CH-623 B **Credits: 02**
02 Hrs /week **Max. Marks: 50**

Student will be required to give seminar on the topic allotted. Each group will consist of five students for the purpose of allocation of work load to the faculty.

M.Sc. Chemistry III-Semester
Physical Chemistry Special –I (Electrochemistry and Solid State Chemistry)

Paper No. CH-625 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Electrifield 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 of electrified interfaces.

(15 Hrs)

UNIT –II

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. Some general and special cases of Butler-Volmer equation, the high-field and low-field approximations, physical meaning of the symmetry factor (ß), a preliminary to a second theory of ß, a simple picture of the symmetry factor and its dependence on overpotential. Polarizable and non-polarizable interfaces. **(15 Hrs)**

UNIT –III

Solid State: Crystal structure of solids: Fundamental of lattices, unit cell, atomic coordinates, Bravais lattices, structure types – NaCl, ZnS, CsCl, Miller indices, Crystal diffraction by X-rays, Neutrons and Electrons; Braggs Law, Structure determination by X-ray diffraction, Powder and single crystal methods. Band theory of solids. **(15 Hrs)**

UNIT –IV

Ionic Liquids: The thermal dismantling of an ionic lattice, characteristics of ionic liquids, the fundamental problems in the study of pure liquid electrolytes, models of simple ionic liquids: lattice oriented models (the vacancy model, the hole model), quantification of the hole model, the Furth approach to the work of hole formation, distribution function for the sizes of the holes and the average size of a hole. **(15 Hrs)**

Books Suggested

1. Electrochemistry-by Glasstone
2. Modern Electrochemistry vol.1 and vol 2A, 2B, 2B J.O.M.Bockris and A.K.N.Reddy, Plenum.
3. Principles of Electrochemistry, Koryta, J., Dvorak, J. & Kavan, L., John Wiley, NY (1993)
4. Electrochemical Methods: Fundamentals and Applications, Bard, A. J. Faulkner, L. R. 2nd Ed., John Wiley: New York, 2002
5. An Introduction to Crystal Chemistry; R.C. Evans, Cambridge University Press.
6 Introduction to solid state Physics; C.Kittel, Wiley New York.
7 Solid State Chemistry; N.B. Hannay; Prentic
8 L.V. Azaroff, Introduction to Solids, (1977) Tata McGraw-Hill, New Delhi.

M.Sc. Chemistry III-Semester
Physical Chemistry Special –II (Quantum Chemistry)

Paper No. CH-627 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Angular Momentum : Angular momentum, angular momentum operators in cartesian coordinates, eigen function & eigen values, commutation relation between angular momentum operators (L_x,L_y , L_z , L^2), total orbital angular momentum and spin angular momentum, commutation relation between components of total orbital angular momentum and spin angular momentum, ladder operators, commutators of [L^2, L_+] and [L^2 , L_-], application of ladder operators to an eigen function of L_Z. **(15 Hrs)**

UNIT –II

Quantum Mechanics I: Schrodinger wave equation for a particle in a three dimensional box and the concept of degeneracy of energy levels. Schrodinger wave equation for linear harmonic oscillator, solution by polynomial method, zero point energy and its consequence. Schrodinger wave equation for three dimensional Rigid rotor, energy of rigid rotor, space quantization; Schrodinger wave equaqtion for hydrogen atom, separation of variable in polar spherical coordinates and its solution. Principle, azimuthal and magnetic quantum numbers and the magnitude of their values, probability distribution function, radial distribution function and shape of atomic orbitals (s,p & d). **(15 Hrs)**

UNIT - III

Quantum Mechanics II: Quantum mechanical treatment of Helium atom and the failure of rigorous quantum mechanical method, need of approximate methods, first order perturbation theory (excluding time dependent), variation principle. Application of first order perturbation and variation principle to evaluate ground state of helium atom. Applicability of perturbation theory to an electron in a one dimensional box under the influence of electric field. **(15 Hrs)**

UNIT – IV

Quantum Mechanics III: Valance bond method, valance bond method to hydrogen, hydrogen molecule ion (their symmetric and anti symmetric solution without actual valuation of various integrals, energy of molecular hydrogen system, LCAO-MO approximation, refined treatment of hydrogen molecules Concept of resonance and its role in the stability of hydrogen molecule ion, electron spin, pauli's exclusion principle, hybridization. **(15 Hrs)**

Books Suggested

1. Quantum Chemistry, I.N. Levine, Prentice Hall of India
2. Quantum Chemistry, A.K. Chandra, Tata McGraw Hill
3. Chemical Application of Group Theory, F.A. Cotton Interscience.
4. Methods in Molecular Orbital Theory, A.G. Turner, Prentice Hall of India
5. Group Theory and Symmetry in Chemistry, L.H. Hall, McGraw Hill.
6. Symmetry and Spectroscopy of Molecules, K.V. Reddy, New Age International
7. Quantum Chemistry by J. P. Lowe.

M.Sc. Chemistry III-Semester
Physical Chemistry Special –III (Molecular Spectroscopy)

Paper No. CH-629 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT - I

Symmetry and Group Theory in Chemistry: Symmetry elements & symmetry operation group and its properties, Multiplication table, point symmetry groups. Schonflies symbol, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh} etc. groups to be worked out explicity) Irreduceable representation of groups, the great orthogonality theorem (without proof) & its importance, character tables and their use in spectroscopy. (**15 Hrs)**

UNIT - II

Electronic Spectroscopy of Polyatomic Molecules : Free electron model, spectra of carbonyl group, spectra of ethene, n-$\pi*$ and π- $\pi*$ transitions, spectra of benzene , spectra of transition metals, charge-transfer transition, fluorescence phosphorescence.

Raman Spectroscopy : Quantum theory of Raman effect, Classical theory of Raman effect, Pure rotational Raman spectra, Raman activity of vibrations, vibrational Raman spectra, polarization of light and Raman effect, applications. **(15 Hrs)**

UNIT - III

Spin Resonance Spectroscopy: Spin and an applied field; the nature of spinning particles, interaction between spin and magnetic field, Larmor precession, population of energy levels. Nuclear MagneticResonance Spectroscopy; Hydrogen Nuclei, the chemical shift, the coupling constant, coupling between several nuclei, analysis by NMR technique, exchange phenomena, simplication of complex spectra. **(15 Hrs)**

UNIT - IV

Electron spin resonance spectroscopy; the theory of E.S.R. the position of E.S.R. absorption, the g factor, the fine and hyperfine structures of E.S.R. absorption. Applications of E.S.R. spectroscopy.

Moss Bauer Spectroscopy: The theory of Moss-Bauer spectroscopy, the chemical shift quadrupole effects, the effect of magnetic field, application of Moss-Bauer spectroscopy. **(15 Hrs)**

Books Suggested

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L. Ho, Wiley Interscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry, R.S. Drago, Saunders College.
5. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
6. Basic Principles of Spectroscopy, G.M. Barrow, McGraw Hill.
7. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
8. Fundamental of Instrumental Analysis, Skoog and West.
9. Inorganic Chemistry, J.E.Huheey, Harper Collins.
10. Application of X-ray crystallography, L.S.Dent Glasser, ELBS.
11. Fundamentals of molecular spectroscopy, C. N. Banwell, Tata Macgraw Hill.
12. Chemical Application of Group Theory, F.A. Cotton Interscience.
13. Methods in Molecular Orbital Theory, A.G. Turner, Prentice Hall of India
14. Group Theory and Symmetry in Chemistry, L.H. Hall, McGraw Hill.
15. Symmetry and Spectroscopy of Molecules, K.V. Reddy, New Age International
16. A. Vincent, Molecular Symmetry and Group Theory, John Wiley & Sons (1977)

M.Sc. Chemistry III-Semester
Physical Chemistry Lab. – III

Paper No. CH-631 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. **Conductometry**

(i) NaOH vs. oxalic acid
(ii) NaOH vs. (HCl + CH_3COOH) mixture
(iii) NaOH vs. (HCl + CH_3COOH + $CuSO_4$ mixture.
(iv) $AgNO_3$ vs. (KCl + KI) mixture

2. Distribution Law

(i) Determination of partition coefficient of benzoic acid between benzene and water

3. Polarography

(i) Determination of half wave potential of Pb^{2+} , Cd^{2+} , Co^{2+}, Zn^{2+} , Mn^{2+} , Ni^{2+}

4. Turbidimetry

(i) Determination of concentration of sulphate ions in the given solution.

5. Ultrasonic Interferrometry

(i) Determination of speed of sound for various liquids.

6. Dipole metry

(i) To determine the dielectric constant of various liquids

7. Polarimetry

(i) Determination of specific rotation for optically active substance
(ii) Estimation of concentration of optical active substance in the given solution

8. Spectrocolorimetry

(i) To test the validity of Lambert Beer's Law for $KMnO_4$ and $K_2Cr_2O_7$ in H_2SO_4

9. Viscosity

(i) To study the variation of viscosity of a liquid with composition of the mixture of liquids.

Experiments **(70 Marks)**
Viva-Voce **(15 marks)**
Note Book/Practical file **(15 marks)**

Books Suggested

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B. Levitt and Findley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Garland McGraw Hill.
6. Senior Practical Physical Chemistry, B.D. Khosla
7. Advanced Practical Physical Chemistry, J. B. Yadav

M.Sc. Chemistry III-Semester
Physical Chemistry Lab. – IV

Paper No. CH-633 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. pH metry

(i) NaOH vs. H_3PO_4

(ii) NaOH vs. (HCl + CH_3COOH) mixture

(iii) NH_4OH vs. HCl

(iv) NH_4OH vs. CH_3COOH

2. Chemical Kinetics

(i) Saponification of ethyl acetate.

(ii) Determination of activation energy for the hydrolysis of ethyl acetate in presence of acid.

3. Refractometry

(i) Determination of molar refractivity of the given liquid.

4. Surface Tension

(i) To determine interfacial tension of the two immiscible liquids.

5. **Adsorption**

(i) To study the adsorption of Oxalic acid and Acetic acid on charcoal from aqueous solution

6. Potentiometry

(i) NaOH vs. H_3PO_4 titration.

(ii) NaOH vs. (HCl + CH_3COOH) mixture

(iii) $K_2Cr_2O_7$ vs. Mohr's salt vs. $FeSO_4$

(iv) $AgNO_3$ vs. KCl titration.

Experiments **(70 Marks)**
Viva-Voce **(15 marks)**
Note Book/Practical file **(15 marks)**

Books Suggested

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B. Levitt and Findley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Garland McGraw Hill.
6. Senior Practical Physical Chemistry, B.D. Khosla
7. Advanced Practical Physical Chemistry, J. B. Yadav

M.Sc. Chemistry III-Semester
Seminar - I (Physical Chemistry)

Paper No. CH-635 B **Credits: 02**
02 Hrs /week **Max. Marks: 50**

Student will be required to give seminar on the topic allotted. Each group will consist of five students for the purpose of allocation of workload to the faculty.

M.Sc. Chemistry III-Semester
Inorganic Chemistry Elective–I (Nuclear and Electroanalytical Chemistry)

Paper No. CH-651 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Nuclear Binding Energy: Justifications and applications; nuclear stability rules and decay of unstable nuclei.

Nuclear Structure: Nuclear forces; liquid drop model, Shell Model and collective model.

Interaction of Radiation with matter: Physical and chemical effects of radiation on matter (photoelectric effect, Compton effect and pair production). **(15 Hrs)**

UNIT – II

Nuclear Reactions: Energetics of nuclear reactions; various types of nuclear reactions including photonuclear, thermonuclear and spallation reactions; mechanism of nuclear reaction by compound nucleus model.
Nuclear fission: Fission probability; energy release; theories of fission.
Nuclear Fusion: Brief idea about breeder reactors; accelerators and cyclotron.

(15 Hrs)

UNIT - III

Polarography: Basic principles, residual current, migration current, diffusion current and limiting current, saturated calomel electrode(SCE) and dropping mercury electrode (DME). Ilkovic equation, Koutecky equation for diffusion current (derivation excluded), Polarographic waves(anodic and cathodic), Half wave potentials. Oxygen interference, maxima, function of supporting electrolyte,

(15 Hrs)

UNIT – IV

Amperometry: Principles of Amperometric titrations, types of titration curves, apparatus and techniques, Determination of stability constants of complexes (reversible systems only) by D.C.Polarography, Qualitative and quantitative applications of polarography. Principle, Techniques and applications of Coulometry. **(15 Hrs)**

Books Suggested

1. Harvey, B. C. Introduction to Nuclear Chemistry Prentice-Hall (1969).

2. Friedlander, G. Kennedy, J. W., Marcus, E. S. & Miller, J. M. Nuclear & Radiochemistry, John Wiley & Sons (1981).

3. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th Edition (1995), Wiely-Eastern Ltd., New Delhi.
4. Christian, G. D., *Analytical Chemistry,* 6th Ed., John Wiley & Sons, Inc. (2004).

5. Skoog, D. A., West, D. M., Holler, R. J & Nieman, T. A. *Principles of Instrumental Analysis* Saunders Golden Sunburst Series (1997).

6. Willard, H. H., Merritt, L. L., Dean, J. A. & Settle, F. A. (Eds.) *Instrumental Methods of Analysis* - 7th Ed., Wadsworth Publishing (1988) ISBN 0534081428

7. Khopkar, S. M. *Concepts in Analytical Chemistry* Halsted (1984).

8. Polarographic Technique, Louis & Mites

9. Introduction to Polarography, Kamla Jutshi, New Age International

10. Principles of Polarography, Kapoor & Aggarwal, New Age International.

M. Sc. Chemistry III-Semester
Organic Chemistry Elective-I (Polymer Chemistry)

Paper No. CH-653 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT – I

Basics of Polymer Chemistry Classification and nomenclature, mechanism of polymerization: - Step Growth, Chain growth Step growth (Radical, Anionic, Cationic), Co-ordination polymerization (Ziegler-Natta Catalysis), Ring opening and co-polymerization. **(15 Hrs)**

UNIT-II

Average Mol Wt (Number Average, Weight Average, Z-Average), Mol Weight distribution and polydispersity, degree of polymerization, radius of gyration, polymerization techniques:-Bulk, Solution, Suspension and emulsion polymerization **(15 Hrs)**

UNIT – III

Molecular weight determination methods- Viscosity, Osmometery, Light scattering End group analysis, GPC and MALDI.

Characterization of polymers:- Applications of NMR , UV and IR in characterization, Thermal Methods-Crystalline melting point, Glass Transition Temp., TGA, DTA and DSC. **(15 Hrs)**

UNIT – IV

Conducting Polymers

Introduction, classification, preparation and properties conducting polymers, electrically and electronically conducting polymers, factors affecting the conductivity of conducting polymers, electrochemical polymerization, doping of polymers and its significance.

Polymer processing

Introduction to - Extrusion, Injection molding, Blow molding, Compression molding and Calendaring and applications of commercial polymers (PE, PMMA, PP, PS). **(15 Hrs)**

Books Suggested

1. Principles of polymerisation by George Odian, Willey, 3rd edition.
2. Polymer characterization, physical techniques by D.campbell and J.R.White, Champman and Hall.

3. Text book of Polymer Science, F.W. Billmeyer, Willey, 3rd edition.
4. Plastic material by J.A. Brydson, Butterworth- Heinemann, 7th edition.
5. Polymer chemistry by C.E. Carraher, Jr. Marcel Dekker, 6th edition.
6. A practical guide to understanding the NMR of polymers by Peter A. Mirau.
7. Polymer: Polymer Characterization and analysis by jaquieline I Kroschwitz. Wiley Interscience.
8. Spectrometric identification of organic compounds by R.M. Silverstein and F.X. Webster, Wiley Interscience.
9. Principles of Polymer Processing by Zehev Tadmor, Costas G. Gogos Willey,2nd edition
10. Introduction to Thermal Analysis, by Michael E. Brown, Kluwer Academic.
11. Thermal Characterisation of Polymeric Materials by Edith A. Turi, 2nd edition, Vol. 1-2.
12. Handbook of polymer technology by Vishnu Shah, willey interscience.
13. Injection moulding of plastic components by John brown, MGH
14. Polymer chemistry by Paul C. Heimenz, marcel-Dekker Inc.
15. Material Science and engineering by V. Raghavan, PHI learning 5th edition.
16. Handbook of conducting polymers by Terje A. Skotheim, M. Dekker 3rd edition.

M.Sc. Chemistry III-Semester
Physical Chemistry Elective-I (Semiconductors and Nanomaterials)

Paper No. CH-655 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Semiconductors: The structure of semiconductor-electrolyte interface, band theory of crystalline solid, conductors, insulators, semiconductors, Garrette-Brattain space charge, the differential capacity due to the space charge, impurity, semiconductors(n-type and p-type semiconductors) , the semiconductor analogue of interface, contact adsorption, electrode kinetics involving the semiconductor-solution interface, negligible surface states, the use of n- and p- semiconductors for thermal reactions, intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions.

Magnetic Materials: Classification of magnetic materials: Quantum theory of paramagnetics - cooperative phenomena - magnetic domains, Hysteresis. Organic solids: Electrically conducting solids, organic charge transfer complexes, organic metals, new superconductors. **(15 Hrs)**

UNIT –II

Semiconductor nanoparticles Synthesis: Cluster compounds, quantum-dots from MBE and CVD, wet chemical methods, reverse micelles, electro-deposition, pyrolytic synthesis, self-assembly strategies,solgel,spin coating dip coating and LB Coating. **(15 Hrs)**

UNIT III

Semiconductor nanoparticles: size–dependant physical properties, Melting point, solid-state phase transformations, excitons, band-gap variations-quantum confinement, effect of strain on band-gap in epitaxial quantum dots, single particle conductance. **(15 Hrs)**

UNIT IV

Semiconductor nanoparticles – applications: Optical luminescence and fluorescence from direct band gap semiconductor nanoparticles, surface-trap passivation in core-shell nanoparticles, carrier injection, polymer-nanoparticle, LED , electroluminescence, barriers to nanoparticle lasers, doping nanoparticles. **(15 Hrs)**

Books Suggested

1. Bockris and Reddy- "Modern electrochemistry"- Springer 2nd Edition volumes 1, 2A and 2B
2. Encyclopedia of Nanotechnology- Hari Singh Nalwa
3. Springer Handbook of Nanotechnology - Bharat Bhusan
4. Handbook of Semiconductor Nanostructures and Nanodevices Vol 1-5- A. A. Balandin, K. L. Wang.
5. Nanostructures and Nanomaterials - Synthesis, Properties and Applications - Cao, Guozhong.

M.Sc. Chemistry IV-Semester
Inorganic Special – IV (Organometallic Chemistry)

Paper No. CH-602 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT - I

Organometallic Chemistry of transition metal complexes: Electron count, application of 18-electron rule. Preparation and properties (Bonding modes, IR Spectra) of transition metal carbonyls and nitrosyls.
Alkyls and Aryls of Transition Metals: Types, routes of synthesis, stability and their decomposition pathways, **(15 Hrs)**

UNIT - II

Transition Metal p–Complexes: Transition metal p–complexes with unsaturated molecules-alkenes, alkynes, allyl, & arenes and Cp (metallocene) complexes: preparation, properties and nature of bonding (MO picture) and structural features, important reactions related to nucleophilic and electrophilic attack on ligands and to organic synthesis. **(15 Hrs)**

UNIT – III

Compounds of Transition Metal-Carbon Multiple Bonds: Transition metal- carbene complexes: Fischer type and Schrock type carbene complexes: synthesis, reactions and structures & bonding; Transition metal-carbyne complexes: synthesis, reactions and structural features.

Fluxional Organometallic Compounds: Fluxionality & dynamic equilibria in compounds such as acyclic alkenes,s -bonded and p–bonded cyclic alkenes, rotation of ligands on metals, ligand scrambling on metals. **(15 Hrs)**

UNIT - IV

Catalysis by transition metal organometallics: Oxidative addition, reductive elimination and Insertion reactions.

Zeigler-Natta polymerization; homogeneous catalytic hydrogenation; alkene hydrogenation-Wilkinson Catalyst; Oxidation of olefins-Wacker's process; hydroformylation of olefins – the oxo process; Monsanto process. **(15 Hrs)**

Books Suggested

1. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley.
3. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.
4. Organometallics, A. Salzer, Ch. Elschenbrioch.VCH Publications.
5. Basic Organometallic Chemistry: Concepts, Syntheses, and Applications of Transition Metals; B. D. Gupta and A. J. Elias, University Press.

M. Sc. Chemistry IV-Semester
Inorganic Special – V (Inorganic Solids, Polymer and Cluster Compounds)

Paper No. CH-604 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT – I

Crystallography: Crystal structure of solids: Fundamental of lattices, unit cell, atomic coordinates, Bravais lattices, types of close packing, packing efficiency, radius ratios; structure types – NaCl, ZnS, Na_2O, $CdCl_2$, wurtzite, nickel arsenide, CsCl, CdI_2, rutile and Cs_2O, perovskite ABO_3, K_2NiF_4 and spinels. **(15 Hrs)**

UNIT - II

X-Ray Diffraction: Crystal diffraction by X-rays, Neutrons and Electrons; Braggs Law, Structure determination by X-ray diffraction, Powder and single crystal methods. Band theory of solids. **(15 Hrs)**

UNIT - III

Inorganic Polymers: Introduction, Preparation and properties of inorganic polymers based on Phosphorus, Sulfur, Silicone and Boron. Synthetic Co-ordination polymers, polymers with cyclopentadienyl rings, Chelating ligands **(15 Hrs)**

UNIT - IV

Metal Clusters: Introduction, Carbonyl clusters (Low and high nuclearity), Structure, Electron counting scheme, Wade's rules, Zintl ions, Chevrel phases. **(15 Hrs)**

Books Recommended

1. A.R. West, Solid State Chemistry and its Applications, (1984) John Wiley and Sons, Singapore.
2. L.V. Azaroff, Introduction to Solids, (1977) Tata McGraw-Hill, New Delhi.
3. L. Smart &E. Moore, Solid State Chemistry: An Introduction, CRC Press.
4.P. B. Saxena, Inorganic Polymers, Discovery Publishing House, New Delhi (2007).
5. R. De Jaeger, M. Gleria, Inorganic Polymers, Nova Science Publishers (2007).
6. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
7. Inorganic Chemistry, J.E. Huheey, HarperCollins.

M. Sc. Chemistry IV-Semester
Inorganic Special – VI (Inorganic Medicinal Chemistry)

Paper No. CH-606 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT - I

Metals in Medicine: Biochemical bases of essential metal deficient diseases; Iron, copper and zinc deficiencies and their therapies,

Heavy metals in Biological systems: Toxicity of heavy metals – and their detoxification, role of Selenium in Biological systems with reference to its essentiality and toxicity, mechanism of metal ion induced toxicity, interaction between orally administered drugs and metal ions in gut. **(15 Hrs)**

UNIT - II

Anticancer Agents: Carcinogens and carcinostatic agents, zinc in tumour growth and inhibition, anticancer activity and mechanism of platinum complexes, anticancer activity of Rhodium, copper and Gold complexes, anti cancer activity of Selenium, antibacterial and antiviral properties of metal complexes, polyamino carboxylic acids and polyethylene amines as chelating drugs. Boron Neutron Capture Therapy. **(15 Hrs)**

UNIT – III

Biomedical Applications of Metal-Containing Luminophores: Transition-Metal Containing Luminescent Agents, Photophysical Properties of Transition Metal Complexes (Ruthenium (II), Iridium (III), Rhenium (I) complexes and Lanthanide based luminophores).

Miscellaneous applications of Inorganic compounds as medicines: Drugs in hypo and hyper activity of thyroids, Inorganic drugs in dental carries, clinical disorders of alkali and alkaline earth metals and their remedies, lithium drugs in psychiatry. **(15 Hrs)**

UNIT – IV

Ligand Therapy: Ligand induced toxicity, interference with haemoglobin in oxygen transport system, intefererence with metallo-enzymes, beneficial effects of ligand chelation; carcinogenic ligands, carcinostatic ligands, alkylating agents as anticancer drugs, Thiosemicarbazones as anticancer drugs, macrocyclic antibiotic ligands and prodable mechanism of the drug, antiviral activity of chelating agents, aspirin chelation, drugs where chelation and therapeutic activity are unrelated. **(15 Hrs)**

Books Suggested

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentne, University Science Books
3. Metallotherapeutic drugs and metal-based diagnostic agents: the use of .metals in medicine, Marcel Gielen, Edward R. T. Tiekink
4. Enzo Alessio (Ed.), Bioinorganic Medicinal Chemistry, Wiley-VCH Verlag (2011).

M.Sc. Chemistry IV-Semester
Inorganic Chemistry Lab. – V

Paper No. CH-608 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Preparation of selected Inorganic compounds/complexes and their characterization using techniques/methods such as elemental analysis, conductance measurement, molecular weight determination, magnetic susceptibility measurements, infrared, UV, visible, Mossbauer and ESR spectra etc.
2. Synthesis of following compunds:
   (i). $VO(acac)_2$
   (ii). $Mn(acac)_3$
   (iii). $[Co(NH_3)_5Cl]Cl_2$; $[Co(NH_3)_5NO_2]Cl_2$; $[Co(NH_3)_5ONO]Cl_2$
   (iv). $K_3[Al(C_2O_4)_3]$
   (v). $[Ni(en)_3]S_2O_3$ etc. **(70 Marks)**

2. Viva-Voce **(15 Marks)**
3. Notebook/Practical file **(15 Marks)**

Books Suggested:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis, revised, G. Svehla, Longman.
3. Practical Inorganic Chemistry, Marr and Rocket.
4. Applied Chemistry by O.P. Virmani and A.K. Narula, New Age International.

M.Sc. Chemistry IV-Semester
Inorganic Chemistry Lab. – VI

Paper No. CH-610 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Separation of cations and Anions by Column Chromatography- Ion exchange.

2. a) Conductometrically – Composition of mixture of weak and strong acids, precipitation and displacement titrations.

   b) pH – metry – Composition of mixture of strong and weak acids, pKa value of organic acids.

   c) Potentiometry- redox titrations, precipitations, simultaneous determination of Halide ions.

   d) Ion – selective electrodes- F, Ca, Na, K etc.

2. Viva-voce **(15 marks)**

3. Note book/Practical File **(15 marks)**

Books Suggested:

1. Synthesis and Characterization of Inorganic Compounds. W.L. Jolly, Prentice Hall.
2. Synthesis and Physical studies of Inorganic compounds C.F. Bell, Pergamon Press.
3. A Textbook of Quantitative Analysis. A.I. Vogel, ELBS, London.

M.Sc. Chemistry IV-Semester
Seminar-II (Inorganic Chemistry)

Paper No. CH-612 B **Credits: 02**
02 Hrs /week **Max. Marks: 50**

Student will be required to give seminar on the topic allotted. Each group will consist of five students for the purpose of allocation of work load to the faculty.

M.Sc. Chemistry IV-Semester
Organic Chemistry Special – IV (Photochemistry & Pericyclic Reactions)

Paper No. CH-614 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT - I

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

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

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

(15 Hrs)

UNIT - II

Intermolecular cycloaddition reactions – dimerizations and oxetane formation.

Photochemistry of Aromatic Compounds: Isomerizations, additions and substitutions.

Miscellaneous Photochemical Reactions: Photo-Fries reactions of anilides. Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photodegradation of polymers.

Free Radicals: Free radicals stability, generation and detection. Types of free radical reactions, free radicals substation at an aromatic substrate, Hunsdiecker reaction.

(15 Hrs)

UNIT - III

Pericyclic Reactions:

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward – Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions – conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions – antarafacial and suprafacial additions, 4n and 4n+2 systems, Sigmatropic rearrangements – suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3-and 5,5-sigmatropic rearrangements. Claisen, and Cope rearrangements

(15 Hrs)

UNIT - IV

Stereochemistry

Conformational analysis of medium and large membered rings, trans annular reactions, conformational analysis of cyclohexanone, effect of conformation on reactivity of acyclic and cyclic compounds.

Stereochemistry of nitrogen containing compounds, strain and their consequences in small ring heterocycles, conformation of six membered heterocyles. Barrier to ring inversion and pyramidal inversion and 1,3-diaxial interactions.

(15 Hrs)

Books suggested

1. Carey, F.A. & Sundberg, R. J. Advanced Organic Chemistry, Parts A & B, Plenum: U.S. (2004).
2. Horspool, W. M. Aspects of Organic Photochemistry Academic Press (1976).
3. Lowry, T. H. & Richardson, K. S. Mechanism and Theory in Organic Chemistry AddisonWesley Educational Publishers, Inc. (1981).
4. March, J. Advanced Organic Chemistry John Wiley & Sons (1992).
5. Marchand, A. P. & Lehr, R. E. Pericyclic Reactions Academic Press (1977).
6. Organic Photochemistry and Pericyclic Reactions, M G Arora, Anmol Publishers, New Delhi.
7. Pericyclic Reactions, S.M. Mukherji, Macmillan, India.
8. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
9. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.
10. Stereochemistry of Organic Compounds, E. L. Eliel and S. H. Wilen, Wiley Interscience.
11. Basic stereochemistry of organic molecules, S Sengupta, Book Syndicate Pvt. Ltd., Kolkata
12. Organic Photochemistry 2e by James Morriss Coxon, Brian Halton from Cambridge.

M. Sc. Chemistry IV-Semester
Organic Chemistry Special – V (Natural Products-2)

Paper No. CH-616 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. 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, a- Cadinene, and Abietic acid, Biogenetic pathways and biosynthesis

(15 Hrs)

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

(15 Hrs)

UNIT - III

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

(15 Hrs)

UNIT - IV

Carbohydrates: Classification of carbohydrates (Reducing and non-reducing sugars), Epimerization, Anomers, Mutarotaion , Conventions for indicating ring size of monosaccharides Structure determination of Maltose and Lactose.

Prostaglandins: Classification, Physiological effects and synthesis of PGE_2 and PGF2 a.

(15 Hrs)

Books suggested

1. Stryer, L. Biochemistry 4th Ed., W. H. Freeman & Co. (1995).
2. Sykes, P. A Guidebook to Mechanism in Organic Chemistry 6th Ed., Prentice-Hall (1996).
3. Zubay, S. Biochemistry Addison-Wesley (1983).
4. Finar, I. L. & Finar, A. L. Organic Chemistry Vol. 2, Addison-Wesley (1998).
5. Finar, I. L. Organic Chemistry Vol. 1, Longman (1998).
6. Gringauz, A. Introduction to Medicinal Chemistry: How Drugs Act and Why? John Wiley & Sons (1997).
7. Patrick, G. L. Introduction to Medicinal Chemistry Oxford University Press (2001).
8. Natural Products, their chemistry and biological significance. J. Mann, R. S. Davidson,
9. Natural Product Synthesis II: Targets, Methods, Concepts. Topics in Current Chemistry, 24thEd. Edited by Johann Mulzer (Universität Wien). Springer: Berlin, Heidelberg, New York.2005.
10. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.

M. Sc. Chemistry IV-Semester
Organic Chemistry Special – VI (Reactions & Reagents)

Paper No. CH-618 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT - I

Preparation, properties and applications of following reagents in organic synthesis with mechanistic details.

Organometallic Reagents:
n-Butyllithium, Grignard reagent, Organo chromium(III) compounds, Dialkyl copper lithium, Pentacarbonyl iron, Tetracarbonyl nickel, octacarbonyl dicobalt, Alkene Palladium (II) complexes, Wilkinsons catalyst, Tri-n-butyl tin hydride, Trimethyl silyl iodide, Diborane. **(15 Hrs)**

UNIT - II

General Reagents:
DCC, 1,3-dithianes, Polyphosphoric acid, diazomethane, Boron Trifluoride, Trifluoro acetic acid, cuprous chloride, N-bromosuccinamide, Phase Transfer catalysts. **(15 Hrs)**

UNIT - III

Oxidation:
Leadtetraacetate, osmium tetraoxide, selenium dioxide, potassium permanganate, Fenton's reagent, ozone, perbenzoic acid, periodic acid, chromium oxide, DDQ.

Reduction:

Catalytic hydrogenation, lithium aluminium hydride, sodium borohydride, sodamide, zinc dust, sodium liquid ammonia, DIBAL, 9-BBN. **(15 Hrs)**

UNIT - IV

Rearrangements:

General mechanistic considerations – nature of migration, migratory aptitude, A detailed study of following rearrangements. Pinacol – pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofman, Curtius, Schmidt, Baeyer-Villiger Shapiro reaction. **(15 Hrs)**

Books Suggested:

1. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March, John Wiley.
2. Modern Synthetic Reactions, H.O. House, W.A. Benjamin.
3. Some Modern Methods of Organic Synthesis, W. Carruthers, Foundation Books.
4. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Reagents in Organic Synthesis, Fieser and Fieser, Wiley.
6. Reactions, Rearrangements & Reagents by Sanyal from Bharti Bhawan.
7. Reaction & Rearrangements by O P Agrawal, Goel Publication
8. Organic reaction mechanism, V K Ahuluwalia
9. Name Reactions and Reagents in Organic Synthesis by Bradford P. Mundy, Michael G. Ellerd and Frank G. Favaloro Jr. from Wiley.

M.Sc. Chemistry IV-Semester
Organic Chemistry Lab. – V

Paper No. CH-620 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Qualitative Analysis **(70 marks)**

Identification of organic compounds using spectroscopic methods (IR, UV, NMR & Mass) followed by characterization by chemical methods.

Note: Two sets to be given in the examination

2. Viva-Voce **(15 Marks)**

3. Note Book **(15 Marks)**

Books Suggested

1. Experiments in Organic Chemistry" Lousis F. Fieser O.C. Heath and Company Boston, 1955.
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
3. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
4. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
5. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
6. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
7. Organic Spectroscopy, by William Kemp. John Wiley & Sons.
8. Introduction to spectroscopy by Donald L. pavia, Brooks cole 4^{th} edition.
9. Advanced practical chemistry, Jagdamba, Yadav and shrivastava, Pragati Prakasan
10. Advanced organic practical chemistry, J.N.Gurtu and R. Kappor, S. Chand
11. Advanced practical organic chemistry, N.K. Vishnoi, Vikas Publishing House

M.Sc. Chemistry IV-Semester
Organic Chemistry Lab. – VI

Paper No. CH-622 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Multi-step synthesis: - **(40 marks)**

(a). m - Nitroaniline from benzene
(b). 5-Acetoxy-1,2-benzoxathiole-2 -one from hydroquinone
(c). 2' - Hydroxy - 4 - methoxyphenyl styryl ketone from resorcinol
(d). p-nitrobenzanilide from Benzophenone

2. Isolation **(30 Marks)**

(i) D (+) Glucose from cane sugar
(ii) Hippuric acid from urine
(iii) Ascorbic acid from fruit juice

3. Viva-Voce **(15 Marks)**

4. Note Book **(15 Marks)**

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

Books Suggested

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

M.Sc. Chemistry IV-Semester
Seminar-II (Organic Chemistry)

Paper No. CH-624 B **Credits: 02**
02 Hrs /week **Max. Marks: 50**

Student will be required to give seminar on the topic allotted. Each group will consist of five students for the purpose of allocation of work load to the faculty.

M.Sc. Chemistry IV-Semester
Physical Chemistry Special – IV (Statistical Thermodynamics)

Paper No. CH-626 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT - I

Statistical Thermodynamics I: Concept of distribution, thermodynamic probability and most probable distribution; canonical, grand canonical and micro canonical ensembles. Maxwell - Boltzmann statistics, Statistical thermodynamic formulation of Maxwell - Boltzmann distribution law, Maxwell - Boltzmann law of distribution of energy and evaluation of average velocity, root mean square velocity; law of equipartition of energy; Partition function and its factorization, relationship of atomic and molar partition function to thermodynamic properties(i) internal energy (ii) entropy (iii) Gibb's free energy (iv) heat contant (v) work function (vi) pressure (vii) heat capacity at constant volume. Derivation of equation of state for a mono atomic ideal gas. **(15 Hrs)**

UNIT -II

Statistical Thermodynamics II: Translational partition function, calculation of absolute entropy of an ideal monoatomic gas, Seckure -Tetrode equation, Vibrational , Rotational, & electronic partition function of diatomic molecules, Derivation of expressions for transitional ,vibrational, rotational, electronic energy; expressions for entropy, Gibbs free energy, work function due to transitional, vibrational and rotational motion of a molecule. Effect of change of zero point energy on partition function and also on thermodynamic properties like internal energy, Gibbs free energy, enthalpy, work function & entropy. Chemical equilibrium and equilibrium constant in terms of partition functions, Free energy function. **(15 Hrs)**

UNIT - III

Statistical Thermodynamics III: Free energy functions and the partition functions, calculation of equilibrium constant using partition function, Bose - Einstein statistics, statistics of photon gas, gas degeneration, Fermi-Dirac statistics, extreme gas degeneration, energy of Bosons & Fermi particles, specific heat of electron gas, , Thermionic emission, comparison of Maxwell-oltsmann, Bose-Einstein and Fermi-Dirac statistics. **(15 Hrs)**

UNIT - IV

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, , Electro kinetic phenomenon.

Theory of fluctuation, energy fluctuations in the canonical ensemble, distribution function and fluctuations, fluctuations of density and energy. **(15 Hrs)**

Books Suggested

1. Physical Chemistry, P.W. Atkins, Oxford University Press.
2. Physical Chemistry, G.W. Castellan, Narosa. Publishers, New Delhi
3. Thermodynamics for Chemists, S. Glasstone, Affiliated East-West Press.
4. Chemical Thermodynamics, I.M. Klotz and R.M. Rosenberg, Benzamin.
5. An Introduction to Chemical Thermodynamics, R.P. Rastogi and R.R. Misra, Vikas Pub.
6. Electrochemistry, S. Glasstone
7. Non-Equilibrium Thermodynamics-principles and applications, C.Kalidas and M.V.Sangaranarayanan, McMillan.
8. Introductory Statistical Mechanics by R. Bowley & M. Sanchez, 2nd Ed. Oxford Science Publication

M.Sc. Chemistry IV-Semester
Physical Chemistry Special – V (Electrochemistry and Quantum Chemistry)

Paper No. CH-628 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT – I

Electrochemistry of Corrosion: Electrode reactions, electrode potentials, electrochemical cell formation, Nernst equation, exchange current density, polarization of electrode (resistance, concentration and activation), mixed potential theory, polarization diagrams, pourbaix diagrams, corrosion rate expression and weight loss method for corrosion rate, galvanic series. Electrochemical techniques to study corrosion –Measurement Cell, Galvanostatic and potentiostatic techniques, Stern –Geary equation, Tafel slopes, measurement of corrosion potential and corrosion current density, Tafel extrapolation and Linear polarization resistance methods, recording and interpretation of anodic and cathodic polarization curves.

(15 Hrs)

UNIT – II

Applications of Electrochemistry: The maximum intrinsic efficiency, actual efficiency Electricity storage: Some important quantities in electricity storage (electricity storage density, energy density, power), desirable conditions for an ideal strorer,charging &discharging of a battery, storage of electricity using the lead-acid battery, dry cell, nickel-cadmium battery, silver-zinc cell and Sodium- Sulfur cell. Fuel cells: 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 alkaline fuel cell, high temperature fuel cell & proton exchange membrane fuel cell (H_2-O_2 fuel cell). **(15 Hrs)**

UNIT – III

Polarography: General principles of polarography, the limiting current and its types, diffusion current, linear diffusion and spherical diffusion, derivation of Ilkovic equation and its consequences, Koutecky's equation for diffusion current, half-wave potential, equations for reversible cathodic, anodic, and cathodic-anodic waves, analysis of reversible polarographic wave, factors(ionic strength & pH) affecting the half-wave potential, reversible processes controlled by diffusion of complex ions , Amperometric titrations,Approximate and rigorous Treatment of Irreversible electrode processes ,electrogravimetry & its application, coulometry at constant potential and its application ,cyclic voltammetry(Technique& applications).

(15 Hrs)

UNIT – IV

Molecular Orbital Theory: Huckel molecular orbital (HMO) theory of linear and cyclic conjugated systems, Applications of HMO theory to (i) set up and solve Huckel determent equation; (ii) calculate resonance energy; (iii) wave functions for molecular orbitals and molecular diagrams for the following :

(a) Ethylene molecule (b) Allyl system (Allyl radical and the related cation and anion) (c) Butadiene; (d) Cyclobutadiene (e) Cyclopropenyl system (cyclopropenyl radical and the related cation and anion. **(15 Hrs)**

Books Suggested

1. Electrochemistry-by Glasstone
2. Modern Electrochemistry vol.1 and vol 2A, 2B J.O.M.Bockris and A.K.N.Reddy, Plenum.
3. *Principles of Electrochemistry*, Koryta, J. Dvorak, J. & Kavan, L., John Wiley, NY (1993)
4. *Electrochemical Methods: Fundamentals and Applications*, Bard, A. J. Faulkner, L. R. 2nd Ed., John Wiley: New York, 2002
5. Quantum Chemistry, I.N. Levine, Prentice Hall of India
6. Quantum Chemistry, A.K. Chandra, Tata McGraw Hill
7. Chemical Application of Group Theory, F.A. Cotton Interscience.
8. Methods in Molecular Orbital Theory, A.G. Turner, Prentice Hall of India
9. Group Theory and Symmetry in Chemistry, L.H. Hall, McGraw Hill.
10. Symmetry and Spectroscopy of Molecules, K.V. Reddy, New Age International
11. Principles of Polarography by J. Heyrovsky & J. Kuta, Academic Press
12. Polarographic Technique, L. Maites
13. Introduction to Polarography, Kamla Jutshi, New Age International
14. Polarography Technique, Kapoor & Aggarwal
15. Physical Chemistry by Maron & Prutton, The Macmillan company
16. Electroanalytical chemistry (Applications by J. Lingane), John Wiley & Sons.

M.Sc. Chemistry IV-Semester
Physical Chemistry Special – VI (Kinetics, Surface and Polymer Chemistry)

Paper No. CH-630 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT – I

Adsorption: Surface tension, capillary action, pressure difference across curved surface (Leplace equation), Gibb's adsorption equation and its applications, determination of BET equation and its application for the determination of surface area; surface active agents and their classification, concept of micelles, critical micelle concentration (cmc), determination of cmc by conductivity and surface tension methods; factors affecting cmc, counter - ion binding to micelles, thermodynamics of micellization. **(15 Hrs)**

UNIT – II

Chemical Dynamics: Theories of unimolecular reactions: Lindemann's theory, Hinshelwoods treatment, R.R.K. and R.R.K.M. theories,The theory of absolute reaction rates, potential energy surfaces, activation energies, London— Eyring - Polanyi method for the calculation of energy of activation.

Kinectics of fast reactions, Flow methods, Stopped flow, Relaxation method, Flash photolysis and shock tube method. **(15 Hrs)**

UNIT - III

Polymers: Classification of polymers and polymerisation, condensation and addition polymers, kinetics of condensation (step-wise) polymerisation, size distribution in linear condensation polymers, molecular size control, degree of polymerization; mechanism of vinyl radical polymerisation, molecular weight and its determination, effect of temperature and pressure on chain polymerisation, stereochemistry of polymer chain & stereo regular polymerisation, Ionic polymerisation (similarities and contrast), kinetics of cationic, anionic polymerisation, kinetics of copolymerisation, criteria for polymer solubility; Mass number and Mass average molecular weight, determination of molecular weight of polymers by osmometry, viscometry, light scattering and sedimentation method. **(15 Hrs)**

UNIT - IV

Polymers: Statistical method of biopolymers: Chain configuration of polymer chains, statistical distribution of end to end dimensions (freely jointed chains in 1D & 3D); influence of bond angle restriction, radius of gyration, thermodynamics of biopolymer solution (entropy of mixing & liquid state model along with limitation), free volume theory, heat & free energy of mixing.

(15 Hrs)

Books Suggested

1. Chemical Kinetics Methods, C. Kalidas, New Age International
2. Chemical Kinetics, K.J. Laidler, McGraw Hill.
3. Theory of Absolute Reaction Rates, K.J. Laidler, McGraw Hill
4. *Catalysis at Surfaces*, Campbell, I. M. Chapman and Hall, New York/London (1988)
5. *Concepts of Modern Catalysis and Kinetics*, Chorkendorff, Ib. & Niemantsverdriet, J. W., Wiley-VCH (2003)
6. *Zeolites, Molecular Sieves- Structure, Chemistry and Use*.Breck, D. W. , John Wiley & Sons.
7. Textbook of Polymer Science, F.W. Billmeyer (Jr), Wiley.
8. Principles of Polymer Chemistry, P J Flory, Cornell University Press.
9. Physical Chemistry of Polymers, A Tager, Mir Publishers, Moscow.
10. Physical Chemistry of Macromolecules, Tanford
11. Polymers: Chemistry & Physics of Modern materials, J.M.G. Cowie, Blackie Academic and Professional.
12. Plastic Materials, J.A. Brydson, Butter worth Heinemann.
13. Principles of Polymerisation, G.Odian, John Willey.
14. Fundamentals of Polymer Processing, S. Middleman..
15. Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Wiley-Eastern.
16. Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R.M. Otta
17. Symmetry and Spectroscopy of Molecules, K.V. Reddy, New Age International
18. A.W.Adamson- "The physical chemistry of surfaces"- 4^{th} edition- Wiley 1982
19. S.J. Gregg and K.S.W. Sing, Adsorption, Surface Area and Porosity, Academic Press, London and New York.
20. Advanced Physical Chemistry, Gurtu & Gurtu, Pragati Prakashan.

Chemistry IV-Semester
Physical Chemistry Lab. – V

Paper No. CH-632 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Polarography

(i) Estimation of cations in the given solution.

(ii) Ampereometry titration: $Pb(NO_3)_2$ vs. $K_2Cr_2O_7$

2. Dipole metry

(i) To determine the dipole moment of a liquid.

3. Viscosity

(i) Determination of Molecular weight of a high polymer (pva, polystyrene etc.) by viscosity method.

4. **Conductometry**

(i) Determination of concentration of Salicylic acid by
(a) Salt line method (b) Double alkali method

(ii) Determination of solubility and solubility product of sparingly soluble salt (AgCl, $PbSO_4$)

(iii) Determination of degree of hydrolysis and hydrolysis constant of analine hydro chloride in aqueous solution.

(iv) Study the kinetics of saponification of ester by NaOH conductometrically

(v) Verification of D.H.O. equation for strong electrolytes.

5. **Chemical Kinetics**

(i) Relative strength of acids

(ii) Study of Iodination of acetone.

6. Polarimetry

(i) Determination of percentage composition of optical substances in the given binary mixture (Glucose + Fructose or Tartaric acid)

(ii) Determination of rate constant for hydrolysis/inversion of sugar

Experiments **(70 Marks)**
Viva-Voce **(15 marks)**
Note Book/Practical file **(15 marks)**

Books Suggested

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B. Levitt and Findley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Garland McGraw Hill.
6. Senior Practical Physical Chemistry, B.D. Khosla
7. Advanced Practical physical Chemistry, J. B. Yadav

M.Sc. Chemistry IV-Semester
Physical Chemistry Lab. – VI

Paper No. CH-634 B **Credits: 04**
08 Hrs /week **External Marks: 100**
Total: 120 Hrs **Sessional Marks: 50**
Duration of Exam: 08 Hrs

1. Potentiometry

(i) $AgNO_3$ vs. (KCl + KI) mixture

(ii) Determination of solubility and solubility product of sparingly soluble salts ($BaSO_4$) and AgCl.

(iii) Determination of degree of hydrolysis of aniline hydro chloride

(iv) Determination of dissociation constant of weak acid.

2. Distribution Law

(i) Determination of partition coefficient of iodine between carbon tetrachloride and water

(ii) Determination of equilibrium constant for $I_2 + I = I_3$

3. Flame Photometry

(i) To determine the concentration of Na^+ , Li^+ , Ca^{++} ions in the given solution

4. Spectrocolorimetry

(i) Determine the concentration of copper sulphate, potassium permanganate and potassium dichromate in their solution.

(ii) Determine the composition of the binary mixture containing $KMnO_4$ and $K_2Cr_2O_7$

5. Refractometry

(i) To determine percentage composition of liquids in the given binary mixture

6. **pH metry**

(i) Determination of Copper amine complex from $CuSO_4$ vs. NH_4OH

(ii) Determination of dissociation constant of weak acid

(iii) Determination of dissociation constant of CH_3COOH by titrating it with KOH.

(iv) Determination of degree of hydrolysis of aniline hydro chloride.

Experiments **(70 Marks)**
Viva-Voce **(15 marks)**
Note Book/Practical file **(15 marks)**

Books Suggested

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B. Levitt and Findley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Garland McGraw Hill.
6. Senior Practical Physical Chemistry, B.D. Khosla
7. Advanced Practical physical Chemistry, J. B. Yadav
8. Advanced Practical physical Chemistry, Gurtu & Gurtu.

M.Sc. Chemistry IV-Semester
Seminar II (Physical Chemistry)

Paper No. CH-636 B **Credits: 02**
02 Hrs /week **Max. Marks: 50**

Student will be required to give seminar on the topic allotted. Each group will consist of five students for the purpose of allocation of work load to the faculty.

M.Sc. Chemistry IV-Semester
Inorganic Chemistry Elective – II (Materials and Nano-Technology)

Paper No. CH-652 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT-I

Ceramic materials: Definition of ceramics, Traditional and new ceramics, structure of ceramics, atomic interactions and types of bonds, phase equilibrium in ceramic systems, one component and multi component systems, use of phase diagrams in predicting material behavior, electrical, magnetic and optical properties of ceramic materials. **(15 Hrs)**

UNIT - II

Crystalline and Non crystalline ceramic materials

Chemical reactions at high temperatures and processing of ceramics, high temperature materials, crystalline ceramic materials, oxide, carbide, nitride, graphite and clay materials and their structures, polymorphism, Non-crystalline ceramic materials, structure and structural requirements for stability, mode of formation, silicate and non-silicate glasses, hydrogen bonded structures. **(15 Hrs)**

UNIT - III

Nano technology

Nano materials- definition, nano structures, self assembly, nano particles, methods of synthesis, sol- gel process, colloids, hydrolysis of salts and alkoxides, precipitation condensation reactions, electro kinetic potential and peptization reactions, gelation network, xerogels, aero gels, drying of gels, chemical modification of nano surfaces, applications of sol, gel process, sol gel coating, porous solids, catalysts, dispersions and powders.

(15 Hrs)

UNIT - IV

Materials for special purposes

Production of ultra pure materials- zone refining, vacuum distillation and electro refining.

Ferro-electric and piezo electric materials

General properties, classification of ferro electric materials, theory of ferro electricity, ferro electric domains, applications. Piezo electric materials and applications. Metallic glasses, preparation, properties and applications.

Magnetic materials

Ferri and ferro magnetism, metallic magnets, soft, hard and super conducting magnets, ceramic magnets, low conducting and super conducting magnets.

Super conducting materials

Metallic and ceramic super conducting materials- theories of super conductivity- Meissner effect- high temperature super conductors, their structure and applications. **(15 Hrs)**

Books Suggested

1. W D Kingery, H K Dowen and R Duhlman- **"Introduction to Ceramics"** John Wiley.
2. F H Nortion- **"Elements of Ceramics"** Addison-Wesley Pub. Co.
3. **C J Brinker and G W Sherer-** "Sol-Gel Science, The Physics and Chemistry of Sol-Gel processing" Academic Press, New York.
4. A G Guy- **"Essentials of material Science"** - McGraw Hill.
5. M J Starfield and Shrager- **"Introductory Materials Science"** - McGraw Hill.
6. V Raghavan- **"A First Course in Material Science**" - Prentice Hall Pvt Ltd, New Delhi.
7. J F Shackelford- **"An Introduction to Materials Science for Engineers**" McMillan Pub. Co. New York.
8. **W F Smith- "Foundation of Materials Science & Engineering" - McGraw Hill Book Co. 2000**
9. M W Barsoum- **"Fundamentals of Ceramics"** - McGraw Hill Book Co. 1997.
10. S K Hajra Chaudhary- **"Material Science and Engineering"** - Indian Book Dist Co. Culcutta.
11. **R S Sharpe - "Research Techniques in Non Destructive Testing, Vol IF" - Academic Press, New York, 1973.**
12. J Kraut Kramer and H Kraut Kramer- **"Ultrasonic Testing of Materials**" - George Allen & Union Ltd, London, 1969.
13. K.N. Tu and R. Rosenberg **"Analytical Techniques for Thin Films in Treatise on Material Science & technology, Vol 27" -**Acad. Press Inc., N.Y,1991.
14. S V Subramanyan and E S Rajagopal- **"High Temperature Super Conductors**" - Wiley Eastern Ltd. 1988.
15. M Tinkham- **"Introduction to Super Conductivity**" - McGraw Hill, Kogakusha Ltd, 1975.
16. A V Narlikar and S N Edbote- **"Super Conductivity and super conducting Materials**" - South Asian Pub., New Delhi 1983.
17. Dekker- **"Electronic Engineering Materials**" - A J Prentice Hall of India Pvt.Ltd. 1985.
18. C M Srivastava and C Srinivasan- **"Science of Engineering Materials**" - Wiley Eastern Ltd, 1987.
19. Azaroff and Brophy- **"Electronic Process in Materials**" - McGraw Hill, 1985.

M. Sc. Chemistry Semester-IV
Organic Chemistry Elective-II (Medicinal Chemistry)

Paper No. CH-654 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT - I

Drug, Prodrug, Pharmacokinetics & Pharmacodynamics Terminology, concept of lead compounds, Factors governing drug design, Drug design (Rational approach and The method of variation), structure-activity relationship (SAR), factors affecting bioactivity: electronic effects, Steric Factors, Hansch Equation , The Craig Plot, isosterism, bio-isosterism. Concepts of drug receptor, drug- receptor interactions and adverse drug effects. **(15 Hrs)**

UNIT-II

Antimalarials, antipyretics & analgesics, sulpha drugs, Antihelmintic, Anti-HIV, anti-cancer drugs and Anti-hypertensive agents (Classification and Important examples).

Structure elucidation of Pencillin, chloroamphenical and Tetracyclins. **(15 Hrs)**

UNIT - III

Enzyme activation of drugs: Utility of prodrugs (Solubility, Absorption and distribution, site specificity, Instability, Prolonged release, toxicity, poor acceptability and formulation) types of prodrugs, Mechanism of prodrug activation: carrier linked prodrugs- Functional groups (alcohol, amine, carbonyl, and carboxylic acid), Macromolecular and mutual prodrugs. Bio-precursor Prodrugs(oxidative and reductive). **(15 Hrs)**

UNIT – IV

Polymer Therapeutics: Definition, Concept and Applications. Drug delivery systems (Definition) & EPR effect. Drug-polymer conjugates, various methods for the synthesis of polymer-drug conjugates (conjugation chemistry, linkers, and reactive groups). Polyethylene glycol and Polyglycerols (hyperbranced & Dendritic) in biomedical applications. **(15 Hrs)**

Books suggested

1. The Organic Chemistry of Drug Design and Drug action by Richard B. Silverman from Academic press, inc.
2. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
3. Principles of Organic Synthesis, R. Norman and J. M. Coxon,Blakie, Academic and Professional.
4. Fundamental of Photochemistry, K.K. Rohtagi Mukherjee, Wiley Eastern.
5. Medicinal chemistry, 4th Edition, A. Burger, Wiley Interscience.
6. Medicinal chemistry, 5th Edition, A.Kar, New age International.
7. Text Book of organic medicinal and Pharmaceutical chemistry, 8th Edition, R.F. Boerge, Ed. Wilson and Gisvelds, J.B. Lippincott Co.
8. Natural Products, their chemistry and biological significance. J. Mann, R. S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longmann, Essex, 1994.Medicinal Biochemistry, N. V. Bhagavan, Academic Press, Elsevier.
9. Natural Product Synthesis II: Targets, Methods, Concepts. Topics in Current Chemistry, 24thEd. Edited by Johann Mulzer (Universität Wien). Springer: Berlin, Heidelberg, New York.2005.
10. Natural Products from Plants 2nd ed., Cseke: National Scientific Book Agency, Delhi.
11. Gringauz, A. Introduction to Medicinal Chemistry: How Drugs Act and Why? John Wiley & Sons (1997).
12. Patrick, G. L. Introduction to Medicinal Chemistry Oxford University Press (2001).
13. Biomedical Polymers and Polymer Therapeutics By Emo Chiellini from Springer.
14. Polymers as Drugs, Conjugates and Gene Delivery Systems, by Ronit Satchi-Fainaro, Ruth Duncan from Springer.
15. Cancer Drug Delivery, Wiley-VCH Books **2011** by Eds. F. Kratz, H. Steinhagen.

M.Sc. Chemistry IV-Semester
Physical Chemistry Elective-II (Phtochemistry and Industrial Catalysis)

Paper No. CH-656 B **Credits: 04**
04 Hrs /week **External Marks: 100**
Total: 60 Hrs **Sessional Marks: 50**
Duration of Exam: 03 Hrs

Note: The question paper will comprise of eight questions, two from each unit. The candidates will be required to attempt five questions selecting at least one from each unit. All questions will carry equal marks.

UNIT – I

Molecular photochemistry: An overview: Transitions between states (Chemical, classical and quantum dynamics, vibronic states). Potential energy surfaces; transitions between potential energy surfaces, The Franck-Condon Principle and radiative transitions. A classical model of radiative transitions. The absorption and emission of light - state mixing, spin-orbit coupling and spin forbidden radiative transitions, absorption complexes, delayed fluorescence and phosphorescence.

Photophysical radiationless transitions: Wave mechanical interpretation of radiation less transitions between state factors that influence the rate of vibrational relaxation. Energy transfer: Theory of radiation less energy transfer, energy transfer by electron exchange: An overlap or collision mechanism. The role of energetics in energy transfer mechanism. Diffusion controlled quenching. The Perrin formulation. Triplet-triplet, triplet-singlet, singlet-triplet energy transfer. **(15 Hrs)**

UNIT – II

Photophysical Processes in Electronically Excited Molecules : Radiationless transition-fluorescence emission. Triplet states and phosphorescence emission. Photophysical kinetics of unimolecular prosesses. Photophysical Kinetics of Bimolecular Processes : Bimolecular collisions in gases and vapours and the mechanism of fluorescence quenching. Kinetics of collision quenching – Stern-Volmer equation. Concentration dependence of quenching and excimer formation. Mechanism of quenching. (**15 Hrs)**

UNIT – III

Photo-Electrochemistry: Effect of radiation of light on matter- photo physical phenomena-photovoltaic effect- Solar cell- construction and working principle Storage of solar energy- Photo assisted electrolysis of water,Waste management by photoelectrochemical process. **(15 Hrs)**

UNIT – IV

Industrial Catalysis: Theories of adsorption-BET theory, Statistical derivation and its application- Adsorption isotherms and isosters-their significance- Determination of heat of adsorption- Kinetics of heterogeneous catalysis- Absolute rate theory of catalysis- Energy profile diagram in heterogeneous catalysis.

Electronic factors in catalysis by metals and semiconductors- Cooperative electronic interaction in catalysis- Preparation of solid catalyst and supports- Preparation of supported catalyst- Silica, silica-alumina, zeolite, carbon catalysts-selectivity. Polymer support and heterogenisation-catalytic deactivation-poisoning and fouling. **(15 Hrs)**

Books Suggested

1. J.G. Calvert and J.N. Pitts, Jr., Photochemistry, (1966) John Wiley & Sons, New York.
2. K. K. Rohtagi-Mukherjee, Fundamentals of Photochemistry, (1986) New Age International, New Delhi.
3. R. P. Wayne, Principles and Applications of Photochemistry, (1988) Oxford University Press, Oxford.
4. N. J. Turro, Modern Molecular Photochemistry, (1991) Univ. Science Books, Sansalito.
5. J. F. L. Lakowicz, Principles of Fluorescence Spectroscopy, 2nd Edition (1999), Plenum Publishers, New York.
6. Dupuy and Chapman- "Molecular Reaction and Photochemistry"- Prentice Hall.
7. G.K. Vemulappally- "Physical chemistry"- Prentice Hall of India
8. A.W.Adamson- "The physical chemistry of surfaces"- 4th edition- Wiley 1982
9. Alexander and Johnson- " Colloid science"- Oxford University Press
10. S.J. Gregg and K.S.W. Sing, Adsorption, Surface Area and Porosity, Academic Press, London and New York.
11. S. Glasstone Introduction to Electrochemistry, Affiliated East-west Press Pvt Ltd (1996)
12. Bard A. J. and Faylkner L.R Electrochemical methods, John Wiley Ed .
13. Bockris and Reddy- "Modern electrochemistry"- Springer 2nd Edition volumes 1, 2A and 2B
14. H.H Willard, LL Merrit, J.A Dean Instrumental methods of Analysis,. Van Nostrand
15. J. M Betty,Ed Bruce, E Leach Applied Industrial Catalysis, Academic Press
16. Ed Pearce, W.R.Patterson Catalysis and Chemical Processes, Blackie and Sons
17. G Somarajan Principles of Surface Chemistry Prentice Hall
18. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 5th ed., J. Wiley