Academic Session: 2022-23

FACULTY OF SCIENCES

SYLLABUS

FOR

Programme Code: *MCHE*
Programme Name: M.Sc. Chemistry
(Semester I-IV)
Examination: 2022-24

Department of Chemistry
Khalsa College, Amritsar

Academic Session: 2022-23

S.No.	PROGRAMME OBJECTIVES
1.	The course was introduced to cater the needs of Academic Institutes (Universities, College, and Schools), Chemical, Pharmaceutical industry, Textile, Sugar Industry, Research Institutes.
2.	Students will be able to develop the theoretical aspects of all the fields of chemistry Organic, Inorganic, Physical and Analytical Chemistry and some interdisciplinary courses needed for better understanding the subject from technology point of view.
3.	Students will be able to develop the better understanding of the Practical aspect of chemistry through lab work and research project.
4.	Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in the subject concerned. Develop the ability to identify unethical behavior such as fabrication, falsification or misrepresentation of data and adoptive objectives, unbiased and truthful actions in all aspects.
5.	Create awareness to become an enlightened citizen with commitment to deliver one's responsibilities within the scope of bestowed rights and privileges.
6.	Integrating multicultural awareness such as race, gender, physical ability, age, income and other social variables, and by creating an environment that is , "welcoming for all students" .
7.	Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning throughout life, through self- paced and self- directed learning aimed at personal development, and adapting to changing academic demands of work place through knowledge/ skill .

Academic Session: 2022-23

S.No.	PROGRAMME SPECIFIC OUTCOMES (PSOS)
PSO-1	Students will develop the advanced theoretical and practical skills in the field of INORGANIC CHEMISTRY in specialized areas of Group Theory, Ligand Field Theory, Reaction Mechanism, Organometallics, Bioinorganic and Metal Clusters, Photoinorganic chemistry, Oxidative addition and Insersion reactions, Structure and bonding of d-Block elements, *Techniques for Structure Elucidation of* Ino*rganic Compounds*, Practical Techniques of qualitative and quantitative analysis of inorganic compounds.
PSO-2	Students will develop the advanced theoretical and practical skills in the field of ORGANIC CHEMISTRY through some specialized areas like *Reaction Mechanism-Substitution reactions, Techniques for Structure Elucidation of Organic Compounds, Reaction Mechanism-Addition, Elimination and Rearrangements, Supramolecular, Reactive Intermediates and Disconnections, Natural Products, Pericyclic & Photochemistry, Asymmetric synthesis, Green Chemistry and Heterocyclic Chemistry,* Practical Techniques of qualitative and quantitative analysis of organic.
PSO-3	Students will develop the advanced theoretical and practical skills in the field of PHYSICAL CHEMISTRY through specialized areas of Thermodynamics, Quantum Chemistry, Electrochemistry and Chemical Dynamics, Analytical Techniques, Surface and Polymer Chemistry Practical Techniques of qualitative and quantitative analysis and use of various electrical and non-electrical Instruments for analysis.
PSO-4	Student will develop the understanding regarding the use of mathematical tools, biological processes, use of computer and softwares for chemistry purpose.
PSO-5	The students to get knowledge of Research Methodology, Advance Analytical Techniques and learn about various tools of Organic and Inorganic synthesis

Scheme of Courses

Eligibility:- The candidate having passed B.Sc. degree (10+2+3 system of education) ie B. Sc. (Medical), B. Sc. (Non-Medical), or equivalent with Chemistry as one of the elective subject in all semesters with at least 50% marks in aggregate from Guru Nanak Dev University or any other UGC recognized University.

COURSE SCHEME							
SEMESTER - I							
Course Code	**Course Name**	**Hours/Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
CHE 411 /CHH 411	Inorganic Chemistry-I: (*Ligand Field and Group Theory)*	4	37		13	50	8-10
CHE 412	Organic Synthesis-I (*Reaction Mechanism-Substitution reactions*)	4	37		13	50	11-13
CHE 413 /CHH 413	Physical Chemistry-I: *Thermodynamics*	4	37		13	50	14-15
CHE 414 /CHH 414	Spectroscopy A: *Techniques for Structure Elucidation of Organic Compounds*	6	56		19	75	16-18
CSC 111	Computer for Chemists – Theory Computer for Chemists – Practical	4	18	18	7+7	50	19-21
CHE 415 /CHH 415	Inorganic Chemistry Lab-I (*Quantitative Analysis*)	6		75	25	100	22-23
CHE 416	Organic Chemistry Lab- I *Quantitative analysis and Multistep Synthesis*	6		75	25	100	24-25
	Total					**475**	

Academic Session: 2022-23

SEMESTER – II							
Course Code	**Course Name**	**Hours/ Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
CHE 421	Inorganic Chemistry-II: (*Reaction Mechanism, Organometallics and Catalysis*)	4	37		13	50	27-29
CHE 422/ CHH 422	Organic Synthesis-II (*Reaction Mechanism-Addition, Elimination and Rearrangements)*	4	37		13	50	30-32
CHE 423 /CHH423	Physical Chemistry-II: *Quantum Chemistry*	4	37		13	50	33-34
CHE 424/ CHH 424	Spectroscopy B: *Techniques for Structure Elucidation of* Inorganic *Compounds*	6	56		19	75	35-37
CHE 425/ CHH 425	Organic Synthesis-III(*Supramolecular, Reactive Intermediates and Disconnections)*	4	37		13	50	38-40
MH CHX 421	Mathematics for Chemists(Medical Students)	3	18		7	25	41.43
BT CHX 421	Biology for Chemists(Non Medical Students)	3	18		7	25	44-45
CHE 426/ CHH 426	Physical Chemistry Lab-I	6		75	25	100	46-47
CHE 427 /CHH 427	Inorganic Chemistry Lab- II	6		75	25	100	48-50
	Total					**500**	

Academic Session: 2022-23

SEMESTER - III							
Course Code	**Course Name**	**Hours/Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
CHE 531 / CHH 531	Inorganic Chemistry-III: (*Bioinorganic and Metal Clusters)*	4	37		13	50	52-54
CHE 532/ CHH 532	Organic Synthesis-IV (*Natural Products)*	4	37		13	50	55-57
CHE 533	Physical Chemistry-III *(Electrochemistry and Chemical Dynamics)*	6	56		19	75	58-60
CHE 534/ CHH 534	Organic Synthesis-V (*Pericyclic & Photochemistry*)	4	37		13	50	61.63
CHE 535/ CHH 535	Physical Chemistry-IV *(Analytical Techniques)*	4	37		13	50	64-66
CHE 536	Organic Chemistry Lab- II	6		75	25	100	67-68
CHE 537	Physical Chemistry Lab-II	6		75	25	100	68-70
	Total					475	

SEMESTER - IV							
Course Code	**Course Name**	**Hours/Week**	**Max. Marks**				**Page No.**
			Th	**Pr**	**IA**	**Total**	
CHE 541/ CHH 541	Inorganic Chemistry-IV: *(Advanced Inorganic Chemistry)*	6	56		19	75	
CHE 542/ CHH 542	*Organic Synthesis-VI (Asymmetric synthesis, Green Chemistry and Heterocyclic Chemistry)*	*6*	*56*		*19*	*75*	
CHE 543/ CHH 543	Physical Chemistry-V *(Surface and Polymer Chemistry)*	6	56		19	75	
	PROJECT WORK					Non-Evaluative	
	Total					225	

Distribution of Marks

SNo.	Semester	Total Marks
1	Semester-I	475
2	Semester-II	500
3	Semester-III	475
4	Semester-IV	225
Grand Total		**1675**

Important Note: M. Sc. (Chemistry) and M. Sc. Chemistry (Under the Honours Scheme) have some common subjects.
The subject code of M. Sc. (Chemistry) starts with CHE…, for 2022 onward batches
The subject code of M. Sc. (Chemistry) starts with CH…, Previous batches
The subject codes of M. Sc. Chemistry (Under the Honours Scheme) starts with CHH… for 2022 onward batches
The subject code of M. Sc. Chemistry (Under the Honours Scheme) starts with MHCH…, Previous batches

Semester-I

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-I)

CHE 411/CHH 411: Inorganic Chemistry-I

Ligand Field and Group Theory

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of nine short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

The main objective of this course is to teach the use of mathematical tool of Group Theory in the field of chemistry for evaluating the properties of the molecules. The Ligand field Theory and its use to predict spectral, magnetic and other physical properties of inorganic compounds will also be the main focus of this course.

COURSE CONTENTS:

UNIT-I

1. Group theory and its applications-I 15 Hrs

Symmetry, symmetry elements and operations, Determination of point groups (flow chart), Order and class of point group, Reducible and irreducible representations(H_2O and BF_3).
Multiplication tables and derivation of character tables for C_{2V},C_{3V} and cyclic group, Great orthogonality theorem, Mullikens notations.

UNIT-II

2. Group theory and its applications-II 15 Hrs

Crystallographic Symmetry, Sub groups, determination of symmetry of atomic orbitals under different point groups.Hybridisation of atomic orbitals: sp,sp^2,sp^3,dsp^2,sp^3d and d^2sp^3 and group theory, Matric representation of symmetry operations, group theory and CFT.
Separation of d-orbitals under the influence of T_d,square planar, O_h and trigonalbipyramid symmetry, Vibrational modes in non-linear molecules, representation of vibrational modes in H_2O, NH_3 and BF_3. Group theory and linear molecules.

UNIT-III

3. Ligand Fields-I 15Hrs

Concept and scope of ligand fields, d and other orbitals, Qualitative determination of ligand field effects, the physical properties affected by LF, Ionic model of coordination compounds, Spin-orbit coupling, free ion in weak CF, Effect of cubic field on S,P,D,F,G,H,I terms.

Heat of ligation and CFSE, Standard electrode potential and CFSE, Cation distribution in lattice, spinels, interionic separation and CFSE and chemical stability.

UNIT-IV

4. Ligand Fields-2 15Hrs

Free ion in medium and strong fields. Transition from weak to strong fields, Correlation and Tanabe Sugano diagrams for d^2 to d^9(O_h and T_d), Elementary MOT, Bonding in octahedral and tetrahedral complexes.

Qualitative calculations of 10 Dq. Electronic spectra of complexes, Selection rules and band widths and factors, Jahn Teller effect.Spectra of $[M(H_2O)_6]^{+2}$.

Spectra of spin free and paired complexes, distorted O_h and T_d complexes, Spectrochemical and Nephelauxetic series and CT spectra.

BOOKS PRESCRIBED:

1) Chemical applications of Group theory by F.A. Cotton.
2) Introduction to Ligand fields by B.N. Figgis.
3) Group theory by Raman.
4) Group theory in Chemistry by Gopinathan and Ramakrishnan.

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Identification of elements of symmetry on chemical compounds on the basis of their structure and correlate these elements of symmetry with point groups to which the molecule belongs
CO2	Apply the mathematical concepts of matrices, determinants on various symmetry operations.
CO3	Apply the mathematical tool of 'Group Theory' on various molecules to derive reducible and irreducible representation. This also leads to the use of group theory derive the type of hybridisations and IR active and Raman active modes of vibrations in the molecules
CO4	Develop the understanding of Bonding in coordination compounds in terms of

	CFT and LFT.
CO5	Construction of Orgel diagrams, Correlation diagrams and Tunabe-Sugano diagrams along with the study of electronic, magnetic and spectrochemical properties of the coordination compounds.

Academic Session: 2022-23

M.Sc. Chemistry (Semester-I)

CHE 412: Organic Synthesis-I

Reaction Mechanism-Substitution Reactions

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of nine short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVE:

The course is designed to introduce the quantitative aspects of reactivity, effect of structure and the different reactive intermediate involved in theorganic reactions. Further, the course provides an in-depth knowledge of mechanisms of different types of substitution reaction of aliphatic as well as aromatic organic compounds.

COURSE CONTENTS:

UNIT-I

1. Reaction Mechanism: Structure and Reactivity 15 Hrs

Type 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.Hard and soft acids and bases.
Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes.
Effect of structure on reactivity- resonance and field effects, steric effect, quantitative treatment.
The Hammett equation and linear free energy relationship, substituent and reaction constants.Taft equation.

UNIT-II

2.Stereochemistry : 8 Hrs

Elements of symmetry, chirality, molecules with more than one chiral center.Threo and erythro isomers, methods of resolution, optical purity.
Prochirality – enantiotopic and diastereotopic atoms, groups and faces.

Stereospecific and stereoselectivesynthesis.Asymmetricsynthesis.Optical activity in absence of chiral carbon (Biphenyls, Allenes, Spiranes).Chirality due to helical shape.

3. Aliphatic Electrophilic Substitutions 7 Hrs

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

UNIT-III

4. Aliphatic Nucleophilic Substitutions 8 Hrs

The S_N2, S_N1, missed S_N1 and S_N2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance.
Classical and nonclassicalcarbocations, phenonium ions, norbornyl system, common carbocation rearrangements.Application of NMR spectroscopy in the detection of carbocations. The $S_Ni$mechanisum,
Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium,
Phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity. Gabriel synthesis

5. Aromatic Nucleophilic Substitution 7 Hrs

The S_NAr, S_N1, benzyne an SR_N1 mechanisms, Reactivity-effect of substrate structure, leaving group and attacking nucleophile.
The von Richter, Sommelet-Hauser, and Smiles rearrangements.

UNIT-IV

6. Aromatic electrophilic substitution 8 Hrs

The arenium ion mechanism, orientation and reactivity in mono substitution and disubstituted aromatics, energy profile diagram, the *ortho*/*para* ratio, ipso attack, orientation in other ring systems, quantitative treatment of reactivity in substrates and electrophiles.
Diazo coupling, Vilsmeir reaction, Gatterman-Koch reaction, Bechmann reaction, Hoben-Hoesch reaction.

7. Free Radical Reactions 7 Hrs

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance.Reactivity for aliphatic and aromatic substrates at a bridgehead.Reactvity in the attacking radicals.The effect of solvents on reactivity.
Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, autooxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

BOOKS PRESCRIBED:

1. Stereochemistry - Eliel

2. Advanced Organic Chemistry – Jerry March.
3. Advanced Organic Chemistry, F. A. Carey, R. J. Sundberg, Volume I and II
4. Highlights of Organic Chemistry, W.J. L. Nobel; An Advanced Text Book.
5. Stereochemistry conformation and Mechanism – P. S. Kalsi

COURSE OUTCOMES:

S. No.	On completing the course, Student will
CO1	understand various methods of generation of carbocations, carbanions, free radicals, carbenes, nitrenes and their applications in organic synthesis.
CO2	study the mechanism of different types of free radical substitution reactions and free radical rearrangements.
CO3	Learn the mechanism of different aliphatic/aromatic nucleophilic and electrophilic substitution reactions
CO4	Able to assign R/S configuration to the molecules with one or more than one chiral centers, allenes, biphenyls, and spiranes and can analyze the effect of structure on reactivity of compound quantitatively.
CO5	develop interest in writing and finding mechanisms of substitution and rearrangement reactions.

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-I)

CHE 413/CHH 413

Physical Chemistry-I

Thermodynamics

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of nine short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVE:

The Course is thoughtfully prepared to give first the overview of the classical laws of thermodynamics and its applications. Further, the course elaborates the concept of statistical thermodynamics to inter-relate the quantum mechanics and thermodynamics. also, the irreversible thermodynamics based on real life examples has been formulated.

COURSE CONTENTS:

UNIT-I

1.Classical Thermodynamics-I 15Hrs

Brief resume of concepts of thermodynamics, Helmholtz and Gibb's free energy, chemical potential and entropy.Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances.Determination of these quantities.Concept of fugacity and determination of fugacity.

UNIT-II

2.Classical Thermodynamics-II 15 Hrs

Non-ideal systems: Excess functions for non-ideal solutions. Activity, activity coefficients, Debye-Huckel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficients, ionic strength.

UNIT-III

3. Statistical Thermodynamics: 15Hrs

Thermodynamic probability, Most probable distribution, Stirling approximation, Maxwell-Boltzmann distribution law, Entropy and probability, Ensemble averaging, postulates of ensemble averaging. Types of ensemble systems, Lagrange's method of undetermined multipliers.

Partition functions: Translational, rotational, vibrational and electronic partition function, calculation of thermodynamic properties in terms of partition functions. Application of partition functions in the determination of equilibrium constants and heat capacity behavior of solids-chemical equilibria.

Types of statistics: Fermi-Dirac statistics-distribution laws, Bose-Einstein statistics- distribution law and application to helium.

UNIT-IV

4. Non Equilibrium Thermodynamics: 15 Hrs

Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes: heat flow, chemical reactions. transformations of generalized fluxes and forces, non-equilibrium stationary states, phenomenological equations, microscopic reversibility, irreversible thermodynamics for biological systems, coupled reactions.

BOOKS PRESCRIBED:

1. S. Glasstone: Thermodynamics for Chemists
2. P.W. Atkins: Physical Chemistry
3. S.H. Maron& C.F. Prutton: Principles of Physical Chemistry
4. Introduction to the Thermodynamics of Biological Processes by D. Jou& J. E. LLebot.
5. Pitts: Non equilibrium thermodynamics
6. I Prigogine: Introduction to thermodynamics of irreversible processes

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Students will learn about the classical thermodynamics and revise the basic concepts
CO2	Learn to conceptualise the statistical mechanics derivations
CO3	Understands the link between classical mechanics and quantum mechanics by studying statistical mechanics
CO4	Deriving the thermodynamic parameters from quantum chemistry
CO5	Studying the irreversible thermodynamics and correlating real life problems

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-I)

CHE 414/CHH 414

Spectroscopy-A

Techniques for Structure Elucidation of Organic Compounds

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 75
Theory: 56
Internal Assessment: 19

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of EIGHT questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of eight short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 12 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVE:

The course is well designed for the introduction of various concepts in molecular spectroscopy covering UV, IR, 1HNMR, 13C-NMR, 2D NMR and mass spectroscopy. It enables the students for interpretation of spectra and data analysis leading to skill enhancement. This course makes students employable in industries.

COURSE CONTENTS:

UNIT-I

1. General Features of Spectroscopy: 5 Hrs

Units and conversion factors.Introduction to spectroscopy, Nature of radiation. Energies corresponding to various kinds of radiation, Experimental techniques, intensities of spectral lines, Selection rules and transition moments, Line widths, Broadening.

2. Nuclear Magnetic Resonance Spectroscopy-I 15Hrs

PMR: Natural abundance of ^{13}C, ^{19}F and ^{31}P nuclei; The spinning nucleus, effect of external magnetic field, precessional motion and frequency, Energy transitions, Chemical shift and its measurements. Factors influencing chemical shift, anisotropic effect; Integrals of protons, proton exchange, spin-spin coupling- splitting theory, one, two and three bond coupling, virtual, long range and allylic coupling, magnitude of coupling constant; factors affecting the coupling constant, Chemical and magnetic equivalence, First and second order spectra, A_2, AB, AX, AB_2, AX_2, A_2B_2 and A_2X_2 spin systems.

UNIT-II

3. Nuclear Magnetic Resonance Spectroscopy-2 20 Hrs

Simplification of complex spectra (solvent effect, field effect, double resonance and lanthanide shift reagents), CW and FT NMR, Relaxation processes, T1 and T2 measurements, Applications of PMR in structural elucidation of simple and complex compounds.^{13}C-NMR: Resolution and multiplicity of ^{13}C NMR, ^{1}H-decoupling, noise decoupling, broad band decoupling; Deuterium, fluorine and phosphorus coupling; NOE and origin of nuclear overhauser effect. off-resonance, proton decoupling.

Structural applications of ^{13}C-NMR., pulse sequences, pulse widths, spins and magnetization vectors, DEPT, INEPT.

Introduction to 2D-NMR, COSY, NOESY, HSQC spectra

UNIT-III

3. Mass Spectra: 10 **Hrs**Introduction, methods of ionization EI & CI, Brief description of LD, FAB, SIMS, FD etc., Ion analysis methods (in brief), isotope abundance, Metastable ions, general rules predicting the fragmentation patterns. Nitrogen rule, determination of molecular ion peak, index of H deficiency, fragmentation patterns for aliphatic compounds, amines, aldehydes, Ketons, esters, amides, nitriles, carboxylic acids ethers, aromatic compounds etc.

4. UV and Visible Spectroscopy of organic molecules: 10 Hrs

Measurement techniques, Beer – Lambert's Law, molar extinction coefficient, oscillator strength and intensity of the electronic transition, Frank Condon Principle, Ground and first excited electronic states of diatomic molecules, relationship of potential energy curves to electronic spectra, Chromophores, auxochromes, blue shift, red shift, hypo and hyperchromic effect, n-σ*,π-π*, n-π* transitions in organic molecules.

Woodward rules for conjugated dienesand , - unsaturated carbonyl groups, extended conjugation and aromatic sterically hindered systems, Quantitative applications.

UNIT-IV

5. Infrared Spectroscopy 10Hrs

Vibrational Energy Levels, Selection Rules, Force Constant, Fundamental Vibration requencies, Factors influencing Vibrational Frequencies (Vibrational Coupling, Hydrogen Bonding, lectronic effect, Bond Angles, Field Effect). Sampling Techniques, Absorption of Common functional Groups, Interpretation, Finger print Regions.

Applications in Organic Chemistry

(a) Determining purity and quantitative analysis.
(b) Studying reaction kinetics.
(c) Determining purity and quantitative analysis.
(d) Studying hydrogen bonding.
(e) Studying molecular geometry & conformational analysis.
(f) Studying reactive species

6. Solution of Structural Problems by Combined Use of the following Spectroscopic Techniques 10Hrs

(a) Electronic spectra
(b) Vibrational spectroscopy
(c) NMR (1H and 13C) spectroscopy
(d) Mass Spectroscopy

BOOKS PRESCRIBED:

1. Pavia, Lampman&Kriz, Introduction to Spectroscopy.
2. C.N Banwell "Fundamentals of Molecular Spectroscopy".
3. R. M. Silverstein, G.C.Bassler, T.C. Morrill, "Spectrometic Identification of Organic Compounds.
4. W. Kemp, "Organic Spectroscopy".
5. D.H. Williams, I. Fleming, "Spectroscopic Methods in Organic Chemistry".
6. D.H. Williams, I. Fleming, "Spectroscopic Problems in Organic Chemistry", 1967.
7. R.C. Banks, E.R. Matjeka, G. Mercer, "Introductory Problems in Spectroscopy", 1980.
8. G.M. Barrow "Introduction to Molecular Spectroscopy".

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Learn the basic principles of interpret uv-visible, vibrational, 1-D and 2-D NMR and Mass spectroscopy for the structure identification of organic compounds
CO2	Students will gain an understanding of molecular-level critical thinking skills
CO3	Analyze and interpret uv-visible, vibrational, 1-D and 2-D NMR and Mass spectral data of organic compounds
CO4	Analyze the mass of organic molecule and fragments present in the molecule from mass spectral studies
CO5	Evaluate various structural possibilities and arrive at the most logical structure of organic compounds by analysis and interpretation of uv-visible, vibrational, 1-D/ 2-D NMR and Mass spectral data.

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-I)

Computer for Chemists

CSC 111

Credit Hours: 4/week
Total Hours: 60
Total Marks: 50
Theory Marks: 18
Theory Internal Assessment Marks: 07
Practical Marks: 18
Practical Internal Assessment Marks: 07

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Note: 1. Medium of Examination is English Language.
2.The question paper covering the entire course shall be divided into three sections.

The paper will consist of 30 Hours of teaching in class room and 15 sessions of 2 hours of practical training on computers. The theory will be of 25(18+7) marks and practical would be of 25(18+7) marks. The students would prepare a record of the programs written by them along with the outputs.

Section A: It consists of 4 questions and each question carries 1 mark. All Questions are compulsory to attempt. Total weightage of this section will be 04 Marks.

Section B: It consists of 4 Questions and attempt any 2 questions. Each question carries 3.5 marks. Total weightage of this section will be 07 marks.

Section C:It consists of 4 Questions and attempt any 2 questions. Each question carries 3.5 marks. Total weightage of this section will be 07 marks

COURSE OBJECTIVES:

1. *To comprehend how C works. To become familiar with the grammar and semantics of the C programming language.*
2. *To figure out how to plan C classes for code reuse.*
3. *To figure out how to carry out duplicate constructors and class part works. To give complete information on C language. Understudies will figure out how to configure programs essentially.*

COURSE CONTENTS:

Unit-I

Principles of programming, algorithms and flowcharts.

Elementary programming, a typical C program, printf function.

Introduction of declarations, assignments and variables: concept of an integer, concept of a variable, rules for naming variables, assignment statement, arithmetic operators.

Integer arithmetic expressions, truncation effects, relative priority of arithmetic operators, use of parenthesis, modulus operator.

Floating point numbers, scientific notation, converting integers to floating point and vice versa coercion and cast operator, type char.

Unit-II

Decision making in C, scanf function, relational operators, logical operators, if statement, if else statement, nesting of if statement. The while loop, do while loop, for loop, nesting of for loop. Type char and ASCII code, character strings and how to print them, octal and hexadecimal notation. User defined functions, returning value from a function, functions with more than one parameters. Arrays, declaring an array, initializing an array, break statement, strings and character arrays, sorting an array, finding maximum and minimum in an array, multidimensional arrays. Input and output.

Practical

*Practical Based on Microsoft Word and Microsoft PowerPoint
*Computer programs to be done in practical class:
Development of small computer codes involving simple formulae in chemistry:
1. Calculation of mean, median, mode.
2. Solution of a quadratic equation.
3. Calculation of linear regression.
4. Calculation of curve linear regression.
5. Calculation of Bohr orbit from de Broglie Lambda for electron.
6. Calculation of wave number and frequency from value of wave length.
7. Calculation of van der Waals radii.
8. Radioactive decay.
9. Rate constant of a 1st order reaction, 2nd order reaction.
10. Calculation of lattice energy using Born Lande equation.
11. Addition, multiplication and solution of inverse of 3 X 3 matrix.
12. Calculation of average molecular weight of a polymer containing n1 molecules of molecular weight m_1, n_2 molecules of molecular weight M_2 and so on.
13. Program for calculation of molecular weight of organic compound containing C, H, N, O and S.
14. Calculation of reduced mass of diatomic molecule.
15. Calculate the RMS and most probable velocity of a gas.
16. Calculate the ionic mobility from ionic conductance values.
17. Determine the thermodynamic parameters for isothermal expansion of monoatomic ideal gas.
18. Calculation of value of g- factor from value of J and S.
19. Calculate the bond length and bond angles using crystal structure data.

BOOKS PRESCRIBED:

1. K.V. Raman, Computers in Chemistry, Tata McGraw Hill.
2. Mullish Cooper, The spirit of c, An Introduction to Modern Programming.
3. "Let Us C" by Yashavant Kanetkar
4. Programming with C by Byron S. Gottfried , Tata McGraw Hill

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	**CO-1.** Figure out the basics of C programming.

CO2	Understudies will secure information and abilities in programming. In addition, this programming will assist them with making programs and applications in C.
CO3	Additionally, by learning the essential programming builds, they can undoubtedly switch over to any another language in future.
CO4	Develops a basic understanding of computers, the concept of algorithms and algorithmic thinking.
CO5	Develops the ability to analyse a problem and develop an algorithm to solve it.

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-I)

CHE 415/CHH 415

Inorganic Chemistry Lab-I

Quantitative analysis

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. The exam will be conducted on two sessions ie Morning and Evening
II. Students will perform two practicals.
III Students will be asked to complete write up of both practical within first 30 minutes on the first sheet provided.
IV. On the second sheet provided after 30 minutes, students will perform and note the record on second sheet during the conduct of practical exam
V. The split of marks will be as under:
(Write-up = 25, Performance = 25, Viva-Voce = 20, Practical notebook = 5)

COURSE OBJECTIVES:

To analyze quantitative estimation of metal ions and anions using Oxidation-Reduction Titrations, . Precipitation Titrations , Complexometric Titrations and Gravimetric Analysis

COURSE CONTENTS:

I. Oxidation-Reduction Titrations

1. Standardization with sodium oxalate of $KMnO_4$ and determination of Ca^{2+} ion.
2. Standardization of ceric sulphate with Mohr's salt and determination of Cu^{2+}, NO_3^{-1} and $C_2O_4^{-2}$ ions.
3. Standardization of $K_2Cr_2O_7$ with Fe^{2+} and determination of Fe^{3+} (Ferric alum)
4. Standardization of hypo solution with potassium iodate / $K_2Cr_2O_7$ and determination of available Cl_2 in bleaching powder, Sb^{3+} and Cu^{2+}.
5. Determination of hydrazine with KIO_3 titration.

II. Precipitation Titrations

1. $AgNO_3$ standardization by Mohr's method by using adsorption indicator.
2. Volhard's method for Cl^- determination.
3. Determination of ammonium / potassium thiocyanate.

III. Complexometric Titrations

1. Determination of Cu^{2+} and Ni^{2+} by using masking reagent by EDTA titration.
2. Determination of Ni^{2+} (back titration).
3. Determination of Ca^{2+} (by substitution method).

IV. Gravimetric Analysis

1. Determination of Ba^{2+}as its chromate.
2. Estimation of lead as its lead molybdate.
3. Estimation of chromium (III) as its lead chromate.
4. Estimation of Cu^{2+}using Ammonium/ Sodium thiocyanate.

BOOKS PRESCRIBED:
Book: Vogel's book on Inorganic Quantitative Analysis.

COURSE OUTCOMES:

S. No.	**On completing the course,**
CO1	Prepare the exact solution and Standardization for quantitative analysis of the solutions.
CO2	Determination of different ions like Ca2+, Fe2+, Oxalate, nitrate, available chlorine in bleaching powder using oxidation reduction titrations
CO3	Able to perform Precipitation Titrations using Volhard's method and Mohr's methods
CO4	Determination of different ions (Cu2+, Ni2+ and Ca2+) using Complexometric Titrations
CO5	Estimation of ions using gravimetric techniques.

Academic Session: 2022-23

M.Sc. Chemistry (Semester-I)

CHE416: Organic Chemistry Lab-I

Quantitative analysis and Multistep Synthesis

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. The exam will be conducted on two sessions ie Morning and Evening
II. Students will perform two practicals.
III Students will be asked to complete write up of both practical within first 30 minutes on the first sheet provided.
IV. On the second sheet provided after 30 minutes, students will perform and note the record on second sheet during the conduct of practical exam
V. The split of marks will be as under:
(Write-up = 25, Performance = 25, Viva-Voce = 20, Practical notebook = 5)

COURSE OBJECTIVES:

This course aims to impart to the student knowledge of: Laboratory set up, safe handling of chemicals, workup procedures and effective disposal of organic waste. The practicals include various methods of preparing organic compounds in a multiple step as well as Quantitative Analysis of Organic Compounds.

COURSE CONTENTS:

1. Quantitative Analysis

(a) Extraction of Organic Compounds from Natural Sources

1. Extraction of Caffeine from tea leaves
2. Isolation of casein from milk (try some typical colour reactions proteins).

(b) Quantitative Analysis of Organic Compounds:

1. Estimation of phenol/aniline using bromate-bromide solution.
2. Estimation of reducing sugar by Fehling solution method.
3. To determine the saponification value of the given fat or oil sample.
4. To determine the iodine number of the given fat or oil sample.

2. Multistep Organic Synthesis

1. Synthesis of 2-chloro-4-bromoaniline from aniline (Bromination and chlorination)
2. Photochemical synthesis of benzpinacol and its pinacol rearrangement.
3. Synthesis of 2,4-dinitrophenyl hydrazine from chloro benzene. (Electrophilic and nucleophilic substitution reactions on aromatic ring).
4. Synthesis of 2-phenyllndole-Fischer Indole Synthesis. Synthesis of 3-nitrobenzoic from benzoic acid

5. Cannizaro's reaction of 4-chlorobenzaldehyde.
6. Green synthesis of dihydropyrimidones and their structure confirmation by spectroscopic techniques

3. Microwave Organic Synthesis

MW-assisted synthesis of substituted pyridines under solvent and catalyst free conditions

4. Introduction to softwares

Chem Draw. All the students should draw scheme of two Chemical synthesis on Chemdraw.

Schrodinger software: Molecular docking of Diclofenac (Anti-inflammatory drugs) in crystal coordinate of COX 2

BOOK PRESCRIBED:

1. Vogel's Textbook of Practical Organic Chemistry
2. Advanced Practical Organic Chemistry by N. K. Vishnoi
3. Lab Mehods in Organic Chemistry by Solomon Marmor
4. Yin G, Liu Q, Maa J, She N. Solvent and catalyst free synthesis of new hydroxylated trisubstituted pyridines under microwave irradiation. Green Chemistry, 2012, 14, 1796-98.

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Predict the results and identify errors associated with a chemical analysis based on the analytical technique and nature of the sample.
CO2	Justify the steps to prepare and standardize different solutions.
CO3	Hands on expertise to synthesize organic compounds.Able to check Purity of organic compounds & the progress of the reaction by performing TLC Techniques individually
CO4	To characterize the structure of the organic compound by interpreting IR, UV, 1H NMR and Mass spectral data.
CO5	Gain hands-on practice of handling Laboratory Equipment.

Semester-II

Academic Session: 2022-23

M.Sc. Chemistry (Semester-II)

CHE 421: Inorganic Chemistry-II

Reaction Mechanism, Organometallics and Catalysis

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of nine short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

The main objective of this course is to Impart knowledge on organometallic compounds and their catalytic applications. in addition to this oxidation reactions and ligand replacement reactions are explained with examples.

COURSE CONTENTS:

UNIT-I 15Hrs

Energy,polarity and reactivity of M-C bond,stability and lability of main group organometallics and their preparation.

Li organometallics: Structure,bonding and reactions. Carbolithitian. Organometallics of group 2 and 12:

Organometallics of Be and Mg: Preparation, mechanism of formation and constitution,Grignard reagent in solution and reactions.

Organometallics of Zn,Cd,Hg: Preparation,structure and properties.Technical applications of tris(alkyl)aluminium compounds.

Organometallics of transition elements:EAN rule and MOT relationship in O_h sigma and O_h sigma and π bonding.The particular case of d^8 and d^{10}complexes.Sigma and π donor/acceptor ligands.

UNIT-II 15Hrs

Olefin complexes: Preparation,structure and bonding.Alkyne and allyl complexes: Preparation,structure and reactions. Complexes of cyclic π parameter C_nH_n; Sandwich complexes, Half sandwich complexes, Multidecker sandwich complexes,Tilted sandwich structure, complexes with more than two C_nH_n ligand. C_4H_4 and $C_5H_5^-$

Organometallics: Preparation,structure,reactions and bonding. MOT for ferrocene and bis(benzene)chromium(0) : preparation and reactions. Cycloheptatrienyl and COT complexes: preaparation and structure and bonding.

Catalytic reactions and 16/18 electron rule,alkenemetathesis,Chauvin mechanism, Olefin polymerization,Ziggler-Natta polymerization,Cosseemechanism,hydrogenation of alkenes, Wilkinson's catalyst,Fischer-Tropsch reactions, water gas shift reactions,Monsanto acetic acid process,hydrocyantion,Reppecarbonylation, hydroformylation of unsaturated compounds.

UNIT-III 15Hrs

Reductive carbonylation of alcohols and other compounds,carbonylation reactions: methanol and methyl acetate,adipic ester and other compounds,synthesis and carbonylationreactions,decarbonylationreaction,catalytic addition of molecules to carbon-carbon multiple bonds,homogeneoushydrogenation,hydrocyanation and hydrosilation of unsaturated compounds,polymerization.Oligomerisation and metathesis of alkene and alkynes.Cluster compounds in catalysis,supported homogeneous and phase transfer catalysis, oxidation reactions,oxidativecarbonylation. Pdcatalysed oxidation of ethylene,acrylonitrilesynthesis,oxygen transfer from peroxo and oxo species and NO_2 groups.

Ligand replacement reaction,Labile and Inert complexes and CFT, water exchange rates,formation of complexes from aqueous ions,Anation,Aquation and acid-base hydrolysis,Mechanism of acid hydrolysis when inert ligand is a π donor/acceptor and cis to leaving group,attack on ligands.

Substitution in square palanar complexes, factors,transeffect,its theories and applications,Kurnakov test.

UNIT-IV 15Hrs

Metal carbonyl reactions,reactions of binuclear carbonyls,associativereactions,species with 17 electrons,electron transfer processes,orbital occupation effects on substituition reactions of octahedral complexes.Synthesis of coordination compounds by substituitionalreactions,synthetic chemistry of some cobalt and plataniumcomplexes.Marcus theory and applications,electron transfer reactions,doubly bridged inner sphere,electrontransfer,other electron transfer,two electron transfer reactions,complimentary and non-complimentary reactions.Ligand exchange *via* electron exchange, Stereochemical non-rigidity of complexes and oraganometalics and NMR,trigonal and trigonalbipyramidmolecules,system with coordination number 6 and more.Isomerisation and racemisation of tris chelates complexes and mechanism.Metal carbonyl scrambling,Rotation within coordination sphere.

BOOK PRESCRIBED:

1) F.A.Cotton and I.G. Wilkinson,Advanced Inorganic Chemistry,5thed.New YORK 1988.
2) Organometallics by Salzer.

COURSE OUTCOMES:

S. No.	On completing the course,

CO1	The course gives a thorough introduction to organometallic chemistry with focus on the transition metals. catalysis
CO2	Students will be able to study the wide variety of organometallic compounds and the choice of hapticity in different conditions.
CO3	Students will be able to understand the role of coordination number, coordination geometry and oxidation state of metal in catalytic cycles.
CO4	Structure and bonding issues in organometallic compounds are discussed in view of the 18-electron rule.
CO5	Students will learn to go through some important emerging compounds especially multidecker sandwich compounds

Academic Session: 2022-23

M. Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-II)

CHE 422/CHH 422

Organic Synthesis-II

Reaction Mechanism- Addition, Elimination and Rearrangements

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of nine short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

The course aims to provide students with an in-depth knowledge of different types of reaction mechanisms i.e. addition, elimination, coupling and rearrangement reactions of aliphatic and aromatic organic compounds. The course further provides the insights into the utility of various oxidising and reducing agents.

COURSE CONTENTS:

UNIT-I

1. Addition to Carbon-carbon and Carbon-Hetero Multiple Bonds-I 15Hrs

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropanering.Hydrogenation of double and triple bonds, hydrogenation of aromatic rings.Hydroboration.Michaelreaction.Sharpless asymmetric epoxidation. Addition of Grignard reagents, organozinc, organolithium and Gillman reagents to carbonyl and unsaturated carbonyl compounds. Use of other organometallic reagents in addition reactions. Wittig reaction,

UNIT-II

2. Addition to Carbon-carbon and Carbon-Hetero Multiple Bonds-II 5Hrs

Mechanism of condensation reactions involving enolates – Aldol,.Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.
Hydrolysis of esters and amides, ammonolysis of esters.

3. Rearrangements and Coupling Reactions 10 Hrs

General mechanistic consideration – nature of migration, migratory aptitude, memoryeffects. A detailed study of the following rearrangements, Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber,Beckmann, Hofman, Curtius, Schmidt, Shapiro reaction, Fries rearrangement.Reaction and mechanism of Diazo coupling, Glaser coupling, Heck reaction, Mcmurry reaction, Stille coupling, Suzuki coupling, Sonogashira reaction. Negishi and Hiyama coupling.

UNIT-III

4. Elimination Reactions: 7 Hrs

The E_2, E_1 and E_1cB mechanisms and their spectrum.Orientation of the double bond. Reactivity – effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

5. Oxidation Reactions: 8 Hrs

Indtoduction.Different oxidative processes. Hydrocarbons- alkenes, aromatic rings, saturated C-H groups)activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxyalicacids.Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzenediacetate and thallium (III) nitrate, DDQ, PCC, CAN, selenium dioxide, peroxyacids, DCC. Oxidation reactions with special emphasis on Baeyer-villeger reaction, Cannizarro oxidation-reduction reaction,

UNIT-IV

6. Reduction Reactions: 15 Hrs

Introduction. Different reductive processes, Hydrocarbons- alkanes, alkenes, alkynes and aromatic rings, Carbonyl compounds – aldehydes, ketones, acids, ester and nitriles. Epoxides, Nitro, nitroso, azo and oxime groups, Hydrogenolysis. Sodium borohydride, sodium cyanoborohydride, LAH, disobutylaluminium hydride, tin hydride, trialkyl tin hydride, trialkylsilanes, alkoxy substituted LAH, DIBAL, diborane, diisoamylborane, hexyl borane, 9-BBN, isopinocamphenyl and disiopinocamphenylborane. Reduction reactions with particular emphasis on Wolf-Kishner reduction, Clemensen reduction.

BOOK PRESCRIBED:

1. Organic Reaction Mechanism by Jerry March, John Wiley Ed. 5, 2002.
2. Advanced Organic Chemistry by Francis Carey, Vol A and vol B

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Students will learn about the various chemical reagents available for addition to carbon-carbon/carbon-heteroatom multiple bonds.
CO2	Students will be able to explain the mechanism of different types of elimination, and rearrangement reactions.
CO3	Students will get insight into the utilization of Pd, Ni, Titanium and silicon in coupling of two molecular entities and their vast applications in organic synthesis.
CO4	Students will study important oxidizing agents and oxidation reactions used in

	organic synthesis.
CO5	Students will acquire knowledge of reducing agents and their applications in organic synthesis.

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-II)

CHE 423/CHH 423

Physical Chemistry-II

Quantum Chemistry

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of nine short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

The main objective of the course is to train the students for applying the principles of Quantum Mechanics on different type of motions like translation, rotation, vibration and electronic motions to show the quantisation of related energies. Moreover the simple solution of Uni-electron system will be extended to the solution of multi-electron systems through approximation methods.

COURSE CONTENTS:

UNIT-I

1. Quantum Theory: Introduction and Principles 15Hrs

Black body radiations, planck's radiation law, photoelectric effect, Compton effect, De- Broglie hypothesis, the Heisenberg's uncertainty principle, Rydberg relation for explaining atomic spectrum of hydrogen. Bohr's Theory and its limitation solution of classical wave equation by separation of variables method.

UNIT-II

2. Quantum mechanical operators 6 Hrs

Operators and observations, normal and orthogonal functions, hermitian and unitary operators, introduction to differentiation and integration, Eigen value equation. Hamiltonian operator, interpretation of wave function, postulates of quantum mechanics.

3. Applications of Quantum Postulates 9Hrs

Solution of particle in one and three dimensional box, degeneracy, the linear harmonic oscillator, rigid rotators, quantization of vibrational and rotational energy levels, hydrogen atom.

UNIT-III

3. Angular Momentum 7 Hrs

Commutative laws, need of polar coordinates, transformation of Cartesian coordinate into polar coordinate, angular momentum of one particle system, orbital angular momentum, the ladder operator for angular momentum, spin angular momentum and their relations.

4. The Approximate Methods 8 Hrs

Need for approximation methods, Perturbation and Variation methods and their application to Helium atom.

UNIT-IV

4. General Orbital Theory of Conjugated Systems 15Hrs

Chemical bonding, linear combination of atomic orbital, overlap integral, coulomb's integral, bond order, charge density calculations for ethylene, allyl system, butadiene system, cyclo butadiene cyclopropenyl system.

BOOK PRESCRIBED:

1. Physical Chemistry, A Molecular Approach by MacQuarrie and Simon.
2. Quantum Chemistry, Ira N. Levine, Prentice Hall.
3. Quantum Chemistry, H. Eyring, Kimball and Walter.
4. Quantum Chemistry, Atkin.
5. Fundamentals of Quantum Chemistry, Anantharaman. R.

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Phenomenon of Black body radiation, photoelectric effect, Compton effect, De-Broglie hypothesis, the Heisenberg's uncertainty and classical wave equation and its solutions
CO2	Concepts of operators, their types, uses and Quantum Mechanical Model of atom.
CO3	Application of Quantum Mechanics to deduce the quantization of Translational, Rotational, Vibrational and Electronic energies.
CO4	Application of Quantum Mechanical model on Single electron system like H-atom and Solution for multi-electron system through Approximation methods
CO5	Understanding orbital and spin angular momentum and related Ladder Operators along with HMO theory and its application on various conjugated pi-electron systems

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-II)

CHE 424/CHH 424

Spectroscopy-B

Techniques for Structure Elucidation of Inorganic Compounds

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 75
Theory: 56
Internal Assessment: 19

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of EIGHT questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of eight short questions carrying 1 Marks each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 12 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

This course aims to impart to the student the knowledge of basic concepts of vibrational spectroscopy and its applications. The fundamental aspects of classifying molecules based on moment of inertia. The students will learn about the principles, applications and instrumentation of different molecular spectroscopic methods like Raman spectroscopy, NQR, Photo Electron Spectroscopy, Mössbauer Spectroscopy and Electron Spin Resonance Spectroscopy .

COURSE CONTENTS:

UNIT-I

1. Vibrational Spectroscopy 20 hrs

Theory of Infrared Absorption: Harmonic and anhormonic oscillators, absorptions of radiation by molecular vibrations, selection rules, force constant, frequency of vibrational transitions of HCl, vibrations in a polyatomic molecule, 3N-6 and 3N-5 rules, types of vibrations, overtones, combination and difference bands, examples of CO_2, SO_2, and H_2O, Fermi resonance, group vibrations.

Raman Spectroscopy: Introduction, selection rules, anisotropic polarizability, Stokes, anti-Stockes lines, vibrational Raman spectra of CO_2 and H_2O, polarised and depolarised Raman lines, rule of mutual exclusion, vibronic coupling.

Determination of I.R/Raman Active Modes**:** Significance of nomenclature: used to describe various vibrations, use of symmetry considerations to determining the number of active infrared and Raman lines (character tables to be provided in the Examination).

Sample handling. Factors affecting absorption frequencies.Interpretation and finger printing regions. Applications of Raman and I.R selection rules to the determination of Inorganic structure with special emphasis on:

i) Metal carbonyls
ii) NSF_3
iii) Geometrical isomerism – differentiation between Cis and trans $[Co(bipy)_2Cl_2]Cl$.
iv) Structures of CO_2, N_2O, H_2O, chlorocomplexes of mercury, cadmium and zinc, and octahedral complexes SiF_6^{2-}, PF_6^-, SF_6.
v) Changes in the spectra of donor molecules upon coordination with special emphasis on N, N-dimethylacetamide and DMSO with Fe^{3+}, Cr^{3+}, Zn^{2+}, Pd^{2+} and Pt^{2+} ions. I.R spectroscopy and modes of coordination of SO_4^{2-}, N_2, O_2, NO, CO_3^{2-}, NO_3^-.

UNIT-II

2. Pure Rotational Spectra 10 **hrs**Classification of molecules according to their moment of inertia.Rotational spectra of diatomic molecules (rigid rotator), Intensities of spectral lines, isotopic substitution effects, non-rigid rotator, polyatomic linear and symmetric top molecules, Stark effect.

3. Nuclear Quadruple Resonance Spectroscopy 10 hrs

Introduction, Experimental considerations, fundamentals of NQR spectroscopy, origin of EFG, measurement of energy differences between two nuclear spin states, the asymmetry parameters, effects of magnetic field, crystal field. Interpretation of spectra, application of the technique to halogen compounds (Organic), group elements, transition metals. Double resonance technique.

UNIT-III

4. Photo Electron Spectroscopy 10 hrs

Introduction, excitation and ejection of electrons, electronic energy in atoms and molecules, core level PES, symmetry and molecular orbitals, molecular orbital diagrams of dinitrogen and dioxygen, their XPS spectra, Valence electron photoelectron spectroscopy, Franck Condon principle, dissociation, predissociation, change of shapes of molecules on excitation.

5. Mössbauer Spectroscopy 10hrs

Principle, experimental considerations, conditions of MB Spectra, the spectrum and its parameters, simple spin states (I ½, 3/2), higher spin states (I > 3/2), magnetic splitting significance of parameters obtained from spectra, quadruple splitting, additive model, interpretation of MB Spectra of ^{57}Fe, ^{119}Sn. Application to biological systems, surface study, and compounds of group elements.

UNIT-IV

6. Electron Spin Resonance Spectroscopy 20hrs

Introduction, principle, brief instrumentation of spectrum, hyperfine splitting in isotropic systems involving more than one nucleus, ESR spectrum of benzene radical anion, methyl radical, CH_2OH, H_3CCH_2 radical, cyclopentadienyl, cycloheptatrienyl radical, pyrazine anion, pyrazine anion with ^{23}Na and ^{39}K counter ion and p-benzosemiquinone, DPPH, Naphthalene. Factors affecting magnitude of g values, zero field splitting, and Krammer's degeneracy. Qualitative survey of EPR spectra of first row transition metal ion complexes (d^1, d^2, d^3, low spin d^5, high

spin d^6, d^7, d^9 system). Spectra of triplet states, rate of electron exchange, double resonance (ENDOR, ELDOR)

BOOK PRESCRIBED:

1) R. S. Drago, "Physical Methods in Chemistry". W.B Saunders Company.
2) C. N. Banwell, "Fundamentals of Molecular Spectroscopy".
3) R. V. Parish, "NMR, NQR, EPR & Mossbauer spectroscopy in Inorganic Chemistry". Ellis Horwood, London, 1990.
4) G. M. Barrow, "Introduction to Molecular Spectroscopy".
5) E. A. Ebsworth, S. Craddock and D. W. H. Rankin, "Structural methods in Inorganic Chemistry".Blackwell Scientific Publications (1991).
6) C. N. R. Rao and J. R. Ferraro, "Spectroscopy in Organic Chemistry, Vol. I". Academic Press (1971)
7) Walker and Straughan, "Spectroscopy, Vol I and III".

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	To get basic idea and application of IR spectroscopy and Raman spectroscopy
CO2	To learn applications of Rotational spectroscopy in inorganic molecules.
CO3	Introduced about NQR spectroscopy.
CO4	applications of photoelectron spectroscopy
CO5	learned principle of EPR spectroscopy and Mossbauer spectroscopy and structure elucidation of inorganic compounds

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) Semester-II)

CHE 425/CHH 425

Organic Synthesis-III

Supramolecular, Reactive Intermediates and Disconnections

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of nine short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVE:

The course aims to design and develop novel technique in the planning of organic syntheses for functional systems by joining multiple chemical components through non-covalent interactions.

COURSE CONTENTS:

UNIT-I

1. Supramolecular Chemistry-I

(a) Concepts 5Hrs

Definition and Development of Supramolecular Chemistry, classification of Supramolecular Host-Guest compounds, Pre- organization and Complementarily, Receptors, Nature of Supramolecular interactions.

(b)Binding of anions and neutral molecules 10Hrs

Biological anion receptors, concepts on anion host design, Fromcation to anion hosts-a simple change in pH, Guanidinium- based receptors, Neutral receptors, organometallic receptors, coordination interactions. Inorganic solid state clathrate compounds, solid state clathrates of organic hosts, intracavity complexes of neutral molecules, supramolecular chemistry of fullerenes.

UNIT-II

2. Supramolecular Chemistry-II

(c) Cation Binding Host 7Hrs

Crown ethers, Lariat ether and Podands, Cryptands, spherands, selectivity, Macro cyclic, Macrobicyclic and Template effects, soft ligands, calixarenes, carbon donor and - acid ligands, siderophores.

(d) Crystal Engineering and Molecular Devices 8Hrs

Concepts, crystal structure prediction, Crystal Engineering with hydrogen bonds, weak hydrogen bonds, hydrogen bonds to metals and metal hydrides, π- πstacking, coordination polymers. Introduction, Supramolecular photochemistry, molecular electronic devices: Switches, wires and rectifiers, machines based on catenanes and rotaxanes.

UNIT-III

3. Organic Reactive Intermediates-I 15Hrs

(a) Carbanions: Chemistry of enolates and enamines, kinetic and thermodynamic enolates, Lithium and boron enolates in aldol and Michael reactions, alkylation and acylation of enolates, Nucleophilic additions to carbonyls and streroechemical aspects through various models (crams / cram chelation / Felkin-Anh models)

(b) Carbocations: Structure and stability of carbocations, classical and non classicalcarbocations, Neighbouring group participation.

(c) Carbenes and Nitrenes: Structute, generation addition and insertion and rearrangement reactions of carbenes such as wolf rearrangement. Generation of ylids by wolf decomposition.Structure, generation and reactions of nitrene and related electron deficient nitrogen intermediates.

UNIT-IV

4. Organic Reactive Intermediates 8Hrs

(d) Ylids: Chemistry of Phosphorous and Sulphurylids-Wittig and related reactions, Peterson olefination etc.

(e) Radicals: Generation of radical intermediates and its addition to alkenes, alkynes for C-C bond formation and Baldwins rule. Fragmanetation and rearrangements reactions like decarboxylation, McMurry coupling etc.

5. Disconnection approach 7Hrs

An introduction to synthons and synthetic equivalents, disconnection approach, functional group interconversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, amine synthesis.

BOOK PRESCRIBED:

1. J.W Steed and J.L Atwood, Supramolecular chemistry, John Wiley & Sons, Ltd. New York.
2. Designing Organic Synthesis, S. Warren, Wiley
3. Organic Synthesis- Concepts, Methods and Starting Materials, J. Fuhrhop and G.

Penzillin, Verlag VCH.
4. Advanced Organic Synthesis Part A and B, F.A. Carey and R. J. Sundberg, Plenum Press.
5. Principles of Organic Synthesis, R. Norman and J. M. Coxon, Blackie Acdemic& Professional
6. *Modern Methods of Organic Synthesis* Cambridge University Press (1971). Carruthers,
7. Reactive Intermediates, Gilchrist and Rees

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	To learn introductory concepts of supramolecular chemistry
CO2	To learn the binding of various metals with synthetic and natural cationic hosts
CO3	To understand the logics involved in anion binding by different hosts including solid state clatharates and fullerenes
CO4	To develop the concept involved in Crystal Engineering
CO5	To learn the construction of molecular devices such as molecular wires, rectifiers and switches
CO6	To acquire an in depth knowledge of various reactive intermediates viz. Carbocations, carbanions, free radicals, carbenes and nitrenes
CO7	To understand retrosynthetic methodology of going from a target molecule to simple starting compound
CO8	To learn the concept of disconnection, functional group interconversions, synthons and their corresponding synthetic equivalents

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-II)

MH CHX 421: Mathematics for Chemists

For Medical Students

Medium: English **Credit Hours: 3 Hrs/week**
Time 3 Hrs **Total Hours: 45**
Maximum Marks: 25
Theory: 18
Internal Assessment: 7

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of eight short questions carrying ½ Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry3½ Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

1. To help the students to understand the relationships between side lengths and angles of triangles.
2. To make the students able to describe the angles that are created when atoms bond together to form molecules in molecular geometry.
3. To acquaint the students with the trigonometry and its properties.
4. To solve problems related to matrices, determinants, derivatives and integrals.
5. To calculate Area under a curve using integration.

COURSE CONTENT:

UNIT-I

1. Trignometry **11 Hrs**

Definition of sin, cos, tan, cot, sec, cosec functions with the help of unit circle, values of sin x,cos x for x = 0, π/6, π/4, π/3, π/2. Meaning of a trigonometrical identity. The following identities (no need of derivation and proof. However, application has to beemphasized).

UNIT-II

2. Determinants and Matrices **11 Hrs**

Definition and expansion properties of determinants, product of two determinants of 3rdorder. Introduction to various terms Matrix, row, column, diagonal unit. Sub, square,

equal matrices, null, symmetricular, order of, character of, transpose of, adjoint of, inverse of matrices. Addition multiplication, diagonalization, similarity transformation of matrices, characteristic equation statement of CayleyHumilton theorem. Rank of matrix, condition of consistency of a system of linear equations. Eigen vectores and Eigen values using matrices.

UNIT-III

3. **Differential Calculus** **12 Hrs**

Differentiation of standard functions, theorems relating to the derivative of the sum, difference, product and quotient of functions, derivative of trigonometric functions, inverse trigonometric functions, logarithmic functions and exponential functions, differentiation of implict functions, logarithmic differentiation.

UNIT-IV

4. **Integral Calculus** **11 Hrs.**

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

BOOKS PRESCRIBED:

1. Santi Narayan – Differential Calculus.
2. Santi Narayan - Integral Calculus.
3. B.S. Grewal – Higher Engineering Mathematics.
4. Joseph B. Dence – Mathematical Techniques in Chemistry.
5. Margenau and Murphy, the Mathematics of Physics and Chemistry.
6. B.L. Moncha and H.R. Choudhary – A Text Book of Engineering Mathematics.

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Students will be able to understand the relationships between side lengths and angles of triangles.
CO2	Students will be able to describe the angles that are created when atoms bond together to form molecules in molecular geometry.
CO3	Students will be acquainted with the matrices, determinants, derivatives and

	integrals.
CO4	Students will be able to calculate Area under a curve using integration.

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-II)

BT CHX 421

Biology for Chemists

For Non-Medical Students

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25
Theory: 18
Internal Assessment: 7

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

1. Examiner will set total of ten questions comprising THREE questions from each unit carrying 3 marks and ONE compulsory question of short answer type of 4 marks covering the whole syllabi.
2. The students are required to attempt SIX questions in all, atleast ONE question from each unit and a Compulsory question.

COURSE OBJECTIVES:

1. To understand the basic cell structure and role of biologically important molecules.
2. To study the basic principle of heredity and gene expression.
3. To learn the taxonomic criteria of classification of living things.
4. To study the basic structure of viruses.

COURSE CONTENTS:

UNIT-I

1. The Organization of life (10 Hrs.)

- Biologically important molecules: Carbohydrates, lipids, proteins and nucleic acids.
- The life of cells- The cell theory, general characteristics of cells, difference between prokaryotic and eukaryotic cells, difference between plant and animal cells, Cell organelles.
- Animal tissues; epithelial tissues, connective tissues, muscle tissue, nervous tissue and neoplasias; plant tissue: meristematic tissue, permanent tissues.

UNIT-II

2. Genetics (10 Hrs.)

- The basic principle of heredity: Mendel's laws, monohybrid cross, dihybrid cross.
- DNA-Double helix structure and replication.
- Genes expression: Transcription and translation, genetic code.

UNIT-III

3. The Diversity of Life (10 Hrs.)

- The classification of living things- criteria of classification, Whittaker's system of classification.
- Viruses, structure of viruses.

BOOKS PRESCRIBED:

1. Cord Biology – South Western Educational Publications, Texas, 2000

COURSE OUTCOMES:

CO-1	The chemical structure of biologically important molecules: Carbohydrates, lipids, proteins and nucleic acids and how physiological conditions influence the structures and reactivates of these biomolecules.
CO-2	The life of cells – The cell theory, general characteristics of cells, difference between prokaryotic and eukaryotic cells, difference between plant and animal cell and will know about the structure and functions of various cell organells.
CO-3	The anatomical structure of plants and animals by studying the Tissues, organs and organ systems: Animal tissues; epithelial tissues, connective tissues, muscle tissue, nervous tissue and neoplasias; plant tissue: maristematic tissue, permanent tissues.
CO-4	The scope and significance of genetics by imbibing the principles of hereditary genetic transmission and interactions of gene with environment.
CO-5	The genes at molecular level, structure of DNA, DNA replication. Gene expression: transcription and translation and genetic code.
CO-6	The taxonomic nomenclature and criteria of classification, Whittaker's systems of Classification and their characteristics.
CO-7	The important and diversified groups of microorganism in nature and their classification.

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-II)

CHE 426/CHH 426

Physical Chemistry Lab-I

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. The exam will be conducted on two sessions ie Morning and Evening
II. Students will perform two practicals.
III Students will be asked to complete write up of both practical within first 30 minutes on the first sheet provided.
IV. On the second sheet provided after 30 minutes, students will perform and note the record on second sheet during the conduct of practical exam
V. The split of marks will be as under:
(Write-up = 25, Performance = 25, Viva-Voce = 20, Practical notebook = 5)

COURSE OBJECTIVES:

This course aims to impart to the student knowledge of: Laboratory set up, calibration and handling and use of instruments like pH-meter, Conductometer, potentiometer, tensiometer, Abbe's Refractometer and Polarimeter for the qualitative and quantitative analysis.

COURSE CONTENTS:

1. To determine the strength of given acid by *p*H metrically.
2. To determine dissociation constant of given acid *p*H metrically
3. Titration of weak acid conductometrically
4. Titration of strong acid conductometrically
5. To determine dissociation constant of given acid conductometrically
6. Determine the dissociation constant of acetic acid in DMSO, DMF, dioxane by titrating it withKOH.
7. Determine the activity coefficient of an electrolyte at different molalities by e.m.f. measurements.
8. Compare the cleansing powers of samples of two detergents from surface tension measurements.
9. Determine the specific refraction, molar refraction and atomic parachor with the help of Abbe's refractometer.
10. To study the distribution of benzoic acid between benzene and water.
11. Determine the equilibrium constant of reaction K_1+ +l_2→ Kl_3 by distribution law and hence Findthe value of GO of the above reaction
12.Compare the relative strength of CH_3COOH and $ClCH_2COOH$ from conductance

measurements.

13. Determine the solubility (g/litre) of sparingly soluble lead sulphate from conductance measurements.

14. Titrate a given mixture of HCl and CH_3COOH against NaOH solution conductometrically..

15. Compare the relative strength of:

i) HCl

ii) H_2SO_4

by following the kinetics of inversion of cane sugar polarimetrically.

BOOK PRESCRIBED:

Advance Practical Chemistry by J. B. Yadav

COURSE OUTCOMES:

S. No.	On completing the course, students will be able to
CO1	Use of Electro-methods like conductivity meter pH-meter for quantitative analysis.
CO2	Use of Electro-methods like pH-meter for quantitative analysis.
CO3	Use of Optical-methods like Abbe's refractometer for quantitative analysis
CO4	Use of Optical-methods like Polarimeter for quantitative analysis
CO5	Use of non-electrical methods like surface tension, distribution law and study of equilibrium

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-II)

CHE 427/CHH 27

Inorganic Chemistry Lab-II

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. The exam will be conducted on two sessions ie Morning and Evening
II. Students will perform two practicals.
III Students will be asked to complete write up of both practical within first 30 minutes on the first sheet provided.
IV. On the second sheet provided after 30 minutes, students will perform and note the record on second sheet during the conduct of practical exam
V. The split of marks will be as under:
(Write-up = 25, Performance = 25, Viva-Voce = 20, Practical notebook = 5)

COURSE OBJECTIVE:

The aim of this course is to impart practical skill to the pupil for synthesis and structure analysis of inorganic complexes.

COURSE CONTENTS:

(Any 8 Complexes.)

1. Preparation of $Co(acac)_3$, its characterization using NMR, IR, UV-Vis and analysis of Cobalt (ref. J. Chem. Edu., 1980, 57, 7, 525)

2. Preparation of Co. $(acac\text{-}NO_2)_3$, its characterization using NMR, IR, UV-Vis and analysis of Cobalt. (ref. J. Chem. Edu., 1980, 57, 7, 525)

3. Preparation of $[Fe(H_2O)_6][Fe(N\text{-salicyldeneglycinato})_2]_2.3H_2O$, its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Iron.(ref. InorganicaChimicaActa, 1977, 23, 35).

4. Preparation of $[Ni(NH_3)_6]Cl_2$its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Nickel and NH_3. (ref. Marr and Rockett, 1972).

5. Preparation of $[Ni(ethylenediamine)_3]Cl_2$ its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Nickel. (ref. Marr and Rockett, 1972, page 270).

6. Preparation of $[Fe(NO)(S_2CN(Et)_2)_2]$ its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Fe(II). (ref. Marr and Rockett, 1972, page 262, J. Chem. Soc. 1962, 84, 3404).

7. Preparation of octahedral and tetrahedral complexes of dichlorodipyridylcobalt(II), differentiate them using IR, UV and magnetic properties. Estimate Co(II) from one of them. (ref. Marr and Rockett, 1972, page 375, Inorganic Chemistry, 1966, 5, 615).

8. Preparation of $VO(acac)_2$and its piperidine complex, characterize using IR, UV and magnetic moment. Estimate for V(IV). (ref. Marr and Rockett, 1972, 243).

9. Preparation of diaquotetraacetataocopper(II), magnetic susceptibility IR and UV-Vis, analysis of Copper(II).

10. Preparation of cis- and trans- potassium dioxalatodiaquochromate(III). Interpretation of IR, UV and magnetic properties.Estimation of Chromium. (ref. Marr and Rockett, 1972, page 386).

11. Preparation of $HgCo(NCS)_4$, its IR and measure its magnetic moment. (ref. Marr and Rockett, 1972, page 365).

12. Preparation of sodium tetrathionate, interpretation of its IR and analysis using potassium iodate. (ref. Marr and Rockett, 1972, page 214).

13. Preparation of Potassium dithionate, interpretation of its IR and analysis using potassium iodate. (ref. Marr and Rockett, 1972, page 214).

14. Preparation of bis(acetylacetonato)copper(II), UV-Vis, and IR, magnetic studies, Demonstration of Jahn Teller effect by solution spectral studies. (ref. Bull. Chem. Soc. Japan, 1965, 29, 852).

15. Preparation of salicylamide complexes of Copper(II). IR, UV, magnetic data and analysis of Cu(II). (ref. Indian J. of Chem., 1977, 15A, No. 5, 459; ibid, 1971, 9, 1396).

16. To prepare a macrocyclic ligand 5,7,7,12,14,14-hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienedi(hydrogeniodide) and its complex with Ni(II). Study IR, NMR and UV-Vis of ligand and complex and magnetic properties of complex. To analyze for Ni and I. (J. Chem. Edu. 1977, 79, 581).

17. Preparation and resolution of tris (ethylenediamine) cobalt (III). UV-Vis, NMR, IR, optical rotation of the resolved complexes. ((ref. Marr and Rockett, 1972, page 386).

BOOK PRESCRIBED:

1. B.N. Figgis, Introduction to Ligand Field, Wiley Eastern.
2. A.B.P. Lever, Inorganic Electronic Spectroscopy, Elsevier.
3. A.Earnshaw, Introduction to Magnetochemistry, Academic Press.
4. J.E. Huheey, Inorganic Chemistry Principles of Structure and Reactivity, Harper Interscience.
5. R.S. Drago, Physical Medhod in Chemistry, W.B.Saunders Company.
6. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Int.

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Students learn how to synthesize inorganic complexes
CO2	Able to synthesize the geometrical isomers of the complexes
CO3	Analyze structure of inorganic complexes from spectral data
CO4	have hands-on experience/ practical knowledge in performing experiments
CO5	Able to get Practical knowledge about UV and FTIR

Semester-III

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-III)

CHE 531 / CHH 531

Inorganic Chemistry-III

Bioinorganic and Metal Clusters

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of nine short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

The main objective of this course is to help the students to understand the use of metals in biological systems, various aspects of coordination chemistry related to bioinorganic research, metallobiopolymers, their structure, function, role of metal ion, etc.

COURSE CONTENTS:

UNIT-I

1. (a)Bioinorganic Chemistry 15 Hrs

Periodic survey of essential and trace elements, biological importance and relative abundance, Na^+/ K^+ion pump and its mechanism.

Porphyrine and metalloporphyrins, Oxygen carriers/storage-Hb and Mb: Structure and mechanism of their function, cooperativity and Bohr effect. Synthetic models of Hb, Cyanide, phosphine and carbon monoxide poisoning.

Inhibition and poisoning by ligand and metal ions, hemocyanin and hemerythrin, models of iron, coalt and copper.

Bioenergetic and ATP cycle process coupled to phosphate hydrolysis, Nucleotide transfer-DNA polymerase, phosphate transfer pyruvate kinase, phosphoglucomutase, creatin kinase, ATPase.

UNIT-II

1. (b)Bioinorganic Chemistry 15 Hrs

Photosynthesis and respiration - chlorophyll : structure, function and its synthetic model. Xanthine oxidase, Gout Disease and its remedy.

Enzymes and their functioning, Bioredox agents, Zn-enzymes carboxipeptidase, carbonic anhydrase, superoxide dismutase, peroxidases and catalases,
Vitamin B_{12} coenzyme, structure, function and "Mn" mechanism and its application in organic synthesis, intake of alcohol and its remedy.
Cytochromes-structure and function, Cytochrome P_{450} enzymes.
Ferrodoxins and rubredoxins their structure and function. Abiological and biological N_2fixation and mechanism.

UNIT-III

1. (c)Bioinorganic Chemistry 15 Hrs

Ferritin, transferring and siderophores and their structure and function.
Availability, competition, toxicity and nutrition of Iron, metal deficiency and diseases, toxic effects of antibiotics, chealte therapy, synthetic metal chelates as antimicrobial agents.
Calcium in living cell, transport and regulation and its mechanism.
Molecular aspects of intramolecular processes and their mechanisms.

2. Metal Clusters
(a)Reaction at Coordinated ligands
The role of metal ions in the hydrolysis of amino acid esters, peptides, and amides Molecular orbital concept of role of metal ions participation, Modified aldol condensation, Imine formation, Template and Macrocyclic effect in detail.

UNIT-IV

(b) Metal to Metal Bonds and Metal atom Clusters 15 Hrs
Metal carbonyl clusters, isoelectronic and isolobal relationship, high nuclearity carbonyl clusters(HNCC), Structural Patterns, synthetic methods, heteroatoms in metal atom clusters
Carbide and nitride containing clusters, electron counting scheme for HNCC's, the capping rule, HNCC's for Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt.
Lower halides and chalcogenides clusters, octahedral metal halides and chalcogenidesclusters($M_6M_8M_6M_{12}$ type).
Cheveral phases, triangular clusters and solid state xtended arrays. Compound with M-M multiple bonds, major structural types, quadruple bonds, other bond orders.
Intragoonal context relation of clusters to multiple bonds and one dimensional solids.

BOOK PRESCRIBED:

1. Principles of Bioinorganic Chemistry, S. J. Lippard and Berg, University Science Books.
2. J.E. Huheey : Inorganic Chemistry III & IV Ed. Pearson Education Asia – (2002).
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 5th Edition.
4. Purcell and Kotz: Inorganic chemistry. W. B. Saunders and Co., London
5. Bioinorganic Chemistry by D. Banergia.

COURSE OUTCOMES:

S. No.	On completing the course,

CO1	Students will be able to analyse the relation between oxidation state of metals and their biological behaviour.
CO2	Students will be able to understand the role of metals and chemicals in biological systems.
CO3	Students will learn the use of porphyrins of different metal ions in biological systems
CO4	Students will be able to make a correlation between enzymatic functions and metals.
CO5	students will understand the structural features of biological systems involving metal ions and their activities and mechanisms

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-III)

CHE 532/ CHH 532

Organic Synthesis-IV

Natural Products

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of nine short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

The aim of this course is to make the students familiar with nomenclature, methods of structure elucidation, general properties and methods of synthesis of natural products .

COURSE CONTENTS:

UNIT-I

1. Studies on Biosynthetic Pathways of Natural Products and Terpenoids 10 Hrs

a)Primary and Secondary reactions of Biosynthesis, Biosynthesis of AcetylCoA, Shikmic acid pathway.

b) Isoprene rule, mechanism of formation of mevalonic acid from acctyl coenzyme, Biogenetic isoprene rule. Geranyl pyrophosphates and its conversion into alphapinene, thujene and borneol. Farnesyl pyrophosphate, geranyl, geranyl pyrophosphate and mechanistic considerations for their interconversions into cadinene and abietic acid.

2. Terpenoids 5 hrs

General classification, General Methods of structure determination, Chemistry of Camphor, Abietic acid and Menthol. Biosynthesis of Squalene and Phytoene.

UNIT-II

3. Carbohydrates 9 Hrs

Nomenclature and Classification, Structure of Maltose, Lactose, Sucrose, Starch and cellulose. Structure elucidation of cellulose.structure and functions of glycosides, deoxy sugars, myoinositol, amino sugars, N-acetylmuramic acid, sialic acid and chitin.Structure and biological functions of glucosaminoglycans or mucopolysaccharides.Carbohydrate metabolism-Kreb's

cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway.

4. Amino-acids, Peptides and Proteins 6 Hrs
Nomenclature and symbols of amino acids.Chemical and enzymatic hydrolysis of proteins to peptides.Secondary and Tertiary structure of proteins.Biosynthesis of aliphatic and aromatic Amino acids. Structure elucidation of oxytocin and Insulin

UNIT-III

5. Steroids 10 Hrs
Biosynthesis of steroids, Diels hydrocarbon, Structure elucidation of Cholesterol and estrone.Synthesis of Cholesterol, Progesterone, Oestrone, Testosterone and Androsterone.

6. Alkaloids 5 Hrs
Classificationof alkaloids, Methods of structure determination of Alkaloids, Structure elucidation and synthesis of Nicotine, Quinine, Morphine, Coniine and Ephiderene

UNIT-IV

6.Haemin and Chlorophyll 5 Hrs
Structure and synthesis of Porphyrins.Chemistry of Haemin and chlorophyll.
7. Antibiotics 5 Hrs
Introduction, chemistry of pencillins, streptomycines, chloromphenicol, tetracyclins.
8. Prostaglandins 5 Hrs
General study, nomenclature, structure of PGE and synthesis of PGE1, PGE2, PGF2x

BOOK PRESCRIBED:

1. Primary Metabolism: A Mechanistic Approach by J. Staunton, Oxford University Press, 1978.
2. Secondary Metabolism by J. Mann, Oxford University Press, Oxford, 1980.
3. Natural Product Chemistry - A mechanistic, Biosynthetic and Ecological Approach by Kurt B. G. Torssell, Swadish Pharmaceutical Society, 1997.
4. Principles of Biochemistry by A. L. Lehninger, CBS Publishers, New Delhi.
5. Fundamental of Biochemistry by D. Voet, J.G. Voet and C.W. Pratt, John Willey & Sons Inc., New York,1999.

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Students will be able to draw structures of monosaccharides, disaccharides and polysaccharides and learn their functions.
CO2	Students will be capable of drawing the structures of amino acids and proteins.

CO3	Learn general as well as advanced methods of structural elucidation and chemistry of important natural products such as steroids, alkaloids, Porphyrins, Nucleic acids, Peptides, antibiotics and prostaglandins.
CO4	Study biosynthesis and chemistry of terpenoids
CO5	Students become familiar with reagents used in organic synthesis and structure elucidation.

Academic Session: 2022-23

M.Sc. Chemistry (Semester- III)

CHE 533

Physical Chemistry-III

Electrochemistry and Chemical Dynamics

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 75
Theory: 56
Internal Assessment: 19

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of EIGHT questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of eight short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 12 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

The aim of this course is to impart advance topics of Chemical Dynamics, Electrochemistry, Voltametry and Polarography and their applications. These topic find wide application in research and industry, so the theoretical knowledge of these topics will help the students during praticals application of these topics.

COURSE CONTENTS:

UNIT-I

1. Electrochemistry 20Hrs

Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion-solvent interactions, Thermodynamics of electrified interface equation, Derivation of electro-capillarity, Lipmann equation(surface excess), method of determination, structure of electrified interfaces, Helmholtz-Perin, Guoy-Chapmann, Stern models, over potential, exchange current density, derivation of Butler-Volmer equation, Tafel plot.

Semiconductor interface theory of double layer at semiconductor electrolyte solution interface, structure of double layer interfaces, effect of light at semiconductor solution interface. Introduction to corrosion, forms of corrosion, corrosion monitoring and prevention.

UNIT-II

2.(a) Chemical Dynamics 20Hrs

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius theory and activated complex theory, ionic reactions, kinetic salt effects,, treatment of uni molecular reactions, Lindemann-Hinshelwood theory.

UNIT-III

2.(b)Chemical Dynamics 20Hrs

Dynamic Chain (hydrogen bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), Photochemical reactions between hydrogen-bromine and hydrogen-chlorine, oscillatory reactions (Belousov-Zhabotinsky reactions), Homogeneous catalysis and kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, , relaxation method, flash photolysis, nuclear resonance.

UNIT-IV

3.Voltmametry and Polarography 20Hrs

Polarography, polarographic cells, polarogram, interpretation of polarographic waves, equation for the polarographic waves, effect of complex formation on polarographic wave, polarograms for irreversible reactions, dropping mercury electrode, current variations during life time of a drop, merits and demerits of dme, polarographic diffusion currents, Ilkovic equation, capillary characteristics, temperature, polarograms for mixture of reactants, anodic and cathodic waves, factors affecting polarographic currents, applications of polarography, treatment of data, organic and inorganic polarographic analysis, voltammetry at solid electrodes, cyclic voltammetry and interpretation of data, , pilot-ion and standard addition method for quantitative analysis.

BOOK PRESCRIBED:

1. Chemical Kinetics, K. J. Laddler, McGraw-Hill
2. Modern Electrochemistry Vol.1,2,3, J. Bochris and A.K.N. Reddy
3. Fundamentals of electrochemistry; P. Monk
4. Principles of Instrumental Analysis; Skoog, West; Saundres Publications

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Students will learn the various laws of electroshemistry, thermodynamic derivations of various electrochemical models
CO2	Study the semiconductor interface theory, semiconductor solution interface. Also understand the process of corrosion its monitoring and prevention
CO3	Students will understand the various theories of reaction rates like collision theory, activated complex theory, Lindemann-Hinshelwood theory in detail.

CO4	Students will learn the mechanisms of kinetics of various chain reactions (both thermal and photochemical), enzyme catalysis.
CO5	They will also study the various methods fo Study the kinetics of fast reactions.
CO6	Students will learn about the polarographic and voltametric methods of analysis. They will also understand about the various applications of these methods of analysis.

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-III)

CHE 534/ CHH 534

Organic Synthesis-V

Pericyclic and Photochemistry

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of nine short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECIVES:

The aim of the course is to make students familiar with the concepts and applications in two important topics in advanced organic chemistry, namely concerted organic reactions and organic photochemistry.

COURSE CONTENTS:

UNIT-I

1. (a)Pericyclic Reactions 15 Hrs

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene, allyl system, classification of pericyclic reactions FMO approach. Woodward-Hoffmann correlation diagrams method and Perturbation of molecular orbital (PMC) approach for he explanation of pericyclic reactions under thermal and photo-chemical conditions.

Electrocyclic reactions – controtatory and disrotatory motions, 4n, 4n+2, allylsystems secondary effects.Cycloadditions – antrafacial and suprafacial additions, notation of cylcoadditions (4n) and (4n+2) systems with a greater emphasis on (2+2) and (4+2) cycloaddition-stereochemical effects and effects of substituents on the rates of cycloadditions, 1,3-dipolar cyclo-additions and cheleotropic reactions.

UNIT-II

1. (b)Pericyclic Reactions 15 Hrs

Sigmatropic Rearrangements-suprafacial and antrafacial shifts [1,2]- sigmatropic shifts involving carbon moieties retention and invertion of configuration, (3,3) and (5,5) sigma-tropic rearrangements, detailed treatment of Claisen and Cope rearrangements, fluxional tautomerism,

aza-cope rearrangements, introductions to Ene reactions, simple problems on pericyclic reactions. Elecrocyclic rearrangement of cyclobutenes and 1,3cyclohexadienes.

UNIT-III

2. Photochemistry
(i) Photochemical Reactions 5 Hrs
Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.
(ii) Determination of Reaction Mechanism 5 Hrs
Classification, rate constants and life times of reactive energy states –determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions.
Types of photochemical reactions – photodissociation, gas-phase photolysis.
(iii) Photochemistry of Alkenes 5 Hrs
Intramolecular reactions of the olefinic bond – geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1, - dinenes.

UNIT-IV

(iv) Photochemistry of Carbonyl Compounds 7 Hrs
Intramolecular reactions of carbonyl compounds – saturated, cyclic and acyclic, β, γ- unsaturated and α,β-unsaturated compounds, Cyclohexadienones. Intermolecular cycloaddition reactions – dimerisations and oxetane formation.
(v) Photochemistry of Aromatic Compounds 4 Hrs
Isomerisations, additions and substitutions.
(vi) Miscellaneous Photochemical Reactions 4 Hrs
Photo-Fries reactions of anilides.Photo-Fries rearrangement.Barton reaction.Singlet molecular oxygen reactions.Photochemical formation of smog.Photodegradation of polymers. Photochemistry of vision.

BOOK PRESCRIBED:

1. Pericyclic reactions: A Mechanistic study by S. M. Mukherji
2. The Conservation of Orbital Symmetry by R. B. Woodward and R. Hoffman
3. Organic Photochemistry – Chapman and Depuy.
4. Organic Photochemistry – W.H. Horsepool.
5. Photochemistry of Excited States – J.D.Goyle.
6. Fundamentals of Photochemistry by K.K. RohtagiMukherji

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	To learn the fundamentals of pericyclic reactions
CO2	To understand the various types pericyclic reactions viz. Cycloaddition reactions,

	Electrocyclic reactions and Sigmatropic reactions
CO3	To understand the logic of working out the reaction pathway of pericyclic reactions using Woodward-Hoffmann rules, Frontier Molecular Method(FMO) and Orbital correlation method(OCD) etc.
CO4	To acquire knowledge to control the kinetics of pericyclic reactions.
CO5	To develop an insight into various types of pericyclic reactions like cope, claisen and ene. Learning flutionality due to these reactions.
CO6	To learn the fate of an excited state molecule, various ways of excitation energy transfers and actinometry
CO7	To determine rate constants and develop stern volmer plots
CO8	To learn photochemical reactions of various functional groups viz. Alkenes, carbonyl compounds, aromatic compounds.
CO9	To develop an insight into Photo fries, barton, singlet molecular oxygen reactions
CO10	To understand the photochemical formation of smog, photodegradation of polymers and photochemistry of vision

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-III)

CHE 535/ CHH 535

Physical Chemistry-IV

Analytical Techniques

Credit Hours: 4 Hrs/week
Total Hours: 60
Maximum Marks: 50
Theory: 37
Internal Assessment: 13

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of nine short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

The course is designed to introduce the advance techniques of analysis like Potentiometry leading to the designing and use of pH electrodes, Thermogravimetric methods (TG), Differential thermal Analysis (DTA), Differential Scanning Calorimetry,Coulometric technique and Chromatographic Advance Techniques for identification and purification of the chemical compounds. Some advance solid state reactions will also be introduced

COURSE CONTENTS:

UNIT-I

1(a) Potentiometric Methods 10Hrs

Reference electrodes: Calomel electrodes, silver- silver chloride electrodes, precautions in the use of reference electrodes, metallic indicator electrodes and its types, metallic redox indicators, membrane indicator electrodes, classification of membranes, properties of ion-selective electrodes, the glass electrodes for pH measurement, composition and structure of glass membrane, the hygroscopicity of glass membrane, conduction across glass membrane, the membrane potential, the boundary potential, the potential of glass electrode, the alkaline and error, the glass electrodes for other cations, crystalline membrane electrode and their conductivity, the fluoride electrode, the electrode based on silver salts.

1.(b) Potentiometric Methods 5Hrs

Direct potentiometric measurement, sign conventions, the electrode calibration method, calibration curves for concentration measurements, potentiometric pH measurements with a glass electrode, errors affecting pH measurements with glass electrode.

UNIT-II

2. Thermal Methods 8Hrs

Thermogravimetric methods(TG) :Instrumentation, The balance, Furnace, instrument control, applications, Differential thermal analysis(DTA), instrumentation, general principles, applications, Differential scanning calorimetry(DSC), applications.

3. Solid State Chemistry 7Hrs

Types of solids, band and band theories, point defects in metals and ionic compounds, energy and entropy defects and their concentration, diffusion and electrical conduction via defects, non-stoichiometric defects, color centers and electrical properties of alkali metals halides, impurity semi-conductors reactions in organic solids, photochemical reactions, sintering solid state reactions, decomposition and dehydration reaction

UNIT-III

4.Coulometric Methods 15Hrs

Current-Voltage relationships during an electrolysis, operation of a cell at a fixed applied potential, initial thermodynamic potential, estimation of required potential , current changes during an electrolysis at constant applied potential, potential changes during an electrolysis at constant applied potential, constant current electrolysis, electrolysis at a constant working electrode potential, An introduction to coulometric methods of analysis, units for quantity of electricity, types of coulometric methods, applications, coulometric titrations, applications of coulometric titrations, comparison of coulometric and volumetric titrations.

UNIT-IV

5. An Introduction to Chromatographic Separations 8Hrs

General description of chromatography, classification of chromatographic methods, Elution chromatography on columns, chromatograms, effect of migration rates and band broadening on resolution, Migration rates of species, partition coefficients, retention time, relationship between retention time and partition coefficients, the rates of solute migration(capacity factor), differential migration rates, the shape of chromatographic peaks, methods for describing column efficiency, definition of plate height, experimental evaluation of H and N, kinetic variables affecting band broadening, relationship between plate height and column variables.

6. Gas Chromatography 7Hrs

Principles of Gas-Liquid chromatography, Instrumentation: carrier gas supply, sample injection system, column configuration and column ovens, detectors, Flame ionization detectors (FID), Thermal conductivity detectors (TCD), Thermionic detectors (TID), Electron capture detectors (ECD), Atomic emission detector (AED), Gas chromatographic columns and stationary phase: packed column, open tubular column, adsorption on column packing, stationary phases.

BOOK PRESCRIBED:

1.Solid State Chemistry : A.R.WEST
2.Principles of Instrumental Analysis: Skoog and West
3.Principles of Instrumental Analysis : Willard, Merit and Dean
4. Solid state physics: A J Dekker, Macmillan Publishers
5. Principles of physical chemistry: Puri, Sharma, Pathania.
6. Chemistry of solid state: W E Garner, Butterworth

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	To learn about structure and working of different reference electrodes and working electrodes
CO2	To develop complete study skills of potentiometric method of analysis of various analytes
CO3	To learn about various thermal methods of analysis like DTA, TG, DSC and their applications
CO4	To understand solids and point defects in solids
CO5	To understand coulometric methods of analysis and current-voltage relation and coulometric titrations.

M. Sc. Chemistry (Semester-III)
CHE 536
Organic Lab-II
Advanced Organic Chemistry Practical

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. The exam will be conducted on two sessions ie Morning and Evening
II. Students will perform two practicals.
III Students will be asked to complete write up of both practical within first 30 minutes on the first sheet provided.
IV. On the second sheet provided after 30 minutes, students will perform and note the record on second sheet during the conduct of practical exam
V. The split of marks will be as under:
(Write-up = 25, Performance = 25, Viva-Voce = 20, Practical notebook = 5)

COURSE OBJECTIVES:

This course aims to give training on performing the experiments involving the multistep synthesis of organic Compounds and technique of recrystallization and impart the knowledge of recording of spectral data using various spectroscopic techniques like NMR, IR and UV-visible spectroscopy.

COURSE CONTENTS:

A. <u>Preparation and characterization using spectroscopic techniques</u>
1. Pechmann reaction
Synthesis of 7-hydroxy-4-methyl coumarin
2. Condensation reaction
Prepare 2-phenylindole from phenyl hydrazine
3. Hoffmann rearrangement
To prepare anthranilic acid from phthalic anhydride
4. Claisen-Schmidt condensation
To prepare chalcone from benzaldehyde and acetophenone
B. <u>Multistep organic synthesis: Synthesis of medicinal compounds</u>
5. Synthesis of Phenytoin
Step 1: Preparation of benzyl from benzoin
Step 2: Preparation of phenytoin from benzyl
6. Synthesis of Anthranilic Acid (or Vitamin L1)
Step 1: Phthalic anhydride to Phthalimide
Step 2: Phthalimide to Anthranilic acid
7. Synthesis of Sulpha Drug From Aniline
Step 1: Aniline to acetanilide

Step 2: Acetanilide to p-acetamidebenzenesulphonyl chloride (sulphonation)
Step 3: p-acetamidebenzenesulphonylchloride to p-acetamidebenzenesulphonamide (s-amination)
Step 4: p-acetamide benzene sulphonamide to p-amino benzenesulphonamide(hydrolysis)

C. Microwave Organic Synthesis

MW-mediated preparation of lophine (2,4,5-triphenylimidazole).

D. Fluorescence spectroscopy

Synthesis of Fluorescein from Phthalic anhydride and Resorcinol and record its fluorescent spectra.

E. Schrodinger software

Molecular docking of Indomethacin (Anti-inflammatory drugs) in the crystal coordinate of COX-2

Recommended Books:

1. An Introduction to Modern Experimental Organic Chemistry, R.M. Roberts, J.C. Gilbert, L.B. Rodewald and A.S Wingrove, Holt Rinehart and Winston Inc, New York. 1969.
2. Vogel's Text Book of Practical Organic Chemistry.
3. Laboratory Experiments on Organic Chemistry, R. Edemas, J.R. Johnson and C.F. Wilcox, The Macmillan Limited, London, 1970.
4. Crouch RD, Howard JL , Zile JL , Barker KH. Microwave-mediated synthesis of lophine: developing a mechanism to explain a product. *J. Chem. Edu* . 2006, 83, 1658-1660

COURSE OUTCOMES

S. No.	On completing the course,
CO1	Synthesis of new products via different named reactions
CO2	Confirmation of data using spectroscopic techniques
CO3	Justify and compare the results with literature
CO4	Write and represent the outcomes of scientific finding in graphical and electronic formats.
CO5	Generate technical skills in handling of instruments and calculation methods

M.Sc. Chemistry (Semester-III)
CHE 537
Physical Chemistry Lab-II
Electroanalytical Techniques

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 100
Theory: 75
Internal Assessment: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. The exam will be conducted on two sessions ie Morning and Evening
II. Students will perform two practicals.
III Students will be asked to complete write up of both practical within first 30 minutes on the first sheet provided.
IV. On the second sheet provided after 30 minutes, students will perform and note the record on second sheet during the conduct of practical exam
V. The split of marks will be as under:
(Write-up = 25, Performance = 25, Viva-Voce = 20, Practical notebook = 5)

COURSE OBJECTIVES:

The aim of this course is based on the hand-on-practice of various physical instruments for analytical studies as well as studying physical properties of various reactions by well defined technical methods.

COURSE CONTENTS:

1. To study the Fluorescence quenching of pyrene in presence of Cu(II) ion in presence of SDS, CTAB and TTAB
2. To study the Fluorescence quenching of pyrene in presence of Cu(II) ion in presence of GEMINI Cationic Surfactants (12-2-12, 14-2-14 and 16-2-16)
3. To determine the surface tension (double cabillary) of mixture of solid and water by deferential method and hence find out parachor of the mixture.
4. To determine the specific and molar refractivity of n-propanol, butanol, hexane and carbon tetrachloride and calculate refraction equivalents of C, H and Cl.
5. To determine the molar refracitivity of water, DMF, dioxane and mixtures of water, DFM, water-Dioxane and verify the refractivity rule. Predict about the interactions between components of mixture by plotting graph between refractive index and mole fraction.
6. To determine the equivalent conductance of weak electrolyte acetic at infinite dilution usingKohlrausch law.
7. Determine equivalent conductance of strong electrolyte at several concentrations and hence verifyonsagars equation.

8. Determine equivalent conductance of weak electrolyte, say, acetic acid at different concentrations and hence test validity of Oswald's dilution law. Also determine dissociation constant of the electrolyte.

9. To determine dissociation constant of a dibasic acid potentiometrically.

10. To study complex formation between Fe(III) and salicylic acid and find out the formula of the complex spectrophotometrically.

11. To determine the formula of the complex ion formed between Fe(III) and Thiocyante ion by Job's method.

12. To study the kinetics of hydrolysis of crystal violet spectrophotometrically.

13. To determine the pH of a buffer solution (*p*H less than 8) using a quinhydrone electrode.

14. To determine the pH of various mixtures of sodium acetate and acetic acid in aqueous solution and hence determine the dissociation constant of the acid.

15. Titrate potentiometrically Zn (II) by $K_4Fe(CN)_6$ and verify the composition of the complex $K_2Zn_3\ [Fe(CN)_6]_2$

16. To determine the amount of Ibuprofen in a tablet as per IP using UV-VIS spectroscopy.

17. To determine the amount of Paracetamol in a tablet as per IP using UV-VIS spectroscopy.

18. Determine the molar refraction of a solid substance by dissolving it in a solvent and its refractive index.

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Understanding the concept of partial molar volume and Measuring it through a simple experimental technique .
CO2	Use of Electrical methods to study various laws of electrochemistry like Oswald dilution law, Kohlrausch's law and Debye-Huckel -Onsager eqaution
CO3	Use of physical methods like surface tension and molar refraction to correlate the physical properties of compounds with molecular structure
CO4	Use of spectroscopic techniques for the study of complex formation and chemical kinetics.
CO5	Use of other electrical techniques like potentiometry, pH metry, turbiditymetry for measurement of physical properties and complex formation studies.

Semester-IV

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-IV)

CHE 541/ CHH 541

Inorganic Chemistry-IV

Advanced Inorganic Chemistry

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 75
Theory: 56
Internal Assessment: 19

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of EIGHT questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of eight short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 12 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COOURSE OBJECTIVES:

To study photoinorganic chemistry and oxidative addition and insertion reactions with suitable examples as well as students also get knowledge on structure and bonding of d-Block elements

COOURSE CONTENTS:

UNIT-I

1.Photoinorganic chemistry 20Hrs

Basics of photochemistry, Absorption, excitation, photochemical laws, quantum yield, electronically excited states, life times, measurements of the times, flash photolysis, energy diddipation by radiative and non-radiative processes, absorption spectra, franckcondon principle, photochemical stages- primary and secondary processes, kashia's rules, thexi states, photosubstitution reactions, adamson's rules, photo substitution reactions of Cr(III) and Rupolypyridyles. Rh(III) ammine complexes. Ligand photoreactions, photoredox reactions, comparision of Fe^{2+} and Ru^{2+} complexes. Photo reactions and solar energy conversion, photosynthesis in plants and bacteriocholophyll synthesis, photolysis of water using inorganic precursors.

UNIT-II

2.Oxidative addition and Insersion reactions 20Hrs

Acid base behavior of metal atom in complexes, protonation and lewis base behavior, acceptor properties of lewis acidity of complexes, oxad and reductive elimination and their mechanism, addition of specific molecules, H_2 , HX and organic halide addition of some others molecules,

reductive elimination, migration reactions their types, promotion of alkyl migration, insertion of CO into M-H bonds, other aspects of CO insertion reactions, transfer of other molecules, CO_2, SO_2, NO_2, RCN.

UNIT-III

3.Transition metal compounds with hydrogen and oxad reactions 20Hrs

Insertion of alkenes and C-C unsaturated compounds, cleavage of C-H bonds, alkane activation.Cyclometallation reactions in detail, reactions of free hydrocarbons.

Characterstics of hydride complexes, synthetic methods, chemical behavior of H^- complexes, mononuclear and homolepticpolyhydride anions, carbonyl H^- and anion H_2 compounds, M-H interactions. Complexes of boron and aluminium hydrides, synthetic applications of metal hydrides.

UNIT-IV

4. Structure and bonding of d-Block elements 20Hrs

Pervoskite, $Ti(NO_3)_4$, $TiCl_4(diars)_2$, $[Ti(OEt)_4]_4$, $Zr(BH_4)_4$, $[M_6X_{12}]^+$ (M= Nb& Ta; X= halide); $VO(acac)_2$; $VOCl_2(NMe_3)_2$, $[Nb(n^5\text{-}C_5H_5)H\text{-}\square\ (n^5,n^1\text{-}C_5H_4)]_2$; Isopoly and heteropoly acids of MO, W & V; $[M_6X_8]^{4+}$ M= MO & W; $CrO(O_2)$ (bipy); $[MO_2O_4(C_2O_4)_2\ (H_2O)_2]^{2+}$; $[W_3O_2\ (O_2CMe)_6\ (H_2O)_3]^{2+}$;$[Cr_3O(O_2CMe)_6\ L_3]^+$;$[H_2W_2(CO)_9]^{2+}$; Re_3Cl_9;$[ReH_9]^{3+}$; $ReCl_6(Pet_3)_2$; $Re_2Cl_6(PEt_3)_2$; $Re_2Cl_5\ (DTH)_2$, Roussin's salts; $[Ir_3O(SiO_4)9]^{10-}$; $[Ir_3N(SiO4)_6(H2O)_3]^{4-}$;$[Co(acac)_2]_4$, α and β-MCl_2 (M=Pd,Pt);Wolffram's salt;$[Ni(acac)_2]_3$; $Ni(Me_6\text{-}acac)_2$; Ni (Me-sal)$_2$; $[Cren_3]$ $[Ni(CN)_5]$ 1.5 H_2O; $[Ni\ (CN)_2\ (NH_3)]$. xC_6H_6; $[Pd(O_2CMe)_2]_3$, $[pt(O_2CMe)_2]_4$; $[PtMe_3(acac)]_2$; helical chian of AuF_3, Silver (III) ethylenedibiguanide ion; $[CuXL]_4$ X=halide, L = P or As Ligand; $[Au_3Cl_2(PMe_2Ph)_{10}]^{3+}$; $[Zn(acac)_2]_3$; $[Cd\{S{=}C(NHCH_3)_2\}_2(SCN)_2]$; $Hg(NH_3)_2Cl_2$

BOOKS PRESCRIBED:

1. Chemistry of Elements by N. N. Greenwood and Earnshaw, Perganon Press
2. W. W. Portfield: Inorganic Chemistry: A Unified approach
3. Cotton and Wilkinson: Advanced inorganic Chemistry: Vth edition

COOURSE OUTCOMES:

S. No.	On completing the course,
CO1	The course provides the students with an overview of different oxidative- reductive reactions and their applications
CO2	understand the structure, bonding and reactivity of -Coordination of C-C multiple bonds
CO3	Students will be able to characterize theoretically the type of bond of hydrogen with the

	transition metal.
CO4	Students also learn the structure and bonding of different inorganic complexes.
CO5	Students will learn to make difference of terminal and bridging hydrogen bonds

Academic Session: 2022-23

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester- IV)

CHE 542/ CHH 542

Organic Chemistry-VI

Asymmetric synthesis, Green Chemistry and Heterocyclic Chemistry

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 75
Theory: 56
Internal Assessment: 19

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of EIGHT questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of eight short questions carrying 1 Mark each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 12 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

The aim of the course is to familiarize students with the concept of Asymmetric synthesis, enzymatic approach towards asymmetric synthesis, enzyme catalyzed reactions, co-enzyme and their function, green chemistry approach towards synthesis.

COURSE CONTENTS:

UNIT-I

1. Asymmetric Synthesis

(a) General Aspects 10Hrs

Introduction, Analytical methods for determination of enantiomeric purity – GC, HPLC and NMR.Natural sources of chiral starting materials, classification and methods of formation of new chiral compounds.

(b) Non-Enzymatic Approaches towards asymmetric synthesis 10Hrs

Methods of asymmetric synthesis using chiral pool synthesis, auxilaries, chiral reagents and catalysts, Asymmetric carbon-carbon bond formation using alkylation, Michael reaction and additiontocarbonyl compounds.Cram's rule and Felkin-Ahn model.Asymmetric oxidationand reductions.

UNIT-II

2. Enzymatic approach towards asymmetric synthesis 10Hrs

Biotransformations: Nomenclature and Classification of enzymes, advantages and disadvantages, Fischer's lock and key and koshland's induced fit hypothesis, concept and identification of active

site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-menten and lineweaver-Burk plots, reversible and irreversible inhibition.Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion.

3. Reaction Catalysed by Enzymes 10Hrs

Nucleophilic displacement on a phosphorus atom, multiple displacement reaction and thecoupling of ATP cleavage to endergonic processes. Transfer of sulphates, addition andelimination reactions, enolic intermediates in isomerization reactions, Enzyme catalyzedcarboxylation and decarboxylation.

UNIT-III

4. Co-Enzyme Chemistry 8Hrs

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological function of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, vitamin B_{12}. .

5. Green Chemistry approach towards synthesis 12Hrs

Principles and concepts of Green Chemistry, atom economic and uneconomic reactions, source and minimizing techniques of waste from chemical industry, homogeneous and heterogeneous catalysis, phase transfer catalysis, biocatalysis and photocatalysis. Principles of ultrasound and microwave assisted organic synthesis. Reactions in ionic liquids and other environmentally benign solvents, Future Prospects.

UNIT-IV

6. Heterocyclic Synthesis 20Hrs

(a) Introduction

Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reaction.

(b) Small Ring Heterocycles

Three-membered and four-membered heterocyclic –synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes

(c) Six-Membered Heterocycles with one Heteroatom

Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium&thiopyrylium salts and pyridones.Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones.

(d) Seven-and Large-Membered Heterocycles

Synthesis and reactions of azepines, oxepines, thiepines, diazepines, thiazepines, azocines, diazocines, dioxocines and dithiocines.

BOOKS PRESCRIBED:

1. Asymmetric Synthesis: The Essentials, Volume 1 Mathias Christmann, Stefan Bräse Wiley, 2008.
2. Principles of Biochemistry by Lehninger

3. Green Chemistry: An Introductory Textby Mike Lancaster, Royal Society of Chemistry, 2002
4. Principles of modern heterocyclic chemistry by Leo A. Paquette
5. Principles of Biochemistry By Voet and Voet

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	Student will be aware of the asymmetric synthesis and enantiomeric purity methods
CO2	Effective and modern synthetic techniques aimed at the production of enantiomerically pure organic molecules will be introduced. Know how to apply the Felkin-Anh model to predict which face nucleophilic attack will occur on an enantiotopic carbonyl group.
CO3	explain and exemplify different enzyme catalyzed processes for stereoselective chemical production.· will able to define the mechanisms of enzyme activity regulation
CO4	To know the importance and applications of green chemistry techniques
CO5	the student will learn nomenclature, structure, properties, syntheses, and reactions of the simple 5 and 6-membered ring heterocycles, the benzene ring fused ring heterocycles, the pyridine group, and the quinoline and isoquinoline groups.

M.Sc. Chemistry/M. Sc. Chemistry (Under the Honours Scheme) (Semester-IV)
CHE 543/ CHH 543
Physical Chemistry-V
Surface and Polymer Chemistry

Credit Hours: 6 Hrs/week
Total Hours: 80
Maximum Marks: 75
Theory: 56
Internal Assessment: 19

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
II. Examiner will set total of EIGHT questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
III. Section-I will consist of eight short questions carrying 1 Marks each.
IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 12 Marks.
V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

COURSE OBJECTIVES:

The objective of the course is to provide the a descriptive knowledge on the topics of surface phenomenon and polymers as both o these fields find wide applications at industrial level.

COURSE CONTENTS:

UNIT-I

1. Adsorption 20Hrs

Surface tension, capillary action, pressure difference across curved surface (Laplace equations), Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro-kinetic phenomena), catalytic activity at surfaces.

UNIT-II

2. Micelles 20Hrs

Surface active agents, classification of surface active agents, micellization, hydrophobic interactions, critical micellar concentration (CMC), factors affecting CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization , solubilization, micro emulsion, reverse micelles, applications of microemulsions.

UNIT-III

3. Macromolecules 20Hrs

(a) Polymer – definition, Different classifications of polymers , Linear, branched and network polymers. Basic concepts: monomers, repeat units, degree of polymerization. Types of polymers:

electrically conducting polymers, Doping of polymers,mechanism of conduction, polarones and bipolarons, fire resistant, liquids crystal polymers,

Molecular mass: number, mass and viscosity average weights; Molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, kinetics of polymerization, thermodynamics of polymerization. calculations of average dimensions of various chain structures.Importance of polymers,

Polymerization: condensation, addition, radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions.Polymerization in homogenous and heterogeneous systems.

UNIT-IV

(b) Structure and Properties: 20Hrs

Polymer structure and properties-crystalline melting point T_m-melting point of homogenous series, effect of chain flexibility and steric factors, entropy and heat of fusion. The glass transition temperature, T_g-Relationship between T_m and T_g, effects of molecular weight, diluents, chemical structure, chain topology, branching and chain linking. Property requirements and polymer utilization.

BOOKS PRESCRIBED:

1. Physical Chemistry, P. W. Atkins.
2. Textbook of polymer science, F. W. Billmeyer Jr. Wiley.
3. Polymer science, V. R. Gowariker, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.
4. Polymer Chemistry, Melcolm P. Stevens, Oxford University Press.
5. Physical chemistry of polymers, A. Tager, Mir Publisher, Moscow.

COURSE OUTCOMES:

S. No.	On completing the course,
CO1	They will have the understanding about the surface tension, adsorption and various theories of adsorption
CO2	They will learn about the surface films, catalytic activity at surfaces and surfactants.
CO3	They will also learn and understand the process of micellization, solubilization and the various factors affecting the process of micellization, solubilization.
CO4	They will study about the polymers and polymer reactions in detail. The various types of polymerization. Kinetics and thermodynamics of polymerization.
CO5	They will learn the structure and properties of polymers.