FACULTY OF SCIENCES

SYLLABUS FOR

THE BATCH FROM THE YEAR 2023 TO YEAR 2025

Programme Code: *MCHH*

Programme Name: M.Sc. (UHS) Chemistry

(Semester I-II)

Examinations: 2023-2025

Department of Chemistry

Khalsa College, Amritsar

S.No.	PROGRAMME OBJECTIVES
1.	This programme was designed for the students of B. Sc. (Honours) Chemistry students to keep their knowledge a step ahead.
2.	The course was introduced to cater the needs of Academic Institutes (Universities, College, and Schools), Chemical, Pharmaceutical industry, Textile, Sugar industry, Research Institutes so that these students can better serve the field in which working.
3.	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.
4.	Students will be able to develop the better understanding of the Practical aspect of chemistry through lab work and research project.
5.	Prepare students for pursuing research or careers in industry in concerned subject and allied fields. Capability to use appropriate software to solve various problems and to apply programming concepts of C++ and Mathematical/ Matlab to various scientific investigations, problem solving and interpretation
6.	The programme continues to develop the ability to identify unethical behaviour such as fabrication, falsification or misrepresentation of data and adoptive objective, unbiased and truthful actions in all aspects will be developed.
7.	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” .
	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 development.

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, *Metal-Carbon bonding and its applications*, Photoinorganic chemistry, Oxidative addition and Insersion reactions, Structure and bonding of d-Block elements, *Techniques for Structure Elucidation of* Inorganic *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 *Modern Methods of Organic Synthesis, 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, *Biophysical Chemistry*, 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

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**	**Credits**			**Total Credits**	**Max Marks**				**Page No.**
			L	**T**	**P**		**Th**	**P**	**IA**	**Total**	
CHE 411 /CHH 411	Inorganic Chemistry-I: (*Ligand Field and Group Theory)*	4	3	1	0	4	75		25	100	54-55
CHH 412	Organic Synthesis-I *Modern Methods of Organic Synthesis*	4	3	1	0	4	75		25	100	56-57
CHE 413 /CHH 413	Physical Chemistry-I: *Thermodynamics*	4	3	1	0	4	75		25	100	58-59
CHE 414 /CHH 414	Spectroscopy A: *Techniques for Structure Elucidation of Organic Compounds*	6	5	1	0	6	112		38	150	60-62
CHE 415 /CHH 415	Inorganic Chemistry Lab-I (*Quantitative Analysis*)	6	0	0	3	3		56	19	75	63-64
CHH416	Organic Chemistry Lab-I *Quantitative analysis and Multistep Synthesis*	6	0	0	3	3		56	19	75	65-66
CHE 417/CHH 417	Basics and Application of Chemistry Softwares	6	2	0	2	4	37	38	25	100	67-69
	TOTAL	**36**				**28**				**700**	

SEMESTER - II											
Course Code	Course Name	Hours /Week	Credits			Total Credits	Max Marks				Page No.
			L	T	P		Th	P	IA	Total	
Major Courses											
CHH421	Inorganic Chemistry-II (*Metal-Carbon bonding and its applications*)	4	3	1	0	4	75		25	100	71-72
CHE 422 / CHH 422	Organic Synthesis-II (*Reaction Mechanism-Addition, Elimination and Rearrangements)*	4	3	1	0	4	75		25	100	73-74
CHE 423/ CHH423	Physical Chemistry-II: *Quantum Chemistry*	4	3	1	0	4	75		25	100	75-76
CHE 424 / CHH 424	Spectroscopy B: *Techniques for Structure Elucidation of* Inorganic *Compounds*	6	5	1	0	6	112		38	150	77-79
CHE 425 / CHH 425	Organic synthesis-III(*Supramolecular, Reactive Intermediates and Disconnections)*	4	3	1	0	4	75		25	100	80-82
MH CHX 421 Or BT CHX 421	Mathematics for Chemists (Med. Students) Or Biology for Chemists (Non Med. Students)	3	2	1	0	3	56		19	75	83-84 85-86
CHE 426 / CHH 426	Physical Chemistry Lab-I	6	0	0	3	3		56	19	75	87-88
CHE 427 /CHH 427	Inorganic Chemistry Lab- II	6	0	0	3	3		56	19	75	89-91
	TOTAL	**37**				**31**				**775**	

Distribution of Marks

SNo.	Semester	Total Marks
1	Semester-I	700
2	Semester-II	775
3	Semester-III	
4	Semester-IV	
Grand Total		

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
The subject codes of M. Sc. Chemistry (Under the Honours Scheme) starts with CHH

YEAR
2023-24

Semester-I

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

CHE 411/CHH 411: Inorganic Chemistry-I

Ligand Field and Group Theory

Total Hours: 60
Total Hours/week: 4 **Maximum Marks: 100**
Total Credits: 4 **Theory: 75**
L T P **Internal Assessment: 25**
3 1 0

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.
III. Section-I will consist of EIGHT questions and students are required to attempt any SIX short questions carrying 2.5 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 15 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, students will be able to
CO1	Identify 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	Construct Orgel diagrams, Correlation diagrams and Tunabe-Sugano diagrams along with the study of electronic, magnetic and spectrochemical properties of the coordination compounds.

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

CHH 412

Organic Synthesis-I

Modern Methods of Organic Synthesis

Total Hours: 60
Total Hours/week: 4 **Maximum Marks: 100**
Total Credits: 4 **Theory: 75**
L T P **Internal Assessment: 25**
3 1 0

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.
III. Section-I will consist of EIGHT questions and students are required to attempt any SIX short questions carrying 2.5 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 15 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 is to provide the knowledge to students regarding the following:
(a) Formation of carbon-carbon single bonds that involves the main group chemistry as well as transition metal chemistry
(b) Various types of reactions that involves formation of carbon-carbon double bonds
(c) Synthesis and applications of selected reagents used for various organic transformations.
(d) Widely used name reactions and rearrangements for the synthesis of industrially and pharmaceutically important compounds.

COURSE CONTENTS:

UNIT-I

1. Formation of carbon-carbon single bonds 15 Hrs

Main-group chemistry: Alkylation of enolates and enamines, Conjugate addition reactions of enolates and enamines, The aldol reaction, Asymmetric methodology with enolates and enamines, Organolithium reagents, Organomagnesium reagents, Organozinc reagents, Allylic organometallics of boron, silicon and tin

Transition-metal chemistry: Organocopper reagents, Organochromium chemistry, Organocobalt chemistry, Organopalladium chemistry.

UNIT-II

2. Formation of carbon-carbon double bonds 15 Hrs

Elimination reactions, Pyrolytic syn eliminations, Fragmentation reactions, Alkenes from hydrazones, Alkenes from 1,2-diols, Alkenes from alkynes, The Wittig and related reactions, Alkenes from sulfones, Alkenes using titanium or chromium reagents, Alkene metathesis reactions

UNIT-III

3. Radical and carbene chemistry 5 Hrs

Radicals: Radical abstraction reactions, Radical addition reactions, Carbenes.

4. Functionalization of alkenes 10 Hrs

Hydroboration: Reactions of organoboranes, Epoxidation and aziridination: Epoxidation, Asymmetric epoxidation, Aziridination, Dihydroxylation: Dihydroxylation with osmium tetroxide, Other methods of dihydroxylation, Amino-hydroxylation, Oxidative cleavage, Palladium-catalysed oxidation of alkenes.

UNIT-IV

5. Oxidation and Reduction 15 Hrs

Oxidation: Oxidation of hydrocarbons, Alkanes , Aromatic hydrocarbons, Alkenes, Oxidation of alcohols, Chromium reagents, Oxidation via alkoxysulfonium salts, Manganese reagents, Other metal-based oxidants, Other non-metal-based oxidants, Oxidation to carboxylic acids or esters Oxidation of ketones, α, β-Unsaturated ketones, α-Hydroxy-ketones, Baeyer–Villiger oxidation of ketones

Catalytic hydrogenation, Reduction by dissolving metals, Reduction by hydride-transfer reagents: Derivatives of lithium aluminium hydride and sodium Borohydride, Mixed lithium aluminium hydride–aluminium chloride, Reagents: Diisobutylaluminium hydride (DIBAL-H), Sodium cyanoborohydride and sodium Triacetoxyborohydride, Borane and derivatives

Other methods of reduction: Enzyme catalysed, Wolff–Kishner reduction, Reductions with diimides, Reductions with trialkylsilanes

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BOOKS PRESCRIBED:

1. Topics in Organometallic Chemistry: 'Palladium in Organic Synthesis' (Editor: Jiro Tsuji) Volume 14, **2005**
2. Advanced Organic Chemistry, 4th Edition, Part B: Reactions and Synthesis by Francis A. Carey and Richard J. Sundberg, Plenum Press, N.York, **2001**, 4th edition.
3. *Modern Methods of Organic Synthesis*, 4th Edition by W. Carruthers and L. Coldham, Cambridge University Press, **1971**, 2nd edition.
4. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford)

COURSE OUTCOMES:

S. No.	On completing the course, students will be able to
CO1	Learn about carbon-carbon bond formation in both main group chemistry and transition metal chemistry
CO2	Develop the understanding of radical and carbene chemistry
CO3	Learn the concept of functionalization of alkenes
CO4	Learn about oxidation and reduction reactions
CO5	Form of carbon-carbon double bond

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

CHE 413/CHH 413

Physical Chemistry-I

Thermodynamics

Total Hours: 60
Total Hours/week: 4 **Maximum Marks: 100**
Total Credits: 4 **Theory: 75**
L T P **Internal Assessment: 25**
3 1 0

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.
III. Section-I will consist of EIGHT questions and students are required to attempt any SIX short questions carrying 2.5 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 15 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, students will be able to
CO1	learn about the classical thermodynamics and revise the basic concepts
CO2	Learn to conceptualise the statistical mechanics derivations
CO3	Understand the link between classical mechanics and quantum mechanics by studying statistical mechanics
CO4	Derive the thermodynamic parameters from quantum chemistry
CO5	Study the irreversible thermodynamics and correlating real life problems

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

Total Hours: 60
Total Hours/week: 6 **Maximum Marks: 150**
Total Credits: 6 **Theory: 112**
L T P **Internal Assessment: 38**
5 1 0

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.
III. Section-I will consist of EIGHT questions and students are required to attempt any SIX short questions carrying 4 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 22 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, students will be able to
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	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.

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

CHE 415/CHH 415

Inorganic Chemistry Lab-I

Quantitative analysis

Total Hours: 90
Total Hours/week: 6 **Maximum Marks: 75**
Total Credits: 3 **Theory: 56**
L T P **Internal Assessment: 19**
0 0 3

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 = 20, Performance = 20, Viva-Voce = 10, Practical notebook = 6)

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, students will be able to**
CO1	Prepare the exact solution and Standardization for quantitative analysis of the solutions.
CO2	Determine of different ions like Ca2+, Fe2+, Oxalate, nitrate, available chlorine in bleaching powder using oxidation reduction titrations
CO3	Perform Precipitation Titrations using Volhard's method and Mohr's methods
CO4	Determine of different ions (Cu2+, Ni2+ and Ca2+) using Complexometric Titrations
CO5	Estimate of ions using gravimetric techniques.

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

CHH 416

Organic Chemistry Lab-I

Quantitative analysis and Multistep Synthesis

Total Hours: 90
Total Hours/week: 6 **Maximum Marks: 75**
Total Credits: 3 **Theory: 56**
L T P **Internal Assessment: 19**
0 0 3

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 = 20, Performance = 20, Viva-Voce = 10, Practical notebook = 6)

COURSE OBJECTIVES:

This course is designed to impart the knowledge regarding multistep organic synthesis and the analysis of formed products via recording of spectral data using various spectroscopic techniques. The knowledge about methods that are employed for extraction/isolation of important natural products.

COURSE CONTENTS:

(a) Isolation of Organic Compounds from Natural Sources

1.Isolation of Piperine from black pepper
2. Isolation of Nicotine from Tobacco
3.Isolation of Lycopene from Tomato
4. Isolation of Trimyrisitin from Nutmeg

(b) Quantitative Analysis of Organic Compounds.

1. Estimation of phenol/aniline using bromate-bromide solution
2. Estimation of Amino Acid by Formal Titration

2. Multistep Organic Synthesis

1. To reduce aldehyde and ketone using environment friendly reagent such as Organozinc. Structure proof by spectroscopy.
2. Synthesis of commonly used medicinally important compounds (any 1). Sulphanilamide, , Benztriazole
3. Synthesis of Quinoxalines and their structure confirmation by spectroscopic techniques.
4. Photochemical synthesis of benzpinacol and its pinacol rearrangement.
5. Cannizaro's reaction of 4-chlorobenzaldehyde
6. Synthesis of Benzimidazole derivatives and their structure confirmation by spectroscopic techniques.
7. Synthesis of biodiesel via transesterification reaction.
8. 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

BOOKS 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, students will be able to
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	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 and use of softwares.

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

Basics and Applications of Chemistry Softwares

CHE 417/CHH 417

Total Hours: 90
Total Hours/week: 6 **Maximum Marks: 100**
Total Credits: 4 **Theory + Practical: 37 + 38**
L T P **Internal Assessment: 25**
2 0 2

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES (Theory):

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.
III. Section-I will consist of EIGHT questions and students are required to attempt any SIX short questions carrying 1.5 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:

1. *To comprehend how to use MS Excel for data processing to generate various types of graphs, carry out calculation based upon formulae and curve fitting of the data along with systematic presentation of graph..*
2. *To comprehend how to use MS power point for presentation of theoretical articles and research outcomes.*
3. *To comprehend how to use ChemDraw for structure drawing, equation writing, IR and NMR data analysis.*
4. *To comprehend how to use Origin Software for data processing.*

COURSE CONTENTS:

Unit-I

1. MS Excel

Excel Basics, Work with Cells and Worksheets, Entering Text and Numbers, Entering Excel Formulas and Formatting Data, Creating Excel Functions, Creating Charts, More on Entering Excel Formulas, Format your Workbook, Add Charts and Graphics, Collaborate with Others, Analyze your Data, Work with Macros and the Web, functions and formulas, charts, data analysis,

2. MS Power Point

Create and Manage Presentations, Create a Presentation, Insert and Format Slides, Modify Slides, Handouts, and Notes, Change Presentation Options and Views, Configure a Presentation for Print, Configure and Present a Slide Show, Insert Tables, Charts, Smart Art, and Media., Insert and Format Smart Art graphics, Insert and Manage Media, Apply Transitions and Animations, Apply Slide Transitions, Animate Slide Content, Set Timing for Transitions and Animations.

Unit-II

3. ChemDraw
ChemDraw Ultra 8.0 software, Introduction, Download and installation process, Drawing various chemical structures (acyclic, cyclic, polycyclic, heterocyclic), Nomenclature generation, conversion of name into molecular structure, Calculation of physical properties such as density, molecular weight, molecular formula, refractive index from structural formula,. 1H, 13C NMR prediction from molecular structure, Drawing structure of bigger molecules such as proteins, carbohydrates, and RNA/DNA, bio arts, Use of templates, Comparison of various Chem Draw software.

Unit-III

4. Origin 8.5 Software
The Origin Workspace. Multi-sheet Workbooks Managing Data and Metadata. Importing Data from different sources. Working with Origin. Basic Data processing. Creating and Customizing Graphs. Custom Graph Templates and Themes. Publishing Graphs. Basic Data Analysis.

Unit IV

5. Introduction to Molecular Docking
Definition and introduction to Molecular Docking, Softwares used for Docking, Types of Molecular docking: Rigid docking, flexible docking, Ligand sources – Natural, synthetic and semi -synthetics, Protein Structure Basics, Protein Databases, Force fields, Ligand Preparation, Protein Preparation, Receptor Grid Generation, Ligand Docking, Analysis of ligand protein interactions, ADME properties. Any two Case studies.

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Practicals

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES (Theory):

1. Invigilator to assign two practical tasks to each student.
2. Students need to complete both practicals within 3 Hrs.
3. Invigilator to vary out the split of marks as per nature of experiment assigned

CONTENTS OF PRACTICAL SYLLABUS

1. Create presentations from a template. Add text, images, art, and videos.
2. Design a poster in MS powerpoint based upon the
3. Draw the structure of following compounds using ChemDraw
(a) Paracetamol (b) Chloramphenicol (c) Amoxicillin (d) Urotropine (e) Morphine
4. Draw the graph based upon data provided from a manuscript and carry out curve fitting of the data for various orders using Origin Sofware.
5. Draw multiple curves on the same axis using Excel and present each curve with different colour and mark the peaks in a separate box within the graph.
6. Draw 3D graphs based upon the three variables provided by using Origin software.
7. To write chemical reaction and mechanism for the following reaction using ChemDraw
(a) Aldol condensation of acetophenone
(b) Cannizarro reaction of benzaldehyde in 50% NaOH solution
(c) Fries Rearrangement
(d) Mannich reaction
(e) HVZ reaction and subsequent hydrolysis with aq KOH.

8 Export data of IR spectrum and plot the IR spectrum using Origin software/Excel.
9. Export data of UV-spectrum and plot the spectru using Origin software/Excel.
10. Molecular docking of Aspirin (Anti-inflammatory Drug) in the crystal coordinate of COX-2.
11. Molecular docking of Trimethoprim (Antibiotic Drug) in the crystal coordinate of DHFR.

BOOKS PRESCRIBED:

1. K.V. Raman, Computers in Chemistry, Tata McGraw Hill.
2. Tamanna Anwar, Pawan Kumar, Asad U. Khan,Chapter 1 - Modern Tools and Techniques in Computer-Aided Drug Design,Editor(s): Mohane S. Coumar, in book Fundamentals, Techniques, Resources and Applications2021, Pages 1-3
https://www.sciencedirect.com/book/9780128223123/molecular-docking-for-computer-aided-drug-design
3. https://www.nature.com/articles/s41429-019-0240-6
4. https://www.sciencedirect.com/science/article/pii/S1878535221005554
5. Chem Draw 7.0: Chemical Structure Drawing Standard - User's Guide Paperback , 2001 by Cambridge Scientific Computing .
6. Tutorial to ChemDraw: For beginner Kindle Edition by JUHN MORTON .
7. Origin Software Complete Usage Instruction and Graph Representation: A complete Guide for new users by Muhammad Arsalan, Azka Awais

COURSE OUTCOMES:

S. No.	On completing the course, students will be able to
CO1	Carry out formula based calculation, plot graphs, carry out curve fitting of the data for research purposes.
CO2	Plot graphs and process research data using Origin software
CO3	Draw the chemical structures and write chemical reactions using ChemDraw software.
CO4	Convert chemical name to structure, structure to chemical name and predict 1H and 13C -NMR data of the compound.
CO5	Make power point slides for presentation of research work.

Semester-II

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

CHH 421: Inorganic Chemistry-II

Metal-Carbon bonding and its applications

Total Hours: 60
Total Hours/week: 4
Total Credits: 4
L T P
3 1 0

Maximum Marks: 100
Theory: 75
Internal Assessment: 25

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.
III. Section-I will consist of EIGHT questions and students are required to attempt any SIX short questions carrying 2.5 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 15 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 impart knowledge about the formation, structure and reactivity of transition metal-carbon (M-C) bonds and their utility in catalysis. The stoichiometric reactivity of transition metal-ligand complexes will provide the basis for our study of catalytic transformations in which we will combine these individual reactions to complete a variety of catalytic cycles.

COURSE CONTENTS:

UNIT I 15 Hrs

Introduction, The 18 Valence Electron Rule: Introduction, The 18 electron rule, counting of electrons and finding metal-metal bonds and related problems. Recaptulation of Metal carbonyls. Alkyl, Aryl and Ligands with Higher Hapticity: (i) Sigma bonded alkyl groups as ligands: Synthesis of metal-alkyl compounds, β-hydride elimination, σ-bonded η1 -aryl ligands. (ii) Cyclic and acyclic polyenyl π-bonded ligands: Cyclopentdienyl (Cp-), Synthesis of Cp based sandwich compounds, Structure and properties of MCp2 complexes, The first metal- sandwich compound Ferrocene, Reactions of metal-sandwich compounds, Bent sandwich compounds, Schwartz reagent and hydrozirconation, Chemistry of Cp* , Chemistry of arene sandwich compounds, Allyl groups as ligands, 1,3-Butadiene complexes, Cyclobutadiene complexes, Cycloheptatriene and Cyclooctatetraene as ligands. Davies-Green-Mingos (DGM) rules.

UNIT II 15 Hrs

Ferrocene: Structure and bonding of ferrocenes, Basic chemical reactions of Ferrocene, Reactions of Acetyl Ferrocene and formylFerrocene, lithiatedferrocenes and their reactions, (Dimethylaminomethyl)Ferrocene and its methiodide salt, Ferroceneboronic acid and haloferrocenes,

Chirality in Ferrocene derivatives, Synthesis of chiral Ferrocene based compounds, Ferrocene based condensation polymers

UNIT-III 15 Hrs

Catalytic reactions and 16/18 electron rule, alkene metathesis, Chauvin mechanism, Olefin polymerization, Ziggler-Natta polymerization, Cossee mechanism, hydrogenation of alkenes Wilkinson's catalyst, Fischer-Tropsch reactions, water gas shift reactions, Monsanto acetic acid process, hydrocyantion, Reppecarbonylation, hydroformylation of unsaturated compounds. Reductive carbonylation of alcohols and other compounds, carbonylation reactions: methanol and methyl acetate, adipic ester and other compounds,

UNIT IV 15 Hrs

Synthesis and carbonylation reactions, decarbonylation reaction, catalytic addition of molecules to carbon-carbonmultiple bonds, homogeneous hydrogenation, hydro cyanation and hydro silation of unsaturated compounds,polymerization. Oligomerisation and metathesis of alkene and alkynes. Cluster compounds in catalysis,supported homogeneous and phase transfer catalysis, oxidation reactions, oxidative carbonylation. Pd catalysed oxidation of ethylene, acrylonitrile synthesis,oxygen transfer from peroxo and oxo species and NO_2 groups

BOOKS PRESCRIBED:

1. J.E. Huheey, Inorganic Chemistry Principles of Structure and Reactivity, Harper Inter- Science.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Inter-Science.
3. B.D. Gupta and A.J. Elias, Basic Organomettallic Chemistry, Universities Press.
4. C.E.A. Salzer and E. Elchinbroich, Organometallics, A Concise Introduction Chemistry, VCH.

COURSE OUTCOMES:

S. No.	On completing the course, students will be able to
CO1	Understand organometallic chemistry with focus on the transition metals. catalysis
CO2	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	Learn Structure and bonding issues in organometallic compounds are discussed in view of the 18-electron rule.
CO5	Learn to go through some important emerging compounds especially multi decker sandwich compounds

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

Total Hours/week: 4 **Maximum Marks: 100**
Total Credits: 4 **Theory: 75**
L T P **Internal Assessment: 25**
3 1 0

Total Hours: 60

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.
III. Section-I will consist of EIGHT questions and students are required to attempt any SIX short questions carrying 2.5 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 15 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, students will be able to
CO1	Learn about the various chemical reagents available for addition to carbon-carbon/carbon-heteroatom multiple bonds.
CO2	Explain the mechanism of different types of elimination, and rearrangement reactions.
CO3	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	Study important oxidizing agents and oxidation reactions used in organic synthesis.
CO5	Acquire knowledge of reducing agents and their applications in organic synthesis.

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

CHE 423/CHH 423

Physical Chemistry-II

Quantum Chemistry

Total Hours: 60
Total Hours/week: 4 **Maximum Marks: 100**
Total Credits: 4 **Theory: 75**
L T P **Internal Assessment: 25**
3 1 0

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.
III. Section-I will consist of EIGHT questions and students are required to attempt any SIX short questions carrying 2.5 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 15 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, students will be able to
CO1	Understand Phenomenon of Black body radiation, photoelectric effect, Compton effect, De- Broglie hypothesis, the Heisenberg's uncertainty and classical wave equation and its solutions
CO2	Understand Concepts of operators, their types, uses and Quantum Mechanical Model of atom.
CO3	Apply of Quantum Mechanics to deduce the quantization of Translational, Rotational, Vibrational and Electronic energies.
CO4	Apply of Quantum Mechanical model on Single electron system like H-atom and Solution for multi-electron system through Approximation methods
CO5	Understand 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

Total Hours: 90
Total Hours/week: 6 **Maximum Marks: 150**
Total Credits: 6 **Theory: 112**
L T P **Internal Assessment: 38**
5 1 0

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.
III. Section-I will consist of EIGHT questions and students are required to attempt any SIX short questions carrying 4 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 22 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, students will be able to
CO1	Get basic idea and application of IR spectroscopy and Raman spectroscopy
CO2	Learn applications of Rotational spectroscopy in inorganic molecules.
CO3	Understand NQR spectroscopy.
CO4	Apply of photoelectron spectroscopy
CO5	Learn principle of EPR spectroscopy and Mossbauer spectroscopy and structure elucidation of inorganic compounds

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

CHE 425/CHH 425

Organic Synthesis-III

Supramolecular, Reactive Intermediates and Disconnections

Total Hours: 60
Total Hours/week: 4 **Maximum Marks: 100**
Total Credits: 4 **Theory: 75**
L T P **Internal Assessment: 25**
3 1 0

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.
III. Section-I will consist of EIGHT questions and students are required to attempt any SIX short questions carrying 2.5 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 15 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, students will be able to
CO1	Learn introductory concepts of supramolecular chemistry
CO2	Learn the binding of various metals with synthetic and natural cationic hosts
CO3	Understand the logics involved in anion binding by different hosts including solid state clatharates and fullerenes

CO4	Develop the concept involved in Crystal Engineering
CO5	learn the construction of molecular devices such as molecular wires, rectifiers and switches
CO6	Acquire an in depth knowledge of various reactive intermediates viz. Carbocations, carbanions, free radicals, carbenes and nitrenes
CO7	Understand retrosynthetic methodology of going from a target molecule to simple starting compound
CO8	Learn the concept of disconnection, functional group interconversions, synthons and their corresponding synthetic equivalents

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

MH CHX 421: Mathematics for Chemists

For Medical Students

Total Hours: 45
Total Hours/week: 3 **Maximum Marks: 75**
Total Credits: 3 **Theory: 56**
L T P **Internal Assessment: 19**
2 1 0

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 questions and students are required to attempt any SIX short questions carrying 2 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 will carry 11 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

Trigonometry and Determinants: 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/3, π/2. Trigonometric identities (without proofs) and their applications.Definition and expansion, properties of determinants, product of two determinants of 3rd order.

UNIT-II

Matrices: Introduction to various forms of Matrices, row, column, diagonal unit, Submatrix, square, equal matrices, null, symmetric and skew symmetric matrices, transpose of a matrix, adjoint and inverse of matrices. Addition, multiplication, characteristic equation of a matrix, statement of Cayley Hamilton theorem. Rank of matrix, condition of consistency of a system of linear equations. Eigen vectors and Eigen values ofmatrices.

UNIT-III

Differential Calculus : Differentiation of standard functions, theorems relating to the derivative of the sum, difference, product and quotient of functions (without proofs), derivative of trigonometric functions, inverse trigonometric functions, logarithmic functions and exponential functions, differentiation of implict functions, logarithmic differentiation.

UNIT-IV

Integral Calculus: 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 as 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, students will be able to
CO1	Understand the relationships between side lengths and angles of triangles.
CO2	Describe the angles that are created when atoms bond together to form molecules in molecular geometry.
CO3	Work with the matrices, determinants, derivatives and integrals.
CO4	Calculate Area under a curve using integration.

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

BT CHX 421

Biology for Chemists

For Non-Medical Students

Total Hours: 45
Total Hours/week: 3 **Maximum Marks: 75**
Total Credits: 3 **Theory: 56**
L T P **nternal Assessment: 19**
2 1 0

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 questions and student has to attempt any SIX short questions carrying 2 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 will carry 11 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 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.

UNIT-I

Organization of life

- **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**: Mitochondria, Golgi apparatus, Ribosomes, Endoplasmic reticulum, Chloroplast, Plastids, Nucleus.

UNIT-II

Organization of Tissues

- **Animal tissues:**Epithelial tissues, Connective tissues, Muscle tissue, Nervous tissue
- **Plant tissues:**Meristematic tissue, Permanent tissues (Simple and Complex).

UNIT-III

Diversity of Life

- **The classification of living things:**Criteria of classification, Whittaker's system of classification.
- **Viruses**:Structure of Viruses.

UNIT-IV

Genetics

- **The Basic Principle of Heredity:** Mendel's laws, Monohybrid cross, Dihybrid cross.
- **DNA:**Double helix structure and replication.

- **Gene expression:** Transcription and translation, Genetic code.

BOOKS PRESCRIBED:

1. Cord Biology – South Western Educational Publications, Texas
2. Bhatia K.N. &Tyagi M.P. Elementary Biology Vol 1 Trueman Book Company,Hoshiarpur.
3. Buffaloe N.D. Principles of Biology Prentice-Hall of India (Private) Ltd. New Delhi.
4. Wiesz P. B. The Science of Biology McGraw–Hill BookCompany, New York

COURSE OUTCOMES:

CO-1	Understand 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	Understand 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 organelles.
CO-3	Understand the anatomical structure of plants and animals by studying the Tissues, organs: Animal tissues; epithelial tissues, connective tissues, muscle tissueandnervous tissue; plant tissue: meristematic tissue, permanent tissues.
CO-4	Understand the scope and significance of genetics by imbibing the principles of hereditary genetic transmission and interactions of gene with environment.
CO-5	Understand the genes at molecular level, structure of DNA, DNA replication. Gene expression: transcription and translation and genetic code.
CO-6	Understand the taxonomic nomenclature and criteria of classification, Whittaker's systems of Classification and their characteristics.
CO-7	Understand 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

Total Hours: 90
Total Hours/week: 6 **Maximum Marks: 75**
Total Credits: 3 **Theory: 56**
L T P **Internal Assessment: 19**
0 0 3

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 = 20, Performance = 20, Viva-Voce = 10, Practical notebook = 6)

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 $K_1 + + l_2 \rightarrow Kl_3$ 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

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

CHE 427/CHH 27

Inorganic Chemistry Lab-II

Total Hours: 90
Total Hours/week: 6 **Maximum Marks: 75**
Total Credits: 3 **Theory: 56**
L T P **Internal Assessment: 19**
0 0 3

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 = 20, Performance = 20, Viva-Voce = 10, Practical notebook = 6)

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.	Understand
CO1	Learn how to synthesize inorganic complexes
CO2	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	Get Practical knowledge about UV and FTIR