Kurukshetra University, Kurukshetra

(Established by the State Legislature Act-XII of 1956)
("A++" Grade, NAAC Accredited)

Revised Syllabus
for
Post Graduate Programme

M.Sc. Chemistry 1st and 2nd Semester

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2025-26 (in phased manner)

DEPARTMENT OF CHEMISTRY
FACULTY OF SCIENCES

KURUKSHETRA UNIVERSITY, KURUKSHETRA -136119
HARYANA, INDIA

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	I		
Name of the Course	Inorganic Chemistry-I		
Course Code	M24-CHE-101		
Course Type	CC-1		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know about the basic aspects of symmetry and group theory and also their applications CLO 2: To know about the concept of bonding using VSEPR theory and applications of Huckel theory to various molecules and also some substitution reactions of boron, silicon and Nitrogen. CLO 3: To know about the metal equilibria in solutions with reference to stability and factors affecting the stability of complexes. CLO 4: To know about the limitations of crystal field theory and its effects in coordination complexes and to apply the concept of molecular orbital theory to tetrahedral square planar and octahedral complexes.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Symmetry and Group Theory in Chemistry** Definitions of group, subgroup, relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Symmetry elements and symmetry operation, Point symmetry group. Schönflies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, $C_{nh,}$ D_{nh} etc. groups to be worked out explicitly). Character of a representation, reducible and irreducible representations, The great orthogonality theorem (without proof) and its importance, Derivation of character tables of C_{2v}, C_{3v} and their use. Molecular asymmetry, dissymmetry and optical activity.	15

II	**Stereochemistry and Bonding in Main Group Compounds** VSEPR Theory, Walsh diagrams (tri- atomic molecules), d-pπ bonds, Bent rule and energetics of hybridization, Huckel theory with reference to ethylene and butadiene, Some simple substitution reactions of covalently bonded molecules of boron, silicon and nitrogen.	15
III	**Metal-Ligand Equilibria in Solution** Stepwise and overall formation constants and their interaction, trends in stepwise constants, inert and labile complexes, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry. Substitution reactions in octahedral complexes, theories of trans effect with respect to Pt(II) complexes.	15
IV	**Metal-Ligand Bonding** Crystal field theory and its limitations of crystal field theory, Crystal field effects on ionic radii, Lattice energies, Heat of hydration & Geometry of coordination complexes, John-Teller distortion, Consequences of John-Teller distortion, Nephelauxetic effect and Nephelauxetic series, spin-orbital coupling, Molecular orbital theory of octahedral, tetrahedral and square planar complexes (with and without n-bonding).	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harper & Row.
3. Chemical Applications of Group Theory; F.A. Cotton, Wiley, New York.
4. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
5. The Chemical bond; J.N.Murrell, SFA Kettle and J.M. Tedder; Wiley, New York.
6. Modern Aspects of Inorganic Chemistry; H. J. Emeleus and Sharpe.
7. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H. McDaniel and J. J. Alexander; John Wiley and Sons.
8. Inorganic Chemistry, A Modern Introduction; T Moeller, John Wiley and Sons.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	I		
Name of the Course	Physical Chemistry-I		
Course Code	M24-CHE-102		
Course Type	CC-2		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understanding thermodynamics and partial molar properties. CLO 2: To demonstrate thermodynamic formulations of activated complex theory. CLO 3: To understand the electrochemistry of ion-ion interaction and concept of electrical double layer CLO 4: Understand different adsorption models and their application in heterogeneous catalysis.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Partial Molar Properties** Recapitulation of thermodynamic laws, Partial molar quantities, chemical potential and Gibbs-Duhem equation, variation of chemical potential with temperature and pressure, chemical potential for an ideal gas, chemical potential of ideal gas mixture(s), determination of partial molar volume, thermodynamic functions of mixing (free energy, entropy, volume and enthalpy), concept of fugacity and activity, dependence of activity on temperature and pressure, determination of activity by (i) measurement of vapour pressure and (ii) emf measurement.	15
II	**Chemical Kinetics** Collision theory of reaction rates, the steric requirement, Arrhenius equation and Conventional Transition State Theory (CTST), Equilibrium hypothesis, Statistical mechanics and Chemical Equilibrium, Comparison of Collision theory and CTST, Potential energy surfaces (Only basic Idea), Thermodynamic formulation of activated complex theory, Chain reactions (hydrogen-halogen reaction), Unimolecular reactions: Lindemann-Christiansen Hypothesis, Hinshelwood treatment.	15

III	**Electrochemistry** Debye-Hückel theory of ion-ion interaction and activity coefficient, applicability and limitations of Debye-Hückel limiting law, its modification for finite-sized ions, effect of ion-solvent interaction on activity coefficient. Physical significance of activity coefficients, mean activity coefficient of an electrolyte. Debye-Huckel-Onsager (D-H-O) theory of electrolytic conductance, Debye-Falkenhagen effect, Wein effect. D-H-O equation - its applicability and limitations, Pair-wise association of ions (Bjerrum treatment), Modification of D-H-O theory to account for ion-pair formation. Metal/Electrolyte interface, Concept of electrical double layer and its structure: Helmholtz-Perrin, Gouy-Chapman, and Stern models, electrokinetic phenomena, determination of zeta potential.	15
IV	**Surface Chemistry and Catalysis** Langmuir adsorption isotherm (L.A.I.) and its derivation for non-dissociative and dissociative adsorption, BET adsorption isotherm, its derivation and applications, Surface Tension and Gibbs Adsorption Isotherm. Heterogeneous catalysis: Fundamentals and examples, Surface heterogeneity, Miller indices and Bravais-Miller indices of planes and directions in solids, Based on L.A.I. - rate calculation of surface catalyzed unimolecular and bimolecular reactions, Activation energy for surface reactions, Comparison of uncatalyzed and catalyzed reaction rates.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. An Introduction to Chemical Thermodynamics, R.P. Rastogi and R.R. Misra, Vikas Pub.
2. Physical Chemistry, P.W. Atkins, Oxford University Press.
3. Thermodynamics for Chemists, S. Glasstone, Affiliated East-West Press.
4. Thermodynamics, I.M. Klotz and R.M. Rosenbers, Benzamin.
5. Chemical Kinetics, K.J. Laidler, McGraw Hill.
6. Kinetics and Mechanism, A. A. Frost and R.G. Pearson, John Wiley and Sons.
7. Electrochemistry, S. Glasstone, Affiliated East-West Press.
8. Physical Chemistry, G.W. Castellan, Narosa.
9. Heterogeneous Catalysis: Fundamentals and Applications, Julian R.H. Ross, Wiley-VCH; 2nd, Revised and Enlarged Edition edition (October 1, 2007).
10. Concepts of Modern Catalysis and Kinetics, I. Chorkendorff and J. W. Niemantsverdriet.
11. Physical Chemistry, by Robert J. Silbey, Robert A. Alberty, Moungi G. Bawendi, Wiley India; Fourth edition (1 January 2015)

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	I		
Name of the Course	Organic Chemistry-I		
Course Code	M24-CHE-103		
Course Type	CC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To understand the general aspects (theoretical and experimental) of organic reaction mechanism and reaction intermediates. CLO 2: To understand mechanistic details of aliphatic nucleophilic substitution reactions and elimination reactions. CLO 3: To understand the stereo-chemical terms and conformational aspects in cyclic and acyclic systems. CLO 4: To understand the important stereochemical terms and aspects related to asymmetric synthesis. Idea about conformations of sugars and decalines.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Reaction Mechanism: Structure and Reactivity** Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, effect of structure on reactivity - resonance and field effects, steric effect, quantitative treatment -The Hammett equation and linear free energy relationship, substituent and reaction constants and Taft equation. Kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining reaction mechanisms. Generation, structure, stability and reactivity of carbocations, carbanions, carbenes and nitrenes.	15
II	**Mechanism of Nucleophilic Aliphatic Substitution** The limiting cases SN^1 and SN^2, detailed mechanistic description and borderline mechanisms, nucleophilicity and solvent effects, ambident nucleophiles, hard and soft nucleophiles and electrophiles, leaving	15

	group effects, steric and other substituent effects on substitution and ionization rates, stereochemistry of nucleophilic substitution. SN^{i}, $SN^{1'}$, $SN^{2'}$ and $SN^{i'}$ mechanisms. **Mechanism of Elimination Reactions** The El, ElcB and E2 mechanisms, Orientation Effects in Elimination Reactions, Saytzeff and Hoffman rules, Stereochemistry of E2 Elimination Reaction and Eclipsing Effects in E2 Eliminations, Dehydration of Alcohols, Pyrolytic eliminations.	
III	**Stereochemistry-I** Symmetry elements, D-L, R-S, E-Z and threo-erythro nomenclature, interconversion of Fischer, Newman, Sawhorse and flying wedge formulae. Conformational analysis, enantiomerism and diastereomerism of simple, cyclic (chair and boat conformations) and acyclic systems. Axial and planar chirality, optical isomerism in allenes, biphenyls (atropisomerism), spiranes, hemi-spiranes. Elementary ideas about stereochemistry of tertiary amines, quaternary salts, sulphur and phosphorous compounds.	15
IV	**Stereochemistry –II** Topicity of ligands and faces, their nomenclature and prostereoisomerism, stereogenecity, chirogenicity, pseudoasymmetry and prochiral centre. Stereospecific and stereoselective reactions. Elementary idea of principal categories of asymmetric synthesis, Cram's rule and its modification, Prelog rule and horeaus rule. Stereochemistry of sugars- C1 and 1C conformations of hexoses, c_2'-endo and c3'-endo conformation of pentoses, homo-morphous sugars, abnormal mutarotation and Δ-2 instability factor. Stereochemistry of decalins, Chemical correlation of configuration-determination of relative configuration of 2-butanol, isoserine, alanine, malic acid, lactic acid and mandelic acid.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Reaction Mechanism in Organic Chemistry by Mukherji and Singh revised by S.P. Singh and Om Prakash published by Laxmi Publication, New Delhi.
2. Advanced Organic Chemistry Reactions, Mechanism and Structure, Jerry March, John Wiley.
3. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
4. A Guide-Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
5. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
6. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
7. Modern Organic Reactions, H. O. House, Benjamin.

8. Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackie Academic & Professional.
11. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
12. Stereochemistry of Organic Compounds, P.S, Kalsi, New Age International.
13. Stereochemistry of Organic compounds, E.L. Eliel, Mc Graw Hills, 1962.
14. Organic Chemistry, Volume 1 and 2, I.L. Finar, Pearson Publication

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	I		
Name of the Course	Environmental and Bioinorganic Chemistry		
Course Code	M24-CHE 104		
Course Type	CC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know about the chemical aspects of hydrosphere and atmosphere CLO 2: To know about the concept and role of various dioxygen carriers with reference to hemoglobin, myoglobin, hemocyanin and also some model compounds as synthetic oxygen carriers. CLO 3: To discuss about the metal storage, their transportations in living organisms and biomineralization and also to learn about the role of vitamin B6 and vitamin B12 and calcium in living organisms.		
Credits	Theory	Tutorial	Total
	3	0	3
Teaching Hours per week	3	0	3
Internal Assessment Marks	25	0	25
End Term Exam Marks	50	0	50
Max. Marks	75	0	75
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 7 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 3 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting at least one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Hydrosphere** Hydrological cycle, water pollutants, eutrophication, trace elements in water, Chemical speciation (heavy metals like Pb, Hg and As). Water quality parameters and standards, monitoring techniques and methodology: effect of pH, Dissolved Oxygen, fluoride, ammonia, nitrate, nitrite, phosphate and sulfide, total hardness of water, chemical oxygen demand, metal and metalloids. **Atmosphere** Air pollutants and their types, air quality standards, analysis of CO, NOx, SOx, hydrocarbons, photochemical smog, acid rain, effect of atmospheric pollution, tropospheric chemistry.	15

II	**Transport and Storage of Dioxygen** Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanin and hemerythrin, model synthetic complexes of iron and cobalt. **Electron Transfer in Biological Systems** Structure and function of metalloproteins in electron transport processes-cytochromes and iron-sulfur proteins, synthetic models.	15
III	**Biomineralization, Metal storage and its transportation** Na /K pump, Ferritin, transferrin, and siderophores **Calcium in Biology** Role of Calcium in living cells, its transport and regulation, calcium pump, role of calcium in muscle contraction	15
	Total Contact Hours	45

Suggested Evaluation Methods			
Internal Assessment: 25		**End Term Examination: 50**	
➢ **Theory**	**25**	➢ **Theory :**	**50**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	10		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Environmental Chemistry; A. K. De, Wiley Eastern.
2. Environmental Pollution Analysis; S. M. Khopkar, Wiley Eastern.
3. Environmental Chemistry; S. K. Banerji: Prentice– Hall.
4. Principles of Bioinorganic Chemistry: S. J. Lippard and J. M. Berg, University Science Books.
5. The Inorganic Chemistry of Biological Process; M. N. Huges; John Wiley & Sons.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	I		
Name of the Course	Inorganic Chemistry Practical-I		
Course Code	M24-CHE-105		
Course Type	PC-1		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Able to analyse the given mixture for the presence of two acidic radicals, insoluble salt. CLO 2: Able to detect the presence of two rare earth metal ions present in the given mixture. CLO 3: Able to perform the Cerimetric/Iodometric titrations to find out the strength of the given analyte.		
Credits	Theory	Practical	Total
	0	3	3
Teaching Hours per week	0	6	6
Internal Assessment Marks	0	25	25
End Term Exam Marks	0	50	50
Max. Marks	0	75	75
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
I	**Qualitative analysis:** Total five radicals to be given containing two less common metal ions, one insoluble and two acid radicals: CH_3COO^-,BO_3^{3-}, PO_4^{3-}, CO_3^{2-}, HCO_3^-, NO_2^-,NO_3^-, Cl^-,B^{r-},I^-, S^{2-}, SO_3^{2-}, SO_4^{2-}, $S_2O_3^{2-}$, F^-, $C_2O_4^{2-}$ Less common metal ions – W, Tl, Mo, Se, Ti, Zr, Th, V, U, Ce, Be (two metal ions in cationic and anionic forms). Insoluble: Halides (AgCl, AgBr, AgI); Sulphates ($PbSO_4$, $BaSO_4$) and Oxides (Al_2O_3, Cr_2O_3, SnO_2, TiO_2, SiO_2) Cerimetric / Iodometric/ Oxidimetry titrations.	30 6 Hours Per Week
	Total Contact Hours	90

Suggested Evaluation Methods

Internal Assessment: 25		**End Term Examination: 50**	
➢ **Practical**	**25**	➢ **Practical**	**50**
• Class Participation:	5	Marks Distribution:	

• Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 35 Lab record Marks: 5 Viva-voce Marks: 10
• Mid-Term Exam:	10	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. A Text Book of Macro and Semi-micro Quantitative Analysis, A. I. Vogel, Orient Longman.
2. A Vogel's Text Book of Quantitative Inorganic Analysis, J. Bassett, R. C. Denney, G. B. Jaffery and J. Menaham, Longman, London.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	I		
Name of the Course	Physical Chemistry Practical-I		
Course Code	M24-CHE-106		
Course Type	PC-2		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To understand the concept of Surface Tension and pH metric titration to find out the strength of acids. CLO 2: To understand the fundamentals of potentiometric experiments and study of extent of adsorption with verification of Freundlich and Langmuir adsorption isotherm. CLO 3: To study and conduct experiments related to chemical kinetics for the determination of order and rate constant of the reaction and further learn about data handling/analysis.		
Credits	Theory	Practical	Total
	0	3	3
Teaching Hours per week	0	6	6
Internal Assessment Marks	0	25	25
End Term Exam Marks	0	50	50
Max. Marks	0	75	75
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Instructions for Paper- Setter:

Unit	Topics	Contact Hours
I	**Surface Tension** 1 Determine the surface tension of given organic solvents. 2 Study the effect of soap concentration on the lowering of surface tension of water. 3 Compare the cleansing powers of two cloth detergents provided to you. **pH-metry** 4 Determine the strength of strong acid by pH-metric titration with strong base. 5 Determine the strength of weak acid by pH-metric titration with strong base. 6 Determine the dissociation constant of acetic acid using pH-meter. **Potentiometry** 7 Determine the standard electrode potential of Cu and Zn. 8 Determine the strength of a given solution of ferrous ammonium sulphate by potentiometric titration with $K_2Cr_2O_7$ solution.	6 Hours per week

	9 Study the precipitation titration between KCl and $AgNO_3$ potentiometrically. 10 Determine the standard free energy change and equilibrium constant for the reaction $Cu + 2Ag^{+} \rightleftharpoons Cu^{2+} + 2Ag$ **Adsorption** 11 Verify the Freundlich and Langmuir adsorption isotherms for adsorption of acetic acid/oxalic acid on activated charcoal. **Chemical Kinetics** 12 Study the hydrolysis of methyl acetate in presence of hydrochloric acid. 13 Study saponification of ethyl acetate by sodium hydroxide solution using the same initial concentration of both the reactants. 14 Study saponification of ethyl acetate by sodium hydroxide solution taking the initial concentration of ester and base to be different. **Data Handling** 15 Wherever possible, error analysis in the experimental observations and results should be reported.	
	Total Contact Hours	90

Suggested Evaluation Methods

Internal Assessment: 25		**End Term Examination: 50**	
➢ **Practical**	**25**	➢ **Practical**	**50**
● Class Participation:	5	Marks Distribution: Experiment Marks: 35 Lab record Marks: 5 Viva-voce Marks: 10	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10		
● Mid-Term Exam:	10		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
5. Advanced Practical Physical Chemistry, J. B. Yadav Krishna Prakashan
6. Systematic experimental Physical Chemistry, T.K. Chandershekhar & S.K. Rajbhoj Anjali Publication.
7. A Comprehensive Guide to Physical Chemistry Experiments and Viva Questions, Neelam Seedher.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	I		
Name of the Course	Organic Chemistry Practical-I		
Course Code	M24-CHE-107		
Course Type	PC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : To understand the basic principle & techniques of separation and analysis of the organic compounds in the given binary mixture by qualitative analysis and confirm by preparing one derivative of each.		
Credits	Theory	Practical	Total
	0	3	3
Teaching Hours per week	0	6	6
Internal Assessment Marks	0	25	25
End Term Exam Marks	0	50	50
Max. Marks	0	75	75
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
I	**Organic Mixture Analysis** **Demonstrations of separation of binary mixtures:** using H_2O, HCl, NaOH, $NaHCO_3$, Ether or other reagent as may be necessary along with required conditions for their use. **Systematic identification** of mixtures of pure organic compounds: separation and identification of simple binary mixtures having acidic, basic and neutral components. Preparation of their derivatives, determination of b.p./m.p. for components and their derivatives. **Any other experiment be added as per requirement**	6 Hrs Per Week
	Total Contact Hours	90

Suggested Evaluation Methods

Internal Assessment: 25		**End Term Examination: 50**	
➢ **Practical**	**25**	➢ **Practical:**	**50**
● Class Participation:	5	Marks Distribution: Experiment Marks: 35 Lab record Marks: 5 Viva-voce Marks: 10	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10		
● Mid-Term Exam:	10		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. A Handbook of Organic Analysis Qualitative and Quantitative by H.T. Clarke and revised by

B.Maynes, Edward Arnold (Pub.) Ltd. London, 1975).
2. Systematic Qualitative Organic Analysis by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.
3. A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis by Arthur I. Vogel, Longmans Green and Co., Ltd., London 1966.
4. Elementary Practical Organic Chemistry by Arthur I. Vogel, CBS Publishers & Distributors.
5. Vogel's Text Book of Practical Organic Chemistry by B.S. Furners et. al., Longman Group Ltd.

Session: 2025-26	
Name of the Programme	M.Sc. Chemistry
Semester	**I**
Name of the Course	Seminar
Course Code	M24-CHE-108
Course Type: (CC/DEC/PC/Seminar/CHM/OEC/EEC)	Seminar
Level of the course	400-499
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To understand the deep concept and get knowledge of topic in details. CLO 2: To understand the teaching methodology and expression of concepts in classroom.
Credits	Seminar
	2
Teaching Hours per week	2
Max. Marks	50
Internal Assessment Marks	0
End Term Exam Marks	50
Examination Time	1 hour
Instructions for Examiner: Evaluation of the seminar will be done by the internal examiner(s) on the parameters as decided by staff council of the department. There will be no external examination/viva-voce examination.	

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	II		
Name of the Course	Inorganic Chemistry-II		
Course Code	M24-CHE-201		
Course Type	CC-5		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know about electronic transitions occurring in the metals and their complexes and also to apply the concept for assignment of absolute configuration in optically active metal chelates and their stereochemical information CLO 2: To explain the synthesis, structural characteristics, chemical properties and reactivity of metal-n complexes. CLO 3: To know the various classifications of metal cluster compounds and to categories the metal boranes carboranes, metallo-boranes and metallo-carboranes and their various aspects. CLO 4: To learn about basic concepts of photochemistry viz photochemical laws, quantum yield, electronically excited states and to learn about the Energy dissipation by radiative and non radiative processes along with Franck condon principle.		
Credits	Theory	Tutorial	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Electronic Spectra and Magnetic Properties of Transition Metal Complexes** Electronic arrangements of microstates, calculation of the number of microstates in various electronic arrangements, spectroscopic term symbols, vector diagrams to indicates coupling of orbital angular momenta in p^2, p^3, d^2 configurations and spin orbit coupling for p^2 arrangement, spectroscopic terms, spectral terms of d^2 to d^8 metal ions,	15

	determining the ground state terms-Hund's rules, derivation of the term symbols for a closed subshell. Interpretation of electronic spectra, Orgel diagrams, Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of Dq, B and b parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.	
II	**Metal л-Complexes** Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important chemical reactions of metal carbonyls, preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.	15
III	**Metal Clusters** Boranes: Introduction, Nomenclature, synthesis and properties of some important members (B_2H_6, B_4H_{10}, B_5H_9, B_5H_{11} and $B_{10}H_{14}$), bonding in Boranes, STYX code, Borane anions, Carboranes: Introduction, general methods of preparations and important properties, Polyhedral skeletal electron pair theory, Metalloboranes and metallocarboranes :Introduction, general methods of preparation and properties, Isolobal analogy, Metal carbonyl and halide clusters, introduction, Structure and bonding of compounds having M-M bonds, calculation of M-M bond.	15
IV	**Photochemistry** Absorption, absorption spectra, excitation, photochemical laws, quantum yield, electronically excited states- Jablonski Diagrams: Vibrational Relaxation, Internal Conversion, Intersystem Crossing, Fluorescence, and Phosphorescence; Fluorescence Spectra, Rules of fluorescence, Fluorescence Quantum Yield, Franck-Condon principle, Radiative Lifetime. Bimolecular quenching: Stern-Volmer relation, photochemical kinetics, photochemical stages-primary and secondary.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harper & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
5. Introduction to Ligand fields; B.N. Figgis, Wiley, New York.
6. Modern Aspects of Inorganic Chemistry; H.J. Emeleus and Sharpe.
7. Introduction to Ligand Field Theory; C.J.Ballahyen, McGraw Hill, New York.
8. Organometallic Chemistry; R.C. Mehrotra and A.Singh, New Age International.

9.	Concepts and Models of Inorganic Chemistry; B. Douglas, D.H.McDaniel and J.J. Alexander; John Wiley.
10.	The Organometallic Chemistry of the Transition Metals; R.H. Crabtree, John Wiley.
11.	Basic concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.
12.	Photochemistry of coordination compounds, K.Balzani and V.Carassti, Academic press.
13.	Elements of Inorganic Photochemistry; G.J. Ferraudi, Wiley.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	II		
Name of the Course	Physical Chemistry-II		
Course Code	M24-CHE-202		
Course Type	CC-6		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To learn to setup Schrödinger equation for simple systems and find their solutions CLO 2: To learn about the systems showing rotational motion and determine solutions of their Schrödinger equations besides knowing about angular momentum operators CLO 3: To understand the basic concepts of polymers ,polymerization and their molecular weights. CLO 4: To know the basic concepts of nuclear and radiochemistry.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Quantum Mechanics-I** The postulates of quantum mechanics, Linear and Hermitian opera Commutation of operators and Uncertainty Principle. Eigen functions Eigen values. Schrödinger equation, free particle, Schrödinger equation particle in a box, the degeneracy, particle in a box with a finite bar Tunneling Problem: Tunneling through a rectangular barrier Schrödi equation for linear harmonic oscillator and its solution, zero point energy	15
II	**Quantum Mechanics-II** Energy levels and wave-functions of Rigid rotator. Hydrogen atom: Complete solution (separation of variables in spherical polar coordinates and its solution). Radial distributions. Angular momentum and its directional quantization, Angular momentum operators, commutation relations, Ladder operators, shapes of atomic orbitals upto d-level and their discussion.	15
III	**Polymers** Basic concepts, Kinetics of Polymerization: Mechanism and Kinetics of chain growth polymerization: free-radical, cationic, anionic and coordination polymerization. Mechanism and Kinetics of step-growth	15

	polymerization. Comparison between step-growth and chain polymerization. Molecular mass of polymers: Significance of average molecular mass. Poly-dispersity. Determination of molecular mass by viscosity method. Electrically conducting polymers, Flame retardant polymers, Liquid crystal polymers.	
IV	**Nuclear and Radiochemistry** Nuclear stability and binding energy. Mass and binding energy, Nuclear fission and nuclear fusion, fission cross section, chain fission, fission product and fission yield. Interaction of nuclear radiation with matter, Detectors (Proportional, Geiger-Muller and Scintillation counters) and their principles. Units for measuring radiation absorbed, radiation dosimetry.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
2. Quantum Chemistry, I.M. Levine, Prentice Hall.
3. Essentials of Nuclear Chemistry, 4th Edition (1995), H.J. Arnikar, Wiley Eastern, New Delhi.
4. Nuclear & Radiochemistry, 3rd Edition (1981), G. Fridlander, J.W. Kennedy, E. S. Macias, and J. M. Miller, John Wiley, New York.
5. Introduction to Nuclear Chemistry, B. C. Harvey Prentice-Hall (1969).
6. Polymer Chemistry, Billmayer.
7. Polymer Chemistry, Gowarikar.
8. Principles of Polymerization, Geroge Odian.
9. Quantum Chemistry, B. K. Sen, Kalyani Publishers.
10. Quantum Chemistry, R.K. Prasad, New Age International.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	II		
Name of the Course	Organic Chemistry-II		
Course Code	M24-CHE-203		
Course Type	CC-7		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know the concept of Aromatic substitution/displacement reactions. CLO 2: To understand the concept of neighbouring group participation and carbocation rearrangements. CLO 3: To describe the generation, structure, stability and reactivity of free radicals and to know the mechanisms of addition to alkenes and alkynes. CLO 4: To understand the concept of addition to carbon hetero atom multiple bonds with emphasis on >C=O group.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Aromatic Electrophilic Substitution** Theoretical treatment of aromatic substitution reactions, structure-reactivity relationship in mono substituted benzene ring, orientation in other ring systems, partial rate factor, energy profile diagram, Vilsmeir-Haak reaction, Reimer-Tiemann reaction, Bischler-Napieralski reaction, Pechmann reaction, Houben-Hoesch reaction, Fries rearrangement. **Nucleophilic Aromatic Substitution** Mechanism of Nucleophilic substitution in aromatic systems via diazonium ions, by addition-elimination and elimination-addition mechanism (involving arynes); von-Richter rearrangement, Sommelet-Hauser, Stevens and Smiles rearrangements. General aspects of generation, structure, stability and reactivity of arynes.	15

II	**Neighbouring Group Participation and Carbocation Rearrangements** Anchimeric assistance, neighbouring group participation by non-bonding electrons, sigma and -bonds, classical and non-classical carbocations. Carbocations rearrangements: migratory aptitudes, Wagner Meerwein rearrangement, pinacol pinacolone rearrangement, Demjanove rearrangement, Tiffeneau-Demjanov ring expansion, aldehyde-ketone rearrangement, dienone-phenol rearrangement and trans-annular rearrangements and the Stieglitz rearrangement.	15
III	**Free Radicals** General aspects of generation, structure, stability and reactivity of free radicals, types of free radical reactions, halogenation including allylic halogenation (NBS), auto-oxidation, decomposition of azo compounds and peroxides, coupling of alkynes, homolytic aromatic substitution, Sandmeyer reaction and Hunsdiecker reaction. **Addition to C-C Multiple Bond** General mechanistic considerations, Mechanism of addition of hydrogen halide, H_2O, halogens, HOX and mercuric salt to alkenes and alkynes. Hydroboration, formation of C-C bonds via organoboranes, hydroboration of acetylenes, nucleophilic addition to alkenes.	15
IV	**Addition to Carbon-Hetero Atoms Multiple Bonds** General mechanistic considerations and reactivity, Hydration and Addition of Alcohols to Aldehydes, Ketones and Acids. Addition -Elimination Reactions of Ketones and Aldehydes, Reactivity of carbonyl compounds towards Addition. Lithium aluminium hydride reduction- carbonyl compounds, acids, esters, nitriles. Additions of Grignard reagents. Reformatsky reaction, Wittig reaction, Claisen condensation, Dieckman reaction, Aldol condensation, Knoevenagal condensation, Perkin reaction, Cannizzaro reaction, Benzoin condensation, Mannich Reaction, Robinson-Mannich reaction, Ester hydrolysis, aminolysis of esters, amide hydrolysis.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Reaction Mechanism in Organic Chemistry by Mukherji and Singh revised by S.P. Singh and Om Prakash published by Laxmi Publication, New Delhi.
2. Advanced Organic Chemistry Reactions, Mechanism and Structure, Jerry March, John Wiley.
3. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
4. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
5. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
6. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
7. Modern Organic Reactions, H. O. House, Benjamin.
8. Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackie Academic & Professional.

9. Advanced Organic Chemistry and Reaction Mechanisms, Reinhard Bruckner, Academic Press.
10. Organic Chemistry, Jonathan Clayden, Nick Greeves, and Stuart Warren, Oxford University Press.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	II		
Name of the Course	Spectroscopy and XRD		
Course Code	M24-CHE-204		
Course Type	CC-8		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand rotational and vibrational spectroscopy and their applications in Chemistry. CLO 2: Understand basics and significance of NMR, NQR and ESR techniques in Chemistry. CLO 3: Understand basics of X-ray Crystallography and interpret powder XRD patterns of cubic crystals.		
Credits	Theory	Practical	Total
	3	0	3
Teaching Hours per week	3	0	3
Internal Assessment Marks	25	0	25
End Term Exam Marks	50	0	50
Max. Marks	75	0	75
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 7 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 3 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting at least one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Microwave Spectroscopy** Basics of spectroscopy. The rotation of molecules, rotational spectra of rigid diatomic molecules, intensities of rotational spectral lines, isotopic effect, non-rigid rotator, spectra of polyatomic linear molecules and symmetric top molecules. **Infrared Spectroscopy** The vibrating diatomic molecule, force constant, zero point energy, simple harmonic vibrator, anharmonicity, Morse potential, overtones, hot bands, diatomic vibrating rotators, P,Q,R branches, vibration of polyatomic molecules, normal mode of vibrations. **Raman Spectroscopy** Classical and quantum theories, pure rotational Raman spectra of linear molecules, vibrational Raman spectra, mutual exclusion principle, polarization of the light and Raman effect, depolarization of Raman lines.	15
II	**Nuclear Magnetic Resonance Spectroscopy**	15

	Basic principles of NMR, theory of nuclear magnetic resonance, spin lattice relaxation, spin-spin relaxation, experimental techniques, chemical shift, chemical shift unit (δ) the origin of shielding constant, pattern of coupling, origin of spin-spin coupling. **Electron Spin Resonance Spectroscopy** Basic principles of ESR, experimental technique, hyperfine splitting and hyperfine structure (Hydrogen, methyl radical etc.), ESR applications to the study of free radicals and Mc-Connell relationship. **Nuclear Quadrupole Resonance Spectroscopy** Introduction, energies of quadrupole transitions, relationship between electric field gradient and molecular structure.	
III	**X-ray Crystallography** Symmetry elements in crystals, stereographic projections, point groups (illustration of R, R-bar, Rm, R/m, (R-bar)m point groups only), criteria for determining unit cell of lattice, space lattices, space groups P1, Pbar1, P2, $P2_1$, Pm, Pc, C2, Cm, Cc. Bragg's Law, Reciprocal lattice concept and its importance, Definition of Reciprocal lattice vector (derivation excluded). Interplanar spacing using reciprocal lattice concept for cubic, tetragonal, orthorhombic and hexagonal crystal systems, Structure factor calculations for primitive, base-centered, body-centered and face centered unit cells. Relation of structure factor to electron density and intensities (derivation excluded), Interpretation of powder photographs for cubic crystals, Data reduction (Brief overview), Phase problem (definition only), Correctness of a structure (Discrepancy Index).	15
	Total Contact Hours	45

Suggested Evaluation Methods			
Internal Assessment: 25		**End Term Examination: 50**	
➢ **Theory**	**25**	➢ **Theory:**	**50**
● Class Participation:	05	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	10		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata McGraw Hill.
2. Modern Spectroscopy, J.M. Hollas, John Wiley.
3. Basic Principles of Spectroscopy, R.Chang, McGraw Hill.
4. Introduction to Magnetic Resonance Spectroscopy, ESR, NMR & NQR, D. N. Sathyanarayan
5. Physical Method in Chemistry, R.S. Drago, Saunders College.
6. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
7. Elementary Crystallography, L. Azaroff.
8. Structure Determination by X-ray Crystallography, M. Ladd and R. Palmer.
9. X-Ray Structure Determination: A Practical Guide, 2nd Edition by George H. Stout and Lyle H. Jensen.
10. X-Ray Diffraction: A Practical Approach by C. Suryanarayana and M. Grant Norton
11. An Introduction to Crystallography by F. C. Phillips

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	II		
Name of the Course	Inorganic Chemistry Practical-II		
Course Code	M24-CHE-205		
Course Type	PC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know the concept of quantitative analysis and its application. CLO 2: Able to separate and quantify the presence of two metal ions in a solution. CLO 3: Able to prepare various coordination complexes and their spectroscopic study.		
Credits	Theory	Practical	Total
	0	3	3
Teaching Hours per week	0	6	6
Internal Assessment Marks	0	25	25
End Term Exam Marks	0	50	50
Max. Marks	0	75	75
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
I	**Quantitative analysis:** Separation of the metal ions and determination of any one of them using volumetric/gravimetric methods. Cu-Ni, Cu-Zn, Cu-Al, Ca-Ba, Fe-Mg, Fe-Ni etc. **Preparations:** Preparation of the following inorganic compounds and their spectroscopic studies. I. $Hg[Co(SCN)_4]$ II. $[Cu(NH_3)_4]SO_4.H_2O$ III. Prussian Blue IV. $Na[Cr(NH_3)_2(SCN)_4]$ V. $Mn(acac)_3$ VI. $[Ni(NH_3)_6]Cl_2$ VII. VO(acac)	30 6 Hours Per Week
	Total Contact Hours	90

Suggested Evaluation Methods	
Internal Assessment: 25	**End Term Examination: 50**

➢ **Practical**	**25**	➢ **Practical:**	**50**
• Class Participation:	5	Marks Distribution: Experiment Marks: 35 Lab record Marks: 5 Viva-voce Marks: 10	
• Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10		
• Mid-Term Exam:	10		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. A Text Book of Macro and Semi-micro Quantitative Analysis, A. I. Vogel, Orient Longman.
2. A Vogel's Text Book of Quantitative Inorganic Analysis, J. Bassett, R. C. Denney, G. B. Jaffery and J. Menaham, Longman, London.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	II		
Name of the Course	Physical Chemistry Practical-II		
Course Code	M24-CHE-206		
Course Type	PC-5		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know the concept of viscosity and solution chemistry of different mixtures. CLO 2: To understand and master the fundamentals of conductometric titrations in aqueous media. CLO 3: To study the specific/molar rotation of sugars and kinetics of inversions of sucrose by polarimetry.		
Credits	Theory	Practical	Total
	0	3	3
Teaching Hours per week	0	6	6
Internal Assessment Marks	0	25	25
End Term Exam Marks	0	50	50
Max. Marks	0	75	75
Examination Time		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
I	**Viscosity** 1 Determine the viscosity of given organic solvents. 2 Study the variation of viscosity with concentration for a glycerol solution using Ostwald viscometer and determine the unknown concentration of given solution of glycerol. 3 Determination of molar mass of a polymer using viscometric method **Conductometry** 4 Determine the strength of strong acid by conductometric titration with strong base. 5 Determine the strength of weak acid by conductometric titration with strong base. 6 Determine the strength of strong acid and weak acid in a mixture by conductometric titration with strong base. 7 Study precipitation titration between KCl and $AgNO_3$ conductometrically. Determine the strength of the given solution of $AgNO_3$. 8 Determine solubility and solubility product of sparingly soluble salts like $CaSO_4$, $BaSO_4$.	6 Hours Per Week

	9 Determine the relative strength of chloroacetic acid and acetic acid by conductivity measurements. **Polarimetry** 10 Study the variation of angle of optical rotation with the concentration of any optically active substance (sucrose or glucose) and determine the unknown concentration of the same substance in given solution. 11 Determine the specific and molecular rotation of sucrose or glucose at a number of concentrations. 12 Study the kinetics of inversion of cane-sugar (sucrose) in presence of an acid. 13 Distinguish between dextro/laevo rotatory substances using polarimeter and determine their specific rotation. **Solution Chemistry** 14 Determine the solubility product of calcium hydroxide by saturation titration method. 15 Determine the molal volume of ethanol and its partial molal volume in dilute aqueous solution. **Note: Any experiment can be introduced / omitted in the practical class on the basis of availability of instruments/chemicals.**	
	Total Contact Hours	90

Suggested Evaluation Methods			
Internal Assessment: 25		**End Term Examination: 50**	
➢ **Practical**	**25**	➢ **Practical:**	**50**
● Class Participation:	5	Marks Distribution: Experiment Marks: 35 Lab record Marks: 5 Viva-voce Marks: 10	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	10		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.
3. Senior Practical Physical Chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati - Publisher: R Chand & Co.
4. Advanced Practical Physical Chemistry, J. B. Yadav Krishna Prakashan
5. Experimental Physical Chemistry, V .D. Athawale and P. Mathur - New Age International Publishers
6. Vogel's Textbook of Quantitative Chemical Analysis by Vogel, Bassett, Jeffrey, Mendam, Denney - Longman Higher Education; 5th edition
7. CRC Handbook of Laboratory Safety, 5th Edition by A. Keith Furr

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	II		
Name of the Course	Organic Chemistry Practical-II		
Course Code	M24-CHE- 207		
Course Type	PC-6		
Level of the course	400-499		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : To understand the basic laboratory and purification techniques in organic chemistry and to know the concept of stepwise synthesis of the organic compounds.		
Credits	Theory	Practical	Total
	0	3	3
Teaching Hours per week	0	6	6
Internal Assessment Marks	0	25	25
End Term Exam Marks	0	50	50
Max. Marks	0	75	75
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	Demonstrations of Laboratory & Purification techniques Refluxing, Solvent extraction, Purification of solvents and reagents using various techniques like crystallization, distillation, steam distillation, and vacuum distillation. Drying and storage of solvents, sublimation etc. **Two-step Preparation of some important organic compounds involving the reactions out of the following representative reactions)** 1. Esterification and saponification 2. Oxidation 3. Reduction or Hydrogenation 4. Partial Reduction 5. Nucleophilic substitution 6. Aromatic electrophilic substitution reaction 7. Condensation reactions 8. Hoffman's Bromamide reaction 9. Heterocyclic synthesis 10. Any other reaction as per requirement For example 1. Synthesis of m-nitroaniline from nitrobenzene. 2. Synthesis of aniline from benzoic acid. 3. Synthesis of m-nitrobenzoic acid from methylbenzoate. 4. Synthesis of anthranilic acid from pthalic anhydride. 5. Synthesis of p-bromoaniline from acetanilide. 6. Synthesis of p-nitroaniline from acetanilide.	6 Hours Per Week

	7. Synthesis of phenytoin from Benzoin 8. Synthesis of 4-aminobenzoic acid from 4-nitrotoluene. 9. Synthesis of S-benzylisothiouronium salt of any acid _____ **The purity of the above synthesized compounds should be checked with thin layer chromatography (TLC)** **Copies of IR & NMR of the above synthesized compounds should be provided for study** **All the students must submit the recrystallised product along with m.p. for all the stages of preparation.**	
	Total Contact Hours	90

Suggested Evaluation Methods

Internal Assessment: 25		**End Term Examination: 50**	
➢ **Practical**	**25**	➢ **Practical:**	**50**
● Class Participation:	5	Marks Distribution: Experiment Marks: 35 Lab record Marks: 5 Viva-voce Marks: 10	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10		
● Mid-Term Exam:	10		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. A Handbook of Organic Analysis Qualitative and Quantitative by H.T. Clarke and revised by B. Maynes, Edward Arnold (Pub.) Ltd. London, 1975).
2. Systematic Qualitative Organic Analysis by H. Middleton, Edward Arnold (Publishers) Ltd., London 1959.
3. A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis by Arthur I. Vogel, Longmans Green and Co., Ltd., London 1966.
4. Elementary Practical Organic Chemistry by Arthur I. Vogel, CBS Publishers & Distributors.
5. Vogel's Text Book of Practical Organic Chemistry by B.S. Furners et. al., Longman Group Ltd.

Kurukshetra University, Kurukshetra

(Established by the State Legislature Act-XII of 1956)
("A++" Grade, NAAC Accredited)

Syllabus of Examination
for
Post Graduate Programme

M.Sc. Chemistry 3rd and 4th Semester

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2025-26 (in phased manner)

DEPARTMENT OF CHEMISTRY
FACULTY OF SCIENCES

KURUKSHETRA UNIVERSITY, KURUKSHETRA -136119
HARYANA, INDIA

Session: 2025-26			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Advanced Organic Spectroscopy		
Course Code	M24-CHE-301		
Course Type	CC-09		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Understand UV-Vis spectroscopy (electronic transitions, influencing factors), Fieser-Woodward rules for conjugated systems, and IR spectroscopy principles for functional group identification. CLO 2: Understand NMR phenomenon and fundamentals, including chemical shift, coupling constant, 1st/2nd-order NMR spectra, and 2D-NMR. Develop skill to predict NMR spectra, interpret them, and use NMR data to determine structure of Organic molecules. CLO 3: Analyse mass spectrometry principles: fragmentation patterns, influencing factors, ion analysis techniques, and structural determination using spectral data. CLO 4: Enable student compare ^{1}H-NMR and ^{13}C-NMR techniques and use C-13 NMR along with other spectra techniques in solving composite structural problems in organic chemistry.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Ultraviolet and Visible Spectroscopy** Introduction and understanding of UV phenomenon, Various electronic transitions (185-800 nm), Beer-Lambert law, Chromophores, Auxochromes, Bathochromic and Hypsochromic shift, Hyperchromic and Hypochromic effect, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl	15

	compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds. **Infrared Spectroscopy** Principle and Theory, Modes of stretching and bending vibrations, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. Problems related to IR spectroscopy.	
II	**Nuclear Magnetic Resonance Spectroscopy** General introduction: Theory and basic principles of NMR, Chemical shift: Definition, mechanism of measurement, shielding mechanism, factors affecting chemical shifts, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto). Spin-Spin coupling: Theory, splitting patterns, coupling constants and their significance, magnetic and chemical equivalence, factors affecting coupling constant, complex spin-spin interaction between two, three, four and five nuclei (first order spectra). Hindered rotation and NMR: Temperature effects and splitting patterns. Spin system: Pople notation. Second order spectra, Virtual coupling, Stereochemistry: concept of topicity, effect of enantiomeric and diastereomeric protons. ^{19}F and ^{31}P-NMR: An overview and heteronuclear couplings. Tools for simplification of complex NMR spectrum (chemical and instrumental)**:**-Deuteration, changing solvent, trifluoroacetylation, basification and acidification, lanthanide shift reagents, increased magnetic field strength, double resonance and nuclear overhauser effect (NOE), variable temperature probe. 2D-NMR spectroscopy: Principle, comparison with 1D-NMR, informations provided by 2D-NMR experiments: COSY, NOESY, HSQC and HMBC.	15
III	**Mass Spectrometry** Introduction, ion production - EI, CI, FD and FAB, Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Nitrogen rule, molecular weight determination molecular formula from isotopic ratio data, isotope profile of halogen compounds, fragmentation pattern - simple cleavage, retro-Diels Alder, Hydrogen transfer rearrangement like scrambling, ortho effect, McLafferty rearrangement, fragmentation patterns of hydrocarbons, alcohols, phenols, ethers, aldehydes, ketones, esters, carboxylic acids, amines, nitro, amides, nitriles.	15
IV	**Carbon-13 NMR Spectroscopy** General considerations: Comparison between 1H and 13C-NMR, Proton coupled and proton-decoupled 13C-NMR, Chemical shifts for different carbon environments (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), Coupling constants, Nuclear Overhauser effect in ^{13}C-NMR. Introduction to DEPT NMR and information provided by various DEPT experiments (DEPT-45, DEPT-90, and DEPT-135).	15

	Composite Problems Problems involving the application of the above spectroscopic techniques (UV/Visible, IR, NMR and Mass) for structural elucidation of organic molecules.	
		Total Contact Hours 60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Introduction to Spectroscopy-A Guide for Students of Organic Chemistry, 2nd Edn. By Donald L. Pavia, Gary M. Lampman and George
2. S. Kriz. Saunders Golden Sunburst Series. Harcourt Brace College Publishers, New York.
3. Spectrometric Identification of Organic Compounds, R. M. Silverstein, G. C. Bassler and T. C. Morrill, John Wiley.
4. Application of Spectroscopy of Organic Compounds, J. R. Dyer, Prentice Hall.
5. Spectroscopic Methods in Organic Chemistry, D. H. Williams and I. Fleming, Tata McGraw-Hill.
6. Spectroscopy of Organic Compounds by P. S. Kalsi, Wiley Estern, New Delhi.
7. Organic Spectroscopy by William Kemp, John Wiley.
8. Organic Mass Spectrometry by K.G. Das & E.P. James, Oxford & IBH Publishing Co.
9. Organic Spectroscopy (Principles & Applications) by Jagmohan.

Session: 2025-26			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Physical Chemistry-III		
Course Code	M24-CHE-302		
Course Type	CC-10		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know about the details of literature survey in research, different indexing used in research, research reports and patents CLO 2: To know about the details of Thermal Analysis techniques and their applications CLO 3: To discuss preparation of nanomaterial through various techniques, electronic structure and properties of nanomaterials and applications of nanomaterials CLO 4: To discuss environmentally oriented electrochemistry with examples and discuss the applications of ion-selective electrodes		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Research Methodology:** Scientific document: Organization and writing of research paper, short communications, monographs, review articles, abstract, keywords, technical and survey reports, authored books and edited books and dissertation. Primary sources of literature survey, journals, patents etc. secondary sources of literature survey, books, reference books and text Books, Citation Index, impact Factor, i-10 index and h index, Journals related to Chemistry in the region and country, electronic forms of Journals, IPR and Patents.	15
II	**Thermal Analysis** Introduction to thermal analysis, thermogravimetry (TG), static and dynamic thermogravimetry, Instrumentation, thermogram, factors affecting thermograms, application of thermogravimetry. Differential thermal analysis (DTA), DTA curves, factors affecting DTA curves,	15

	applications of DTA, Differential Scanning Calorimetry (DSC) Introduction, Instrumentation, Power compensated and Heat Flux DSC, factors affecting DSC curves, applications of DSC. Hyphenated thermal techniques, Evolved gas analysis (TG-MS, TG-FTIR)	
III	**Material Chemistry** Definition of nanomaterials, Thermodynamics and Kinetics of Nucleation, Various techniques for the preparation of nanomaterials, Thin Films and Langmuir-Blodgett films - Preparation techniques, evaporation/sputtering, chemical processes, MOCVD, sol-gel. Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films. Electronic structure and properties of nanomaterials, optical, electrical and magnetic properties, diffusion and chemical behaviour, applications of nanomaterials.	15
IV	**Environmentally oriented electrochemistry** Electrochemistry of water splitting, electrolysis of sea water, electrochemical reduction of CO_2, Electrochemical sewage disposal, electrochemical decontamination of soil. **Ion Selective Electrodes** Electrical Properties of membrane, glass electrode with special reference to H^+, Na^+, K^+ ions, operation of solid membrane electrode, operation of liquid membrane electrode, coated type ion electrode, Applications of ion selective electrode in determination of some toxic metals and some anions (F^-, Cl^-, Br^-, I^- and NO_3^-).	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Handbook of Thermal Analysis and Calorimetry; M. E. Brown.
2. Instrumental methods of Analysis: Willard, Merritt & dean.
3. Advanced Analytical Chemistry: Meiter and Thomas.
4. Instrumental methods of chemical analysis: Braun.
5. Physical Biochemistry: Applications to Biochemistry and Molecular Biology by D. M. Freifelder.
6. Biophysical Chemistry: Principles and Techniques by A. Upadhyay, Himalaya Publishing House.
7. An Introduction to Nanoscience & Nanotechnology by A. Nouailhat, Wiley.
8. Nano-The Essentials by T. Pradeep, Tata McGraw Hill
9. Nanotechnology Principles and Practices by S.K. Kulkarni,

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Inorganic Chemistry Special-I		
Course Code	M24-CHE-303		
Course Type	DEC-1		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To Learn about alkyl, aryls of transition metals and fluxional behavior of organometallic compounds CLO 2: To Learn about Compounds of Transition Metal-Carbon Multiple Bonds and Transition Metal Compounds with Bonds to Hydrogen CLO 3: To learn about Transition Metal π-Complexes CLO 4: To learn about Homogeneous catalysis		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Alkyls and Aryls of Transition Metals** Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis **Fluxional Organometallic compounds** Fluxionality and dynamic equilibria in compounds such as η^2-olefin, η^3-allyl and dienyl complexes, Carbonyl scrambling.	15
II	Compounds of Transition Metal-Carbon Multiple Bonds, Alkylidenes, alkylidynes, low valent carbenes and carbynes- synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis **Transition Metal Compounds with Bonds to Hydrogen**: bonding and different types.	15
III	**Transition Metal π-Complexes** Transition metal π-complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparations, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.	15

IV	Stoichiometric reactions for catalysis: lithium, Magnesium, zinc, cadium, mercury, aluminium, Thallium, tin and silicon, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction), oxopalladation reactions, activation of C-H bond.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegedus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals; R.H. Crabtree, John Wiley.
3. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.
4. Coordination Chemistry; Banerjea; Tata McGraw Hill.
5. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H. McDaniel and J.J. Alexander; John Wiley and Sons Inc.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Physical Chemistry Special-I		
Course Code	M24-CHE-304		
Course Type	DEC-1		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To apply of approximation methods to analyse multi-electron systems and to identify molecular term symbols. CLO 2: To apply MO, VB, and Huckel theories, to analyze bonding in diatomic and conjugated systems. CLO 3: To know about photochemical behaviour of the chemical systems at the quantum level CLO 4: To discuss the micelles and micellization and related phenomena. To be acquainted about the intermolecular forces involved in liquids and micelle solutions		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Quantum Mechanics-I** Problem of two electrons. Time-independent perturbation theory for non-degenerate and degenerate cases. Ground and first excited state of helium atom. Variation theorem and variation methods. Variation treatment of ground state of Helium. Electron spin, Pauli Exclusion principle and Slater determinants. Brief overview of Hartree-Fock SCF method. Electron correlation. Coupling of angular momentum for many electron system, spin-orbit coupling, Molecular Term symbols.	15
II	**Quantum Mechanics-II** Born-Oppenheimer approximation, atomic units, the hydrogen molecule ion, its symmetric and antisymmetric solution (without actual evaluation of various integrals). Valence bond and MO treatment of hydrogen molecule. Comparison of the MO and VB treatments and their equivalence limit. Configuration Interaction. Extension of MO theory to	15

	other systems- Homonuclear and heteronuclear diatomics. The pi-electron approximation, Huckel theory of conjugated systems. Applications to ethylene, butadiene, cyclobutadiene and cyclopropenyl molecules. Calculation of properties- Delocalization energy, electron density, bond order.	
III	**Quantum Photochemistry** Types of Photophysical Pathways, Radiative and Non-Radiative transitions, Einstein Treatment of Absorption and Emission Phenomena, Probability of Induced Emission and Its Application to Lasers, Time-dependent Schrödinger equation, Time-dependent perturbation theory for photochemical systems, Transition moment integral, Theoretical Absorption Intensity, Oscillator Strength, Rules governing the transition between two energy states.	15
IV	**Micelles** Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solubilization, emulsions, micro emulsion. **General Properties of Liquids** Liquids as dense gases, liquids as disordered solids, thermodynamics relations of internal pressure and its significance in liquids, equation of state, critical constants, Different types of intermolecular forces in liquids.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Quantum Chemistry, I. N. Levine, 7th edition, Pearson Education India.
2. Quantum Chemistry, Donald A. McQuarrie, Viva.
3. Fundamentals of Photochemistry, K.K. Rohtagi-Mukherjee, 3rd Edition, New Age.
4. Significance of liquid structures, H. Eyring.
5. Chemical Kinetics, K.J. Laidler, McGraw Hill.
6. Theories of Chemical Reaction Rates, K.J. Laidler, McGraw Hill.
7. Theory of Rate Processes, S. Glasstone, K.J. Laidler and H. Eyring, McGraw Hill.
8. Micelles, Theoretical and Applied Aspects, Y. Moroi, Plenum Press.
9. Significant Liquid Structures, H. Eyring and M. S. Jhon, John Wiley & Sons.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Organic Chemistry Special-I		
Course Code	M24-CHE-305		
Course Type	DEC-1		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To understand the principle of oxidation, oxidative processes related to Hydrocarbons-alkenes, aromatic rings, activated and unactivated saturated C-H groups, alcohols, diols, aldehydes, ketones, ketals and carboxylic acids, amines, hydrazines, and sulphides. CLO 2: To understand the general pathways of reduction reactions. Reduction of Hydrocarbons – alkanes, alkenes, alkynes, substituted and unsubstituted aromatic rings, carbonyl compounds-aldehydes, ketones, acids and their derivatives, Epoxides, compounds containing nitro, nitroso, azo and oxime groups. CLO 3: To understand the light-induced reactions in carbonyl compounds (Paterno-Büchi reaction, photoreduction, etc.), photochemistry of unsaturated systems (olefins, 1,3-butadiene) CLO 4: Understanding of photochemical rearrangements (Di-π-methane, Photo-Fries, Barton, Hoffman-Löffler-Freytag) and their applications in biological systems, including vision mechanisms and neonatal jaundice treatment.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours

I	**Oxidation** Introduction, Different oxidative processes, Hydrocarbons- alkenes, aromatic rings, saturated C-H groups (activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides.	15
II	**Reduction** Introduction, Different reductive processes, Hydrocarbons—alkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides. Nitro, nitroso, azo and oxime groups. Hydrogenolysis.	15
III	**Photochemistry** Excitation and excited states, Franck-Condon Principle, Jablonski diagram, energy transfer photosensitization, quenching, quantum yield, excimer and exciplex complex, P-type and E-type delayed fluorescence Photochemistry of carbonyl compounds (Norrish type I and type II changes, photoreaction of cyclic ketones, Paterno-Buchi reaction and Photoreduction. Photochemistry of olefins and 1,3-Butadiene (cis-trans isomerisation, dimerization, and cycloadditions).	15
IV	**Photochemistry** Di-π-methane rearrangement, enone and dienone rearrangements, photochemistry of aromatic compounds (substitution, isomerization, cyclization and cycloaddition reactions), Photo-Fries rearrangement, photolysis of nitrile esters and Barton reaction, Hoffman-Loeflller-Freytag reaction, photochemistry of vision and neonatal jaundice.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Some Modern Methods of Organic Synthesis, W. Carruther, Cambridge Univ. Press.
2. Advanced Organic Chemistry, Reactions Mechanism and Structure, J. March, John Wiley.
3. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
4. Advanced Organic Chemistry and Reaction Mechanisms, Reinhard Bruckner, Academic Press.
5. Organic Chemistry, Jonathan Clayden, Nick Greeves, and Stuart Warren, Oxford University Press.
6. Organic Photochemistry, J Coxan & B. Halton, Cambridge University Press.
7. Introductory Photochemistry, A. Cox and T. Camp McGraw Hill.
8. Organic Photochemistry, V. Ramamurthy, CRC Press First Edition, 1997.
9. Organic Photocatalysts for Energy and Synthesis Emily R. Smith, James M. R. Narayanam Publisher: Royal Society of Chemistry Year: 2024.
10. Photoinduced Reactions in Organic Synthesis, Stefano Protti, Maurizio Fagnoni, Publisher: Wiley-VCH, Year: 2020.

11. Reaction Mechanisms in Organic Chemistry by S.M. Mukherhjee and S.P. Singh, Lakshmi Publications.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Pharmaceutical Chemistry Special-I		
Course Code	M24-CHE-306		
Course Type	DEC-1		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Become familiar with the basic concepts of synthon approach and to apply the concept of disconnection approach for the synthesis of drug molecules. CLO 2: To apply the protection and deprotection strategy for important functional groups namely alcoholic, amino, carbonyl and carboxylic groups. CLO 3: To be acquainted with mechanistic details of the methods of preparation and reactions of five-membered, dihetero-atomic molecules, 1,2- and 1,3-azoles. CLO 4: Discuss the concept related to the synthesis and reaction of different natural products.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting at-least one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Synthon approach-I** Definition of terms- Disconnection, synthons, functional group interconversions (FGI), synthetic equivalents. General principles of the disconnection approach, the importance of order of events in organic synthesis, one group C-X and two group C-X, One group C-C disconnections-alcohols and carbonyl compounds, chemoselectivity, reversal of polarity, amine synthesis.	15
II	**Synthon approach-II** Two group C-C disconnections-1, 3 & 1,5-difunctionalized compounds, Stereochemistry in organic synthesis-stereoselectivity, stereospecificity, regioselectivity and regiospecificity.	15

	Synthon approach in the synthesis of the following drugs: Salbutamol, Propanolol, moxnidazole, nafimidone, drildone, belfosih. Ocfentanil, afornine Principle of protection of alcoholic, amino, carbonyl and carboxylic groups.	
III	**Heterocyclic Compounds - I** Systematic (Hantzsch-Widman) nomenclature for monocylic and fused ring systems. Methods of synthesis and Reactions including mechanism of the following five-membered 1,2- and 1,3-heterocycles: pyrazole, imidazole, oxazole, isooxazole, thiazole, isothiazole; their basic character.	15
IV	**Heterocyclic Compounds - II** Methods of synthesis and Reactions including mechanism of the following six-membered heterocycles: purines and pyrimidines. Caffeine, xanthine, theobromine, theophylline. Methods of synthesis and Reactions including mechanism of-Indoles, quinolines and isoquinolines. Flavanoids: Occurrence, nomenclature and general methods of structure determination, isolation, importance and synthesis of Cyanin, Quercetin, Diadzein and Chrysin.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	05	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Designing Organic Synthesis, S. Warren, Wiley.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
3. Modern Synthetic Reactions, H. O. House, W.A. Benzamin.
4. Advanced Organic Chemistry Reactions, Mechanisms a Structures, J. March, Wiley.
5. Advanced Organic Chemistry Part B. F.A. Carey and R.J. Sundberg, Plenum Press.
6. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Inorganic Chemistry Special-II		
Course Code	M24-CHE-307		
Course Type	DEC-2		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To Learn about Reaction Mechanism of Transition Metal Complexes CLO 2: To Learn about Electron transfer reactions in transition metal complexes CLO 3: To learn about Photochemistry of transition metal complexes CLO 4: To learn about solid state, glasses, ceramics and alloys		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Reaction Mechanism of Transition Metal Complexes** Energy profile of a reaction, reactivity of metal complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. ligand Substitution reactions in square planar complexes, factors affecting substitution reactions in square planar complexes, the Trans effect, mechanism of the substitution reactions.	15
II	**Electron Transfer Reactions** Redox reactions, electron transfer reactions, general discussion and kinetic rate laws., mechanism of one electron transfer reactions, outer-sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions, two electron transfer reactions, metal ion	15

	catalyzed reactions, mixed valence complexes and their electron transfer.	
III	**Excited States of Metal Complexes** Electronically excited states of metal complexes: charge-transfer spectra, charge transfer transition, photosubstitution reactions, photo rearrangements, photoisomerisation, photoredox processes conditions of excited states to be useful redox reaction Illustration of some reducing and oxidizing character of Ru(2+) tris-bipyramidal complex. Transformation of chemical energy into light energy **Metal Complex Sensitizers** Metal complex sensitizer, photosensitised reactions in metal complexes, water photolysis, nitrogen fixation and carbon dioxide reduction	15
IV	**Solid State** Crystalline and non-crystalline materials, Glass transition temperature (Tg) and melting temperature (Tm), classes of compounds of the type A2B3 (corundum structure), and AB3 (Cu3Au, ReO3), **Glasses, ceramics and silicates**: Types and uses. **Alloys**: Interstitial and substitutional alloys, superconducting alloys, Hume-Rothery rules and Meissner effect.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Mechanism of Inorganic Reactions; F.Basolo and R.G. Pearson, John Wiley and Sons, New York.
2. Inorganic Chemistry; K.F. Purcell, J.C. Kotz; Holt-Sanders International Editions; Philadelphia.
3. Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.
4. Photochemistry of coordination compounds, K.Balzani and V.Carassti, Academic press.
5. Elements of Inorganic Photochemistry; G.J. Ferraudi, Wiley.
6. An Introduction to Crystal Chemistry; R.C. Evans, Cambridge University Press.
7. Introduction to solid state Physics; C. Kittel, Wiley New York.
8. Solid State Chemistry; N.B. Hannay; Prentice.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Physical Chemistry Special-II		
Course Code	M24-CHE-308		
Course Type	DEC-2		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand and apply the concepts of ensemble averaging and different statistical ensembles (microcanonical, canonical, grand canonical) along with their distribution laws. Derive and interpret classical distribution laws including Maxwell-Boltzmann and Boltzmann distributions, and velocity distributions. CLO 2: Explain and apply quantum statistics (Bose-Einstein and Fermi-Dirac) to systems like photon and electron gases, and distinguish between degenerate and non-degenerate systems. CLO 3: Use partition functions to calculate thermodynamic properties and analyze molecular systems (monoatomic, diatomic, polyatomic). CLO 4: Relate statistical thermodynamics to equilibrium constants and free energy functions (Helmholtz, Gibbs). Understand the principles of non-equilibrium thermodynamics, Onsager's relations, entropy production, and stationary states.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Statistical Mechanics** Ensemble averaging, postulates of ensemble averaging. Micro canonical, canonical and grand canonical ensembles, corresponding distribution laws (using Lagrange's method of undetermind multipliers).	15

	Maxwell- Boltzmann statistics, Boltzmann distribution, derivation of the Boltzmann distribution expression, determination of the Boltzmann constant, Maxwell distribution law of velocities from Boltzmann distribution expression.	
II	**Quantum Statistics** The Bose-Einstein statistics, statistics of a photon gas, the Fermi-Dirac statistics, Fermi-Dirac systems, extreme gas degeneration, slight gas degeneration, electron gas in metals, thermionic emission and comparison of two statistics, non-degenerate and degenerate systems.	15
III	**Statistical Thermodynamics – I** Partition function and thermodynamic properties, partition function and factorization of partition function, translational partition function, translational thermodynamic function, atoms and monoatomic molecules, Sackur-Tetrode equation, diatomic molecules, separation of internal partition function. Rotational and vibrational energies, entropy due to internal degrees of freedom. Rotational partition function, rotational partition function for polyatomic molecules, vibrational partition function.	15
IV	**Statistical Thermodynamics – II** Determination and calculation of thermodynamic properties i.e. internal energy, entropy, Helmholtz and Gibbs free energy, ortho and para hydrogen states, free energy functions. Relationship of Partition function and equilibrium constant with different systems. **Non-equilibrium Thermodynamics** Meaning and scope of irreversible thermodynamics. Thermodynamic criteria for non-equilibrium states, Phenomenological laws-liner laws, Gibb's equation, Onsager's reciprocal relation, Entropy production-specific laws of entropy production, Non-equilibrium stationary states.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Introduction to Statistical Thermodynamics, H. Dole.
2. Theoretical Chemistry, S. Glasstone, Affiliated East-West Press.
3. Thermodynamics, Lewis and Randall.
4. Chemical Physics, J.C. Slater.
5. Non-equilibrium Thermodynamics, C. Kalidas.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Organic Chemistry Special-II		
Course Code	M24-CHE-309		
Course Type	DEC-2		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand the role of Li, Mg, Zn, Cu, S, Si, and B reagents in organic synthesis—including their preparation, reactivity, mechanisms, and applications in bond-forming reactions. CLO 2: Master retrosynthetic analysis concepts: synthon identification, synthetic equivalents, functional group interconversion (FGI), and strategic disconnection approaches (C-X and C-C bonds). Explore selectivity principles (chemo-/regio-/stereo-selectivity) in reaction design. CLO 3: Apply advanced strategies like polarity reversal (umpolung), Wittig olefination, alkyne/nitro compound chemistry, and ring-forming reactions (3-6 membered rings) for target molecule synthesis. CLO 4: To develop the skill of protection/deprotection strategies (alcohols, amines, carbonyls, acids) in multistep organic synthesis, and multi-step disconnections using Diels-Alder reactions, 1,3-/1,5-difunctional systems, Michael additions, and Robinson annelation for complex molecule assembly.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Organometallic Reagents**	15

	Principle, preparations, properties, and applications of the reagents of the following metals/non-metals in organic synthesis with mechanistic details: Li, Mg, Zn, Cu, S, Si and B.	
II	**Disconnection Approach-I** An introduction of synthons and synthetic equivalents, general principles of the 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, one group C-C disconnection, chemoselectivity, regioselectivity, regiospecificity, stereoselectivity, and stereospecificity.	15
III	**Disconnection Approach-II** Reversal of polarity, amine synthesis, use of Wittig reagents, use of acetylene and aliphatic nitro compounds in organic synthesis, synthesis of three-membered rings, photochemistry in organic synthesis-synthesis of four-membered rings, uses of ketenes in organic synthesis, synthesis of five and six-membered rings.	15
IV	**Disconnection Approach-III** Protective Groups: Introduction, principle of protection of alcoholic, amino, carbonyl, and carboxylic groups, Protection and deprotection of Alcohols: ethers, silyl ethers, acetals, esters, Carbonyl Groups: acetals/ketals, dithioacetals/dithioketals, Amino Groups: carbamates, amides, Carboxylic Groups: esters, silyl esters, amides. Two group C-C disconnections: Diels Alder reactions, 1,3-difunctionalized compounds and α,β-unsaturated carbonyl compounds, Control in carbonyl condensations, 1,5-difunctionalized compounds-Michael addition and Robinson Annelation.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Designing Organic Synthesis, S.Warren, Wiley.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
3. Advanced Organic Chemistry Reactions, Mechanisms and Structures, J. March, Wiley.
4. Advanced Organic Chemistry Part B. F.A. Carey and R.J. Sundberg, Plenum Press.
5. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
6. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
7. Advanced Organic Chemistry and Reaction Mechanisms, Reinhard Bruckner, Academic Press.
8. Organic Chemistry, Jonathan Clayden, Nick Greeves, and Stuart Warren, Oxford University Press.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Pharmaceutical Chemistry Special-II		
Course Code	M24-CHE-310		
Course Type	DEC-2		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To discuss antineoplastic agents alkylating agents, antimetabolites, antiviral agents and antimalarials drugs. CLO 2: To understand penicillins in detail, lactamase inhibitors, cephalosporins, sulfonamides, tetracyclines, aminoglycosides, macrolides, quinolones and lincomycin. CLO 3: To inform about prostaglandins, NSAIDS, antipyretic-analgesics. CLO 4: To know about the antifertility agents, ovulation inhibitors and related hormonal contraceptives. Concept of antihypertensive agents, calcium channel blockers, ACE inhibitors and alpha-blockers, beta-blockers and centrally acting adrenergic drugs.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting at-least one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**General mode of action, Medicinal Uses and Synthesis of Important Drugs in the Following Categories.** **Antineoplastic Agents:** Metastasis, classification, mode of action of alkylating agents (synthesis of melphalan, thiotepa, busulfan, lomustine) and antimetabolites (synthesis of methotrexate, 5-fluorouracil, 6-mercaptopurine), hormone-based therapies, plant products, radiotherapeutic agents. Taxol related compounds. **Antiviral agents:** RNA and DNA viruses, an introduction to AIDS, how HIV infects the system, mode of action of nucleoside reverse	15

	transcriptase inhibitors- AZT, ddI, ddC, d4T & 3TC and HIV-protease inhibitors-Ritonavir. Synthesis of AZT. An overview of HIV entry inhibitors, Integrase inhibitors, Chemokine receptor binders, Inhibitors of gp41 fusion activity. **Antimalarials:** Cinchona alkaloids, 4-aminoquinolines, 8-aminoquinolines, Mefloquine, 9-aminoacridines. Synthesis of Mefloquine, chloroquine, primaquine.	
II	**Antibiotics** **Penicillins:** Discovery, mode of action, SAR, Penicillins and semi-synthetic penicillins, problems of sensitivity to acids, β-lactamases and narrow spectrum of activity; solving these problems leading to the development of penicillin V, oxacillin, cloxacillin, ampicillin, amoxycillin, carbenicillin and carfecillin; β-lactamase inhibitors-Clavulanic acid, Olivanic acids. **Cephalosporins:** Classification, SAR, synthesis of cephalosporin-C, recent advances of fourth generation cephalosporins Sulfonamides-SAR, mode of action. Sulfanilamide analogs- synthesis of Sulfathiazole, sulfadiazine, sulfacetamide. **Tetracyclines and aminoglycosides:** Structure, mode of action, SAR, streptomycin, neomycin, gentamycin; Macrolides- mode of action, erythromycin, azithromycin; Synthesis of chloramphenicol. **Quinolones, fluoroquinolones:** Structure, mode of action, synthesis of nalidixic acid, ciprofloxacin and Lincomycin.	15
III	**Prostaglandins:** General Introduction, nomenclature of prostaglandins and eicosanoid biosynthesis. **Non-Steroidal anti-inflammatory agents:** Classification, mode of action, COX-2 inhibitors, salol principle. Synthesis of celecoxib, valdecoxib, aspirin, phenylbutazone, mefenamic acid, indomethacin, piroxicam, diclofenac, Naproxen. **Antipyretic-Analgesics:** Opioid antagonists and agonists-codeine and heroin, synthesis of meperidine, methadone, dextropropoxyphene.	15
IV	**Antifertility agents:** Ovulation inhibitors and related hormonal contraceptives- norethindrone, norethynodrel, estradiol and mestranol. Recent Advances. **Antihypertensive agents:** Classification, Hypertension, Renin-Angiotensin system, mode of action, Calcium channel blockers, ACE inhibitors and α-blockers, β-blockers, centrally acting adrenergic drugs, Synthesis of atenolol, clonidine, methyldopa, guanabenz, diltiazem, captopril, enalapril.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	05	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ed. Robert F. Dorge.

2. Burger's Medicinal Chemistry and Drug Discovery Vol-I Ed. M.E. Wolf, John Wiley.
3. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
4. Organic Chemistry Vol.-2 I.L. Finar, ELBS.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Inorganic Chemistry Special Practical-I		
Course Code	M24-CHE-311A		
Course Type	PC-7		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : To learn and perform the experiments on different instruments like spectrophotometry, conductometry, pH-metry and potentiometry		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	Instrumentation **I Spectrophotometric Analysis** To find out the **λ max** of the different substances **II Conductometric Titrations** Strong acid vs strong base Strong acid vs weak base Weak acid vs strong base Precipitation titrations To Validate the Ostwald's Dilution law Any other experiments related to this instrumentation **III Potentiometric Titrations** Strong acid vs strong base Strong acid vs weak base Weak acid vs strong base Any other experiments related to this instrumentation **IV pH metric Titrations** Strong acid vs strong base Strong acid vs weak base Weak acid vs strong base Any other experiments related to this instrumentation **V Any other techniques introduced**	120
	Total Contact Hours	120

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practical**	**30**	➢ **Practical:**	**70**

<table>
<tr><td>● Class Participation:</td><td>5</td><td rowspan="3">Marks Distribution:
Experiment Marks: 50
Lab record Marks : 10
Viva-voce Marks : 10</td></tr>
<tr><td>● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:</td><td>10</td></tr>
<tr><td>● Mid-Term Exam:</td><td>15</td></tr>
<tr><td colspan="3">Part C-Learning Resources</td></tr>
<tr><td colspan="3">Recommended Books/e-resources/LMS:
1. A Text Book of Quantitative Analysis: A. I. Vogel, ELBS, London.
2. Practical Chemistry, A.M. James and F.E. Prichard, Longman.</td></tr>
</table>

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Physical Chemistry Special Practical-I		
Course Code	M24-CHE-311B		
Course Type	PC-7		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1 : To apply the technique of potentiometry for determining activity coefficients of different electrolytes, determining stability constants of the complexes and finding the solubility of sparingly soluble salts CLO 2 : The potentiometry technique is used to perform the acid-base titrations, studying the equilibrium constant for redox reactions and determining liquid junction potential CLO 3 : To apply the technique of polarimetry for determining the percentage of optically active substance in a mixture, finding out the relative strength of acids and effect of substituents on rate constant of inversion kinetics CLO 4 : To develop the ability to compile interpreted information in the form of lab record and to face viva-voce		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	Potentiometry 1. Determination of activity coefficient of Ag^+ in the different solution of silver nitrate. 2. Determination of solubility of silver halides in water. 3. Determination of first and second ionization constant of phosphoric acid. 4. Study of silver-ammonia complex and determination of the stability constant. 5. Determination of strength of ferrous ammonium sulphate using potassium dichromate or ceric sulphate and determination of redox potential. 6. Determination of strength of HCl and CH_3COOH in a mixture using NaOH.	120

	7. Titration of weak acid with strong base using quinhydrone and determination of dissociation constant of the acid. 8. Study of equilibrium constant of the reaction $Fe^{++} + Ag^{+} \rightarrow Fe^{+++} + Ag$ 9. To determine the degree of hydrolysis of aniline hydrochloride. 10. Titration of Potassium halides mixture (two/three) with $AgNO_3$ potentiometrically **Polarimetry** 1. Determine the percentage of two optically active substances in a mixture polarimetrically. 2. Determination of relative strength of acids by the study of inversion of sucrose. 3. Investigate the effect of substitution of chloride ions on rate constant of inversion of cane sugar by using mono- and tri-chloroacetic acids as catalysts. **Note:** Any experiment may be introduced/deleted in the practical class based on the availability / non-availability of the instruments / chemicals.	
		Total Contact Hours 120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practical**	**30**	➢ **Practical:**	**70**
● Class Participation:	5	Marks Distribution:	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10	
● Mid-Term Exam:	15	Viva-voce Marks : 10	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Practical Physical Chemistry, S.R. Palit and S.K. De, Science.
2. Senior Practical Physical Chemistry, B.D. Khosla, V.C. Garg and A. Gulati, S. Chand & Co.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, McGraw Hill.
4. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
5. Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.
6. Systematic experimental Physical Chemistry, T.K. Chandershekhar & S.K. Rajbhoj
7. A Comprehensive guide to physical chemistry experiments and viva questions, Neelam Seedhar, Notion Press.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Organic Chemistry Special Practical-I		
Course Code	M24-CHE-311C		
Course Type	PC-7		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To understand the methods of separation of binary (liquid-liquid, liquid-solid, or solid-solid) organic mixtures, qualitative analysis of each compound, and preparation of their derivatives. CLO 2: Characterize the separated organic compounds by interpreting their ^{1}H NMR and FT-IR spectra and develop the ability to compile the results in the form of a lab record.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	1. Qualitative Analysis: Separation of components of a binary or ternary (liquid-liquid, liquid-solid or solid-solid) organic mixture using physical and chemical methods. Characterization of these components with the help of chemical analysis and derivative formation. 2. Spectroscopic confirmation of the components of binary or ternary mixtures using IR and NMR tools (IR & NMR spectra will be provided).	120
	Total Contact Hours	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practical**	**30**	➢ **Practical:**	**70**
● Class Participation:	5	Marks Distribution:	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10	
● Mid-Term Exam:	15	Viva-voce Marks : 10	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (2023). Vogel's Textbook of Practical Organic Chemistry (6th ed.). Pearson. Harlow, England.
2. Mann, F. G., & Saunders, B. C. (2018). Practical Organic Chemistry (3rd ed.). Wiley. Hoboken, NJ.
3. Mohrig, J. R., Hammond, C. N., & Schatz, P. F. (2020). Modern Projects and Experiments in Organic Chemistry (2nd ed.). W.H. Freeman. New York, NY.
4. Doxsee, K. M., & Hutchison, J. E. (2021). Green Organic Chemistry: Strategies, Tools, and Laboratory Experiments (1st ed.). Cengage Learning. Boston, MA.
5. Leonard, J., Lygo, B., & Procter, G. (2019). Advanced Practical Organic Chemistry (3rd ed.). CRC Press. Boca Raton, FL.
6. Harwood, L. M., & Moody, C. J. (2020). Experimental Organic Chemistry (2nd ed.). Oxford University Press. Oxford, UK.
7. Lehman, J. W., & Morrill, T. B. (2021). Techniques in Organic Chemistry (4th ed.). Springer. Cham, Switzerland.
8. Shriner, R. L., Hermann, C. K. F., & Morrill, T. C. (2018). The Systematic Identification of Organic Compounds (9th ed.). Wiley. Hoboken, NJ.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Pharmaceutical Chemistry Special Practical-I		
Course Code	M24-CHE-311D		
Course Type	PC-7		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : To develop the understanding for organic synthesis, different isolation, purification and estimation techniques used for samples of medicinally important compounds.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	16	16
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	Preparations: 1) Preparations of organic compounds of medicinal interest. 2) Techniques in isolation and extraction of crude drugs, purification of various active principles having medicinal, industrial and chemical importance. 3) Quantitative estimation of drugs in biological samples. 4) Identification of microbes on the basis of Gram staining, sterility testing, microbial assays.	120
	Total Contact Hours	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**
● Class Participation:	05	Marks Distribution:
● Seminar/ Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10
● Mid-Term Exam:	15	Viva-voce Marks : 10

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B.Maynes, Edward Arnold (Pub.)., Ltd. London, 1975).
2. "Systematic Qualitative Organic Analysis" by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.
3. "A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis" by Arthur I. Vogel, Longmans Green and Co., Ltd., London 1966.
4. "Elementary Practical Organic Chemistry" by Arthur I. Vogel, CBS Publishers & Distributors.
5. "A Guide to spectroscopy in Organic Chemistry' by PAVY

6.	"Spectrometric Identification of Organic Compounds", Fifth Ed., R.M. Silverstein, G.S. Bassler and T.C.Morrile, John Wiley and Sons, New York.
7.	"Organic Spectroscopy', 3rd Ed., by William Kamp. John Wiley & Sons.
8.	"Spectroscopic" Methods in Organic Chemistry, D.H. William & Ian Fleming.
9.	Vogel's Text Book of Practical Organic Chemistry by B.S. Furners et. al., Longman Group Ltd.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Inorganic Chemistry Special Practical-II		
Course Code	M24-CHE-312A		
Course Type	PC-8		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : To prepare selected Inorganic Compounds and their study by various spectroscopic methods (IR, NMR, EPR etc.)		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	Preparations: Preparation of selected Inorganic Compounds and their study by spectroscopic methods (IR, NMR, EPR etc.) **I** Choloropentaamminecobalt (III) Chloride **II** Nitro/Nitritopentaamminecobalt (III) Chloride (Distinction between nitro and nitrito by IR) **III** Potassium trioxalatoferrate (III) **IV** Chromous acetate **V** Cis and trans $[Co(en)_2Cl_2]$ **VI** Tris(acetyl-acetonato) manganese (III) **VII** Preparation of Ferrocene **VIII** Tris thioureacopper(I) sulfate **IX** Tris(acetylacetonato)chromium(III)	120
	Total Contact Hours	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practical**	**30**	➢ **Practical:**	**70**
● Class Participation:	5	Marks Distribution:	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10	
● Mid-Term Exam:	15	Viva-voce Marks : 10	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Synthesis and Characterization of Inorganic compounds. W. L. Jolly, Prentice Hall, Englowood.
2. A Text Book of Quantitative Analysis: A. I. Vogel, ELBS, London.
3. Inorganic Preparations: W. G. Palmer.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Physical Chemistry Special Practical-II		
Course Code	M24-CHE-312B		
Course Type	PC-8		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1 : To apply the conductometry method for performing conductometric acid -base titrations and Determining equivalent conductance of weak and strong electrolytes CLO 2 : To apply the conductometry method for Determining solubility of sparingly soluble silver salts and Determining CMC of surfactants CLO 3 : To apply the technique of spectrophotometry for Verifying Lambert-Beer's law and Determining composition of various mixtures CLO 4 : To develop the ability to compile interpreted information in the form of lab record and face viva-voce		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	Conductometry 1. Conductometric titration of: (i) Strong acid vs. strong base, (ii) Strong acid vs. weak base, (iii) Weak acid vs. strong base, (iv) Weak acid vs. weak base, (v) CH_3COOH + HCl vs. NaOH, (vi) $CuSO_4$ vs. NaOH. 2. Determination of the equivalent conductance of weak acid (benzoic/ acetic acid) at several concentrations and the dissociation constant of the acid. 3. Determination of the equivalent conductance of strong electrolytes such as HCl, KCl, KNO_3 and NaCl and the validity of Onsagar equation. 4. Study of degree of hydrolysis of aniline hydrochloride. 5. Determine the critical micelle concentration (CMC) of surfactants by conductivity method. **Colorimetry/Spectrophotometry**	120

	1. Verification of the Lambert-Beer's law using aqueous solutions of $KMnO_4$, $K_2Cr_2O_7$ and $CuSO_4$. 2. Study of iron-tiron and iron-salicylic acid complexes. 3. Determination of the composition of Potassium dichromate and potassium permanganate mixture spectrophotometrically: 4. Determine the dissociation constant of an indicator spectrophotometrically. **Note:** Any experiment may be introduced/deleted in the practical class based on the availability / non-availability of the instruments / chemicals.	
	Total Contact Hours	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practical**	**30**	➢ **Practical:**	**70**
● Class Participation:	5	Marks Distribution:	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10	
● Mid-Term Exam:	15	Viva-voce Marks : 10	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Practical Physical Chemistry, S.R. Palit and S.K. De, Science.
2. Senior Practical Physical Chemistry, B.D. Khosla, V.C. Garg and A. Gulati, S. Chand & Co.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, McGraw Hill.
4. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
5. Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.
6. Systematic experimental Physical Chemistry, T.K. Chandershekhar & S.K. Rajbhoj
7. A Comprehensive guide to physical chemistry experiments and viva questions, Neelam Seedhar, Notion Press.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Organic Chemistry Special Practical-II		
Course Code	M24-CHE-312C		
Course Type	PC-8		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To understand the basics of quantitative analysis and application in analysis of the Amino group, hydroxyl group, acetoxy group, carbonyl group, unsaturation, reducing and non-reducing sugars. CLO 2: To understand the saponification value and iodine value of fats and oils, formalin and glycine. Determination of the molecular weight.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	1. **Quantitative estimation of the following:** Amino group, hydroxyl group, acetoxy group, carbonyl group, unsaturation, reducing and non-reducing sugars. 2. Saponification value and iodine value of fats and oils, formalin and glycine, Determination of the molecular weight of acid by titration and by the silver salt method.	120
	Total Contact Hours	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practical**	**30**	➢ **Practical:**	**70**
● Class Participation:	5	Marks Distribution:	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10	
● Mid-Term Exam:	15	Viva-voce Marks : 10	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (2023). Vogel's textbook of practical organic chemistry (6th ed.). Pearson Education.
2. Mann, F. G., & Saunders, B. C. (2018). Practical organic chemistry (3rd ed.). Wiley.

3. Harris, D. C., & Lucy, C. A. (2020). Quantitative chemical analysis (10th ed.). W. H. Freeman.
4. Ahluwalia, V. K., & Dhingra, S. (2019). Advanced practical chemistry (2nd ed.). CRC Press.
5. Reaction Mechanisms in Organic Chemistry by S.M. Mukherhjee and S.P. Singh, Lakshmi Publications.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Pharmaceutical Chemistry Special Practical-II		
Course Code	M24-CHE-312D		
Course Type	PC-8		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : To develop the understanding about different forms of dosage e.g., emulsion(s), solution(s), cream(s), ointment(s), lotion(s) their preparations and evaluations.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	16	16
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	Preparation and evaluation of the followings: Emulsion, simple syrup, aqueous iodine solution, strong iodine solution, calamine lotion, boroglycerine, tannic acid glycerine, phenol glycerine, peppermint water, rose water, camphor water, formulation of simple and medicated ointments, magnesium hydroxide mixture (milk of magnesium), simple and complex powders, cough mixture, cold cream, vanishing cream and lotions.	120
	Total Contact Hours	120

Suggested Evaluation Methods

Internal Assessment: 30		End Term Examination: 70
● Class Participation:	05	Marks Distribution:
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10
● Mid-Term Exam:	15	Viva-voce Marks : 10

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B. Maynes, Edward Arnold (Pub.)., Ltd. London, 1975).
2. "Systematic Qualitative Organic Analysis" by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.
3. "A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis" by Arthur I. Vogel, Longmans Green and Co., Ltd., London 1966.
4. "Elementary Practical Organic Chemistry" by Arthur I. Vogel, CBS Publishers & Distributors.
5. "A Guide to spectroscopy in Organic Chemistry' by PAVY

6.	"Spectrometric Identification of Organic Compounds", Fifth Ed., R.M. Silverstein, G.S. Bassler and T.C. Morrile, John Wiley and Sons, New York.
7.	"Organic Spectroscopy', 3rd Ed., by William Kamp. John Wiley & Sons.
8.	"Spectroscopic" Methods in Organic Chemistry, D.H. William & Ian Fleming.
9.	Vogel's Text Book of Practical Organic Chemistry by B.S. Furners et. al., Longman Group Ltd.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	III		
Name of the Course	Applied Chemistry		
Course Code	M24-OEC-305		
Course Type	OEC		
Level of the course	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To understand the basics of polymers and polymerizations CLO 2: To discuss about different types of polymer composites CLO 3: The students will be understand the mechanism of drug action CLO 4: The students will have the knowledge of common drugs		
Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleastone question from each unitand the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Polymer** Polymer basic concepts: monomers, degree of polymerization, classification of polymers, types of polymerization, Concept of no. average molecular weight and mass average molecular weight, Methods of determining molecular weights, concept of kinetic chain length Polydispersity index, kinetics of polymerization (addition and chain polymerization). Thermoplastics and Thermoseting Polymers, Glass transition temperature and (melting point, factors affecting Tg and Tm),	8
II	**Polymer Composites** Thermal properties of polymers, Flame retardant polymers, Flame retarding Polymer composites, its classification, polymer composites using filler reinforcement, Biocomposites, application of biocomposites in automobiles and in construction materials. Polymer nanocomposites, Properties of polymer nanocomposites, application of polymer nanocomposites	7
III	**Medicinal Chemistry** Concept of drug and drug development, lead compound and lead modification, prodrugs and soft drugs, an elementary idea of structure reactivity relationship (SAR), Elementary idea about drug action: the	8

	receptor role, neurotransmitters and receptors, ion channels and their control, membrane bound enzymes-activation/deactivation, chemical basis of messenger induced change of shape by the receptor.	
IV	**Some Common Drugs** Definition, uses and side effects of the following categories of drugs: Antipyretics, analgesics & anti-inflammatory agents (paracetamol, asprin, mefenamic acid, ibuprofen and diclofenac), antimalarial (Chloroquine, chloroguanide), Anticancer (Chlorambucil, cyclophosphamide), Cardiovascular drugs (sorbitrate, diltiazem), Antifertility agents (introduction to hormonal and nonhormonal contraception only).	7
	Total Contact Hours	30

Suggested Evaluation Methods

Internal Assessment: 15		**End Term Examination: 35**	
➢ **Theory**	**15**	➢ **Theory:**	**35**
● Class Participation:	4	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	4		
● Mid-Term Exam:	7		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Textbook of Polymer Chemistry, F. W. (Jr) Billmeyer, Wiley, New York.
2. Polymer Science, V. R. Gowarikar, N. V. Viswanathan and Jayadev Sridhar, New Age International
3. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, Ed. Robert F. Dorge.
4. Burger's Medicinal Chemistry and Drug Discovery, Vol-I, Ed. M.E. Wolf, John Wiley.
5. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.

Session: 2025-26			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Inorganic Chemistry-III		
Course Code	M24-CHE-401		
Course Type	CC-11		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To learn about the statistical evaluation of various experimentation data CLO 2: To know about the concept of molecular luminescence and sewage, fertilizers and their various aspects in life CLO 3: To learn about the polarographic techniques and application of group theory in investigation of IR spectra of various compounds CLO 4: To know about the Mössbauer spectroscopy, ESR spectroscopy and their application		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Errors and Evaluation** Definition of terms in mean and median. Precision-standard deviation, relative standard deviation. Accuracy-absolute error, relative error. Types of error in experimental data-determinate (systematic), indeterminate (or random) and gross. Sources of errors and the effects upon the analytical results. Methods for reporting analytical data, confidence limits, Statistical evaluation of data-indeterminate errors, Test of significance. Significance of the F test, the student 't' test and the Chi-square test.	15
II	**Sewage and fertilizers** Sewage treatment (Primary, Secondary and Tertiary), Biochemistry of sewage, Water quality parameters, Nitrogen cycle; ammonification, nitrification, denitrification, fixation of nitrogen, biochemistry and ecology of nitrogen fixation, Nitrogenase (Mo-, V- and Fe- nitrogenase), factors limiting biological nitrogen fixation, fertilizers -nitrogen and phosphorus fertilizers in agriculture, surfactants - cationic, anionic and	15

	non-ionic, specific properties, degradation of surfactants. **Molecular luminescence** Fluorimetry and Phosphorimetry: Introduction, principles of fluorescence and phosphorescence, interpretation of fluorescence spectra, factors affecting fluorescence and phosphorescence, fluorescence intensity and concentration, instrumentation for fluorimetry, applications of fluorimetry. Phosphorimetry, instrumentation, applications, comparison between fluorimetry and phosphorimetry.	
III	**Polarography** General principles, diffusion controlled current, dropping mercury electrode, Ilkovic equation (without proof), Half-wave potential, over potential, Evaluation of Polarographic waves, conditions for performing Polarographic determinations and applications of Polarography, theories of hydrogen overvoltage (Tafel's theory, Recombination theory and Volmer, Erdy and Gruss theory/theory of slow discharge of ions). **Vibrational Spectroscopy** Symmetry, shapes and number of IR modes AB_2, AB_3, AB_4, AB_5 and AB_6 (Group theoretical treatment) mode of bonding of ambidentate ligands like Nitro, thiocyanate and diketonato complexes,	15
IV	**Mossbauer Spectroscopy** Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{2+} and Fe^{3+} compounds including those of intermediate spin, (2) Sn^{2+} and Sn^{4+} compounds – nature of M-L bond, coordination number, structure and (3) detection of oxidation state. **Photoelectron Spectroscopy** Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

10. A Textbook of Quantitative Inorganic Analysis, A.I. Vogel; ELBS, London.
11. Fundamentals of Analytical Chemistry; D.A. Skoog, O.M. West and F.J. Holler; W.B. Saunders.
12. Instrumental methods of Analysis; L.L. Merits, R.H. Willard and J.A. Dean; Van Nostrand-Reinhold.
13. Physical methods in Chemistry; R.S. Drago; Saunders.
14. Fundamentals of Molecular Spectroscopy; C. N. Banwell; McGraw Hill.
15. Introduction to polarography and allied techniques: Kamla Zutshi.
16. Symmetry and spectroscopy: An introduction to vibrational and electronic spectroscopy: Daniel C Harris.

Session: 2025-26			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Organic Chemistry-III		
Course Code	M24-CHE-402		
Course Type	CC-12		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To understand the role of Molecular Orbitals in analysing Pericyclic Reactions. CLO 2: To interpret the stereochemical course of a Pericyclic Reaction and identify the product. To understand the concepts of aromaticity, non-aromaticity, anti-aromaticity, homoaromaticity, and pseudo-aromaticity, aromaticity in charged rings, and the application of 1H-NMR in determining the aromatic character of annulenes. CLO 3: To understand the mechanism and synthetic applications of the above listed name reactions CLO 4: Explore transition-metal reagents in organic synthesis, focusing on: Principles, Preparations, Mechanistic details in organic synthesis		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Pericyclic Reactions** Molecular orbital symmetry, frontier orbital of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system classification of pericyclic reactions. Woodward-Hoffmann correlation diagram. FMO & PMO approach, Electrocyclic reaction - conrotatory and disrotatory motions. 4n, 4n+2, allyl systems, Ring opening of cyclopropyl halides and tosylates, cycloadditions-antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3-dipolar cycloadditions and cheleotropic reactions.	15
II	**Pericyclic Reactions** Sigmatropic Rearrangements-suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, retention and inversion of	15

	configuration, [3,3] and [5,5] sigmatropic rearrangements, Sommelet-Hauser, Claisen and Cope rearrangements. Introduction to ene reactions. Simple problems on Pericyclic reactions. **Aromaticity** Concept of aromaticity, non-aromaticity, anti-aromaticity, homoaromaticity, and pseudo-aromaticity. Aromaticity in charged rings and application of 1H-NMR in determining the aromatic character of annulenes.	
III	**Name Reactions in Organic Chemistry** Mechanism and synthetic applications of Arndt-Eistert synthesis, Beckmann, Hofmann, Curtius, Lossen, Schmidt, Favorskii, Neber, Fritsch-Butenberg-Wiechell, Baeyer-Villiger, Benzil benzillic acid rearrangements, Darzens synthesis, Stork enamine reaction, Shapiro reaction, Sharpless asymmetric epoxidation reactions.	15
IV	**Transition Metals in Organic Synthesis** Preparations and applications of the reagents of the following metals in organic synthesis with mechanistic details: Pd, Ni, Fe, Co, Cr and Ti compounds.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test, etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
2. Pericyclic Reactions, S.M. Mukherji Macmilan India.
3. The Conservation of Orbital Symmetry, R.B. Woodward and R. Hoffmann" Verlag Chemie Academic Press.
4. Problem Solving approach to Orbital Symmetry, R.E. Lehr and A.P. Merchand.
5. Organic Reactions and Orbital Symmetry, T.L. Gilchrist and R.C. Storr, Cambridge University Press, Cambridge, 2nd Edn. 1979.
6. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
7. Modern Synthetic Reactions, H.O. House, W. A. Benzamin.
8. Advanced Organic Chemistry Reactions, Mechanisms and Structures, J. March, Wiley.
9. Advanced Organic Chemistry Part B. F.A. Carey and R.J. Sundberg, Plenum Press.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Inorganic Chemistry Special-III		
Course Code	M24-CHE-403		
Course Type	DEC-3		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know about the concept of electroanalytical techniques and their applications CLO 2: To know about the atomic absorption spectroscopy and flame photometry CLO 3: To learn about the spectrophotometric techniques and about of ESR spectroscopy CLO 4: To learn about the concept and applications of NMR spectroscopy and about Nephelometry and Turbidimetric techniques		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Electro analytical methods of Analysis** Current-voltage relationship during an electrolysis, decomposition potential, constant current electrolysis, constant cathode potential electrolysis, apparatus, electrodes, mercury cathode, physical properties of deposition, chemical factors of importance in electrodeposition. Applications of electrogravimetry. **Coulometric analysis** Coulometric methods of constant electrode potential and coulometric titrations. Apparatus and applications. **Amperometric titrations** Basic principle, types of curves with special reference to use of indicator and compensation reaction curve. **Fundamental concept of Cyclic voltammetry**	15
II	**Flame photometry** Theory of flame photometry, flame temperature, Emission Flame	15

	photometry - intensity of spectral lines, selection of optimum working conditions, application of flame photometry in trace metal analysis. **Atomic Absorption Spectroscopy** General principles, resonance line, its natural width, Doppler effect, broadening due to pressure, Hollow cathode lamp. Application to alkali and alkaline earth metals.	
III	**Spectrophotometry and Colorimetry** Fundamental concepts, instrumentation for absorption measurements, interferences, application of absorption spectroscopy and Colorimetry to analysis of inorganic substance. **Electron Spin Resonance Spectroscopy** Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensor, application to transition metal complexes (having one unpaired electron) and inorganic free radicals such as PH_4^-, F_2^- and $[BH_3]^-$. Double resonance in EPR.	15
IV	**Nephelometry and Turbidimetry** Theory - light scattering, choice and comparison between nephelometry and turbidimetry, factors affecting measurement, instrumentation, applications **Nuclear magnetic Resonance** Basic Principle of NMR, Nuclear relaxation, Factors affecting nuclear relaxation, effect of chemical exchange on spectrum and evaluation of reaction rate of fast reactions, Double resonance, Lanthanide shift reagents, an overview of NMR of other nuclides with emphasis on ^{31}P, ^{19}F, ^{195}Pt and ^{119}Sn NMR. Application in inorganic chemistry	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Fundamentals of Analytical Chemistry; D.A. Skoog, O.M. West and F.J. Holler; W.B. Saunders.
2. Instrumental methods of Analysis; L.L. Merritt, R.H. Willard and J.A. Dean; Van Nostrand-Reinhold.
3. Physical methods in Chemistry; R.S. Drago; Saunders.
4. Introduction to Magnetic Resonance; McLachlan and Carrington; Chapman and Hall.
5. NMR, NQR, EPR and MB Spectroscopy in inorganic Chemistry, R.V. Parish, Ellis Horwood.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Physical Chemistry Special-III		
Course Code	M24-CHE-404		
Course Type	DEC-3		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To discuss about the different types of polymers, biodegradable polymers, dendrimers glass transition temperature and related properties CLO 2: To explain the different methods for the determination of molecular weight of polymers and to discuss about parameters of polymer chains, thermodynamic properties of mixing and thermodynamic relations for dilute polymer solutions. CLO 3: Understand the kinetics and mechanisms of fast and chain reactions. Explain apparent activation energy, chain lengths, and theories of branching and explosions. Describe modern techniques for studying fast reactions (e.g., flash photolysis, flow methods, relaxation and shock tube techniques). Analyze kinetic data to interpret reaction mechanisms. CLO 4: To learn about classification, properties and applications of liquid crystal material		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Polymers**	15

	Recapitulation and basics of polymers and polymerizations (step and radical chain). Biodegradable polymers; Polyglycolic acid (PGA), Polylactic acid (PLA): basic idea about preparation, properties and applications. Hyperbranched–star polymers, Dendrimers (basic idea about preparation, properties and applications), Polymer composites. Properties of commercial polymers: Polyethylene, polyvinylchloride, polyamides, polyesters. Glass transition temperature (Tg), factors influencing the glass transition temperature, effect of molecular weight and melting point on glass transition temperature, plasticizers, importance of glass transition temperature.	
II	**Determination of Molecular Weight of Polymers** Molecular weight determination of polymers. Sedimentation or ultracentrifugation: Sedimentation velocity method, sedimentation equilibrium method. Light scattering: Debye and Zimm plot methods, comparison of Zimm and Debye methods, Determination of molecular weight by Gel Permeation Chromatography. **Thermodynamics of Polymer Solutions** Entropy of mixing and enthalpy of mixing by lattice model, Flory Huggins lattice theory, limitations of lattice model, entropy of mixing by free volume theory, heat and free energy of mixing, partial molar quantities i.e., chemical potential, heat of dilution and partial molar entropy of mixing, excluded volume, thermodynamic relations for dilute polymer solutions.	15
III	**Kinetics of Fast Reactions** General treatment of chain reaction, apparent activation energy of chain reactions, chain lengths, theories of branching chain and explosion (hydrogen-oxygen reaction). Modern techniques in gas phase and in solution, flash photolysis, flow methods, relaxation techniques (temperature jump, pressure jump) and shock tube technique.	15
IV	**Liquid Crystals** Mesmorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; molecular arrangement in smectic A and smectic C phases, smectic – nematic transition and clearing temperature – homeotropic, planar and schlieren textures, twisted nematics, chiral nematics, optical properties of liquid crystals. Dielectric susceptibility and dielectric effects. Lyotropic phases and their description of ordering in liquid crystals.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Principles Of Polymer Chemistry, P.J. Flory, Cornell University Press.
2. Physical Chemistry of Polymers, A. Tager, Mir Publishers.

3. Physical Chemistry of Macromolecules, C. Tanford, John Wiley & Sons.
4. Polymer Science, V. R. Gowarikar, N. V. Viswanathan and Jayadev Sridhar, New Age International.
5. Chemical Kinetic Methods: Principles of Fast Reaction Techniques and Applications, C. Kalidas, New Age.
6. Thermotropic Liquid Crystals, G.W. Gray, John Wiley.
7. Handbook of Liquid Crystals, Kelker and Hatz, Verlag Chemie.
8. Applications of Liquid Crystals, G. Meier, E. Sackmann and J.G. Grabmaier, Springer Verlag.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Organic Chemistry Special-III		
Course Code	M24-CHE-405		
Course Type	DEC-3		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand enzyme fundamentals: nomenclature, classification, extraction/purification; lock-key vs. induced fit hypotheses; kinetics of enzyme reactions; inhibition types; and mechanisms of action for key chymotrypsin; nomenclature and biological roles of prostaglandins. Chemical Synthesis of PGE_2 and $PGF_{2\alpha}$ CLO 2: Analyze terpenoid structure determination (general methods), synthesis (listed compounds), and biosynthesis pathways. CLO 3: Study cholesterol: nomenclature, structural analysis, synthesis routes, stereochemistry; conversion into testosterone, progesterone, and cholanic acids; Johnson's hydrochrysene approach for androsterone synthesis. CLO 4: Explore alkaloids: physiological roles, classification by nitrogen ring systems, isolation techniques, structural analysis methods; and detailed study of listed alkaloids (structure, stereochemistry, synthesis, and biosynthesis).		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Enzymes** Introduction and historical perspective, chemical and biological catalysis, and remarkable properties of enzymes like catalytic power, specificity	15

	including reaction specificity, substrate specificity, stereospecificity. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept, and identification of active site by the use of inhibitors and affinity labelling. Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots, reversible and irreversible inhibition. **Prostaglandins:** General introduction, nomenclature, and biological roles of prostaglandins. Chemical Synthesis of PGE_2 and $PGF_{2\alpha}$.	
II	**Terpenoids:** Introduction, classification, essential oils, methods for extraction of essential oils, Isoprene and special isoprene rule. General aspects of structure determination of terpenoids. Structure elucidation and synthesis of Geraniol, α-terpineol, α-pinene, camphor, farnesol and squalene. Biogenetic isoprene rule, Biogenesis, biosynthesis of terpenoids.	15
III	**Steroids:** Introduction, nomenclature of steroids. Structure elucidation of cholesterol, synthesis (Woodward) and stereochemistry of cholesterol. Biological functions of cholesterol. Methods for the following conversions. (i) Cholesterol → Testosterone (ii) Cholesterol → Progesterone (iii) Cholesterol → 5-α and 5-β-cholanic acids. Johnson's hydrochrysene approach towards the synthesis of Androsterone.	15
IV	**Alkaloids** Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis, and biosynthesis of the following: Ephedrine, Quinine and Reserpine.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test, etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Organic Chemistry, Vol. 2, I.L. Finar, ELBS.
2. Natural Products: Chemistry and Biology Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
3. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
4. Biochemistry, A.L. Lehninger.
5. Outlines of Biochemistry, Cohn & Stumpf.
6. Enzymes, Biochemistry, Biotechnology, Clinical Chemistry, T. Palmer and P.L. Bonner
7. Lehninger Principles of Biochemistry, D.L. Nelson, M.M. Cox
8. Chemistry of alkaloids by Pelletier, S. W. Publisher: Van Nostrand Reinhold Inc.,U.S. (17 September 1970).
9. Medicinal natural products: A biosynthetic approach. by Dewick, P. M. Publisher Wiley.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Pharmaceutical Chemistry Special-III		
Course Code	M24-CHE-406		
Course Type	DEC-3		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know about the procedure followed in drug design, in-depth knowledge of lead compounds and their modification. Concepts of prodrugs-drug latentiation, carrier linked- & bioprecursor prodrugs, structure-activity relationship and to understand significance of isosterism & bioisosterism CLO 2: To understand the details of quantitative structure-activity relationship and its parameters. To have understanding about co-enzymes and related terms. CLO 3: To understand the concept related to adsorption, dissociation, metabolism and elimination phenomenon for drugs. CLO 4: To understand the concept of Enzyme kinetics-Michaelis-Menten, Lineweaver-Burk plots, Enzyme inhibitors- reversible, irreversible, suicide inhibitors. Mechanism of enzyme Action-Transition-state theory.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting at-least one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Drug Design** Introduction, Procedure followed in drug design-Screening of natural compounds, isolation, purification, structure determination, Search for lead Compounds, Molecular Modification of Lead Compound, prodrugs- utility, drug latentiation, carrier linked and bioprecursor	15

	prodrugs, Prodrugs of compounds containing alcohols, carboxylic acids, amines and carbonyl groups, drug synergism, hard and soft drugs. Structure-Activity Relationship (SAR), isosterism, Bioisosterism, Factors affecting Bioactivity, Theories of Drug Activity; Occupancy theory, Rate theory, Induced Fit theory.	
II	**Quantitative structure-activity relationships (QSAR)** Development of QSAR, Physicochemical parameters- Lipophilicity parameter, Polarizability, Electronic parameter, Ionization Constants, steric Parameters- Taft's steric factor, molar refractivity, Verloop steric parameter, chelation parameters, Surface activity parameter, redox potential, hansch analysis, Craig plot, Topliss Scheme, Free-Wilson Approach. **Co-Enzyme Chemistry** Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD^+, $NADP^+$, FMN, FAD, Mechanisms of reactions catalyzed by the above cofactors.	15
III	**Pharmacokinetics & Biopharmaceutics:** Compartment Concepts: One Compartment open model/ Multicompartmental models. Absorption Kinetics of oral drugs (absorption and elimination) after one dose or multiple doses; Zero-order absorption model, First-order absorption model, Significance of absorption rate constant and physiologic factors related to oral absorption Distribution and Protein Binding; Physiologic factors and Volume of distribution; Kinetics of protein binding; Apparent volume of distribution Biotransformation / Metabolism: phase I and II Elimination and Clearance Elimination rate constant, half-life, clearance; Concepts: Drug clearance, Renal clearance, Hepatic clearance. Kinetics of Intravenous (IV) Drugs, IV Bolus, IV infusion, IV intermittent infusion, Multiple daily dosage regimens; Nonlinear pharmacokinetics and clinical application of pharmacokinetics; examples of Pharmacokinetics Calculations; Drug concentration vs. time curves; Loading doses and time to reach steady state	15
IV	**Enzymes** Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling. Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots. Enzyme inhibitors- reversible, irreversible, suicide inhibitors. Mechanism of Enzyme Action. Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**

● Class Participation:	05	Written Examination
● Seminar/presentation/assignment/quiz/class test etc.:	10	
● Mid-Term Exam:	15	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. An Introduction to Medicinal Chemistry, G. L. Patrick, Oxford University Press.
2. Medicinal Chemistry, An Introduction, G. Thomas, John Wiley.
3. Principles of Biochemistry, A. L. Lehninger, Worth Publishers.
4. Outlines of Biochemistry, E. E. Conn and P. K. Stumpf, John Wiley.
5. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, T. Palmer, Woodhead Publishers.
6. Bio-Pharmaceutics and Pharmacokinetics, New Edition, Brahmankar Jaiswal, A Treatise Vallabha Prakashan; ISBN-10 8185731934, ISBN-13 978-8185731476.
7. Biopharmaceutics and pharmacokinetics, Jayant S Kulkarni and AP Pawar, India, 2020, CBS Publishers and Distributors PVT Ltd, ISBN-10 8123913079, ISBN-13 978-8123913070.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Inorganic Chemistry Special-IV		
Course Code	M24-CHE-407		
Course Type	DEC-4		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know about the various types of metalloenzymes and their mode of action CLO 2: To learn about the concept of supramolecular chemistry and their applications CLO 3: To know about the various principles of Bio-Inorganic Medicine and their mode of action CLO 4: To learn about the chromatographic techniques and of solvent extraction and their uses		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Metalloenzymes** Zinc enzymes – carboxypeptidase and carbonic anhydrase, alkaline phosphatase and alcohol dehydrogenase, Copper enzymes – superoxide dismutase. Molybdenum oxo transferase enzymes – xanthine oxidase	15
II	**Supramolecular Chemistry** Concepts and language. 1. Molecular recognition: Molecular receptors for different types of molecules including anionic substrates, design and synthesis of co-receptor molecules and multiple recognition. 2. Supramolecular reactivity and catalysis. 3. Transport processes and carrier design. 4. Supramolecular devices. Some examples of self-assembly in supramolecular chemistry	15
III	**Principles of Bio-Inorganic Medicine** Evaluation of modern therapeutical, means of administering chemicals to humans, concentration effects, and dose-response relationship, future	15

	developments and trends in bio-inorganic therapy. **Metals in Medicine** Metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs.	
IV	**Chromatography** General principles, types of chromatography, absorption chromatography, partition chromatography, vapour phase chromatography, paper and thin layer chromatography, retardation factor, retention volume, mechanism and efficiency of separations. **Ion-Exchange** General principles, ion exchangers-natural and synthetic, ion-exchange capacity, purification of water and other applications. **Solvent Extraction** General Principles, extraction coefficients, Batch, continuous, and counter current extractions, applications.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
3. Supramolecular Chemistry, J.M. Lehn, VCH.
4. A Textbook of Quantitative Inorganic Analysis, A.I. Vogel; ELBS, London.
5. Fundamentals of Analytical Chemistry; D.A. Skoog, O.M. West and F.J. Holler; W.B. Saunders.
6. Dynamics of Chromatography Part I.; J.C. Gidding; Dekker, New York.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Physical Chemistry Special-IV		
Course Code	M24-CHE-408		
Course Type	DEC-4		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To understand advanced theories of kinetics of unimolecular reactions. To be acquainted about the kinetics of reactions taking place in solutions. CLO 2: Understand theoretical models describing the properties of solids. CLO 3: Understand the fundamental principles of semiconductors and photovoltaic devices. CLO 4: Understand and apply advanced electrochemical concepts and techniques.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Advanced Chemical Kinetics** London-Eyring-Polanyi method of calculation of energy of activation. Applications of activated complex theory of reaction rates. Temperature dependence of pre-exponential factors. Kassel's theory (RRK), Rice-Ramsperger-Kassel-Marcus (RRKM) theory. **Solution Kinetics** Ion-ion reaction, ion-dipole reaction, reactions between polar molecules, effect of ionic strength, kinetic salt effect, enzyme kinetics (effect of pH and temperature). Lineweaver-Burk & Eadie plots for the analysis of enzymolysis.	15
II	**Solid State – I** Free electron theory of metals – Classical and Quantum mechanical models, density of states, Successes and Failures. Band theory of solids, Bloch theorem, Brillouin zones, Kronig–Penney Model, Effective mass of charge carriers, Direct and indirect band gap semiconductors, hole	15

	concept, temperature dependence of electrical conductivity. Thermal properties of solids. Heat capacity – both classical and quantum models (Einstein, Debye models).	
III	**Solid State – II** Free carrier concentration in intrinsic and extrinsic semiconductors, mass action law and its applications, Generation of carriers and their recombination in semiconductors. Temperature dependence of carrier mobility. Types of junctions (metal-semiconductor, semiconductor-semiconductor), Analysis of p-n junction including I-V characteristics. Application of p-n junction in photovoltaics. Introduction to Photovoltaics. Basic PV system design. Design and physics of solar cells, I-V characteristics, Solar radiation and conversion efficiency. Parameters = J_{SC}, V_{OC}, FF) solar cell efficiency, Shockley–Queisser limit. Silicon solar cells, alternatives to silicon, III-V materials for solar cells, thin film solar cells and third generation solar cells. Brief overview of concentrator photovoltaics. Photovoltaics storage system.	15
IV	**Advanced Electrochemistry** Advanced concepts: Overpotential concept, Exchange current density, Butler-Volmer equation, Polarizable and non-polarizable interfaces. Tafel equations. Electrochemical Processes: Distinction between kinetically and mass transport controlled electrochemical processes. Role of diffusion, migration, and convection in electrochemical systems. Brief introduction and working principles of various electrochemical methods such as chronoamperometry, cyclic voltammetry, chronopotentiometry, coulometry, AC-impedance spectroscopy (EIS).	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Chemical Kinetics, K.J. Laidler, McGraw Hill
2. Theories of Chemical Reaction Rates, K.J. Laidler, McGraw Hill.
3. Theory of Rate Processes, S. Glasstone, K.J. Laidler and H. Eyring, McGraw Hill.
4. Reaction Kinetics Oxford Press (1997), M. J. Pilling and P. W. Seakins.
5. Kittel's Introduction to Solid State Physics, C. Kittel, Wiley India Edition
6. Solid State Physics, S.O. Pillai, 10th Edition, New Age International Pvt Ltd
7. Solid State Physics, Neil W. Ashcroft, Cengage Learning
8. Solid State Physics, R.K. Puri, V. K. Babbar, S. Chand Publishers
9. The Physics of Solar Cells, J. Nelson, World Scientific Publishing Company
10. Optoelectronics of Solar Cells, Greg P. Smestad, New Age International Publishers
11. Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan S. Solanki, 3rd Edition, PHI Learning
12. Fundamentals of Electrochemical Science, H. B. Oldham, J. C. Myland, Academic Press.

13. Electrochemical Methods: Fundamentals and Applications, Allen J. Bard, Larry R. Faulkner, Wiley; 2nd edition

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Organic Chemistry Special-IV		
Course Code	M24-CHE-409		
Course Type	DEC-4		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To understand the basic concept of drug design and development using the examples of penicillin and its modifications. CLO 2: To understand the synthesis, general mode of action, and medicinal uses of listed classes of drugs. CLO 3: Analyze the structures, reactivity, and applications of enolates and other carbanions in organic synthesis. CLO 4: To understand the Systematic nomenclature, General synthesis and reactions of Five-membered heterocycles: pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, General reactivity of purines and pyrimidines.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting atleast one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Drug Design** Classification and discovery of new drugs, history and development of chemotherapeutic agents, therapeutic index, LD50 and ED50, naming of (new) drugs. Elementary idea about drug action: the receptor role, neurotransmitters and receptors, ion channels and their control. Membrane bound enzymes-activation/deactivation. Chemical basis of messenger induced change of shape by the receptor. Design of agonists, antagonists and partial agonists. **Drug development** Screening of natural products, isolation and purification, structure determination, SAR (structure-activity relationships) with reference to penicillins, synthetic analogues, isosteres and bioisosteres, concept of lead	15

	compounds (problems with penicillin G and solving the problems leading to the development of penicillin V, oxacillin, cloxacillin, ampicillin, amoxicillin, carbenicillin and carfecillin. Brief overview of pharmacokinetics and pharmacodynamics, concept of prodrug (sultampicillin) and synergism (β-lactamase inhibitors with pencillins).	
II	Synthesis, General Mode of Action, and Medicinal Uses of the Following Drugs**:** **Antineoplastic Agents:** Classification**,** Mechlorethamine, Chlorambucil, cyclophosphamide, carmustine, methotrexate, 6-mercaptopurine, paclitaxel (synthesis of paclitaxel excluded). **Antimalarials:** Classification, Chloroquine, primaquine, chloroguanide, pyrimethamine, Artemisinin and its potential derivatives (synthesis excluded). **Analgesics, Antipyretics and Antiinflammatory agents:** Morphine and related compounds (codeine and heroin), methadone, tramadol, aspirin, acetaminophen, indomethacin, mefenamic acid, ibuprofen, diclofenac, naproxen, celecoxib. **Antifertility agents:** Ovulation inhibitors and related hormonal contraceptives-norethindrone, levonorgestrel, estradiol, mestranol, non-hormonal contraceptive- centchroman (synthesis of all the drugs excluded). **Cardiovascular Drugs:** Sorbitrate, Calcium channel blockers: verapamil, diltiazem, beta-blockers: atenolol. **AIDS and drugs against HIV:** HIV infection to the system, structure, and mode of action of important drugs against HIV (nucleoside reverse transcriptase inhibitors) -AZT, ddI, ddC, d4T and 3TC (synthesis only of AZT).	15
III	**Alkylation of Enolates and Other Carbon Nucleophiles** **Introduction**, Generation, and Properties of Enolates and Other Stabilized Carbanions, Generation of Enolates by Deprotonation, Regioselectivity and Stereoselectivity in Enolate Formation from Ketones and Esters, Other Means of Generating Enolates, Solvent Effects on Enolate Structure and Reactivity. **Alkylation of Enolates**: Alkylation of Highly Stabilized Enolates, Alkylation of Ketone Enolates, Generation and Alkylation of Dianions, Intramolecular Alkylation of Enolates, Control of Enantioselectivity in Alkylation Reactions. **Nitrogen Analogs of Enols and Enolates:** Enamines and Imine Anions	15
IV	**Heterocyclic compounds** Systematic (Hantzsch-Widman) nomenclature for monocyclic and fused ring systems. General synthesis and reactions (including mechanism) of the following: Five-membered heterocycles: pyrazole, imidazole, oxazole, isoxazole, thiazole, and isothiazole; comparison of their basic character. General reactivity of purines and pyrimidines.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	5	Written Examination	
● Seminar/presentation/assignment/quiz/class test, etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources
Recommended Books/e-resources/LMS: 1. Carey, F. A., & Sundberg, R. J. (2007). Advanced organic chemistry: Part B: Reaction and synthesis (5th ed.). Springer. 2. Carruthers, W., & Coldham, I. (2004). Modern methods of organic synthesis (4th ed.). Cambridge University Press. 3. Rappoport, Z. (Ed.). (1990). The chemistry of enols. John Wiley & Sons. 4. Smith, M. B. (2020). March's advanced organic chemistry: Reactions, mechanisms, and structure (8th ed.). Wiley. 5. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, Ed. Robert F. Dorge. 6. Burger's Medicinal Chemistry and Drug Discovery Vol-I Ed. M.E. Wolf, John Wiley. 7. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill. 8. Organic Chemistry Vol.-2 I.L. Finar, ELBS. 9. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical. 10. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, eds. Pergamon Press. 11. Handbook of Heterocyclic Chemistry, Alan Katritzky, Christopher Ramsden, John A. Joule and Viktor Zhdankin, 3rd Edition, Elsevier.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Pharmaceutical Chemistry Special-IV		
Course Code	M24-CHE-410		
Course Type	DEC-4		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know the details of the biosynthetic pathways for plant secondary metabolism, acetate-malonate pathway, Acetate-mevalonate pathway, shikimic acid pathway. CLO 2: To elaborate importance of alkaloids, carotenoids- β-carotene and vitamin-A. CLO 3: To have knowledge of carbohydrate chemistry and terpenoids. CLO 4: To learn about steroids discussing nomenclature, structural elucidation (Cholesterol), ergosterol and cardiac glycosides and porphyrin compounds-chlorophyll, haemoglobin.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions, selecting at-least one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Mechanistic and biosynthetic approach to plant secondary metabolites:** Acetate-malonate pathway: Biosynthesis of plant fatty acids, biosynthesis and oxidation of ricinoleic acid. Polyketides: Biosynthesis of 6-methylsalicyclic acid, pencillic acid, griseofulvin. Acetate- mevalonate pathway: Biosynthesis of psoralen, gibberellic acid, cholesterol, conessine. Shikimic-acid pathway: Biosynthesis of chlorogenic acid and cichoriin, Cyanin, Quercetin, Biosynthesis of Porphyrins.	15
II	**Alkaloids:** Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation,	15

	degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, synthesis, biosynthesis and biological importance of the following: Ephedrine, (+)-Coniine, Nicotine, Quinine and Reserpine. Carotenoids; Structure, synthesis and biogenesis of β-carotene and Vitamin-A.	
III	**Carbohydrates:** Introduction, stereoisomerism, mutarotation of monosaccharides, ring structure of glucose, structure elucidation, of disaccharides, sucrose, maltose, lactose, polysaccharides, starch, glycosides, general structure elucidation. Terpene: General introduction, isoprene rule, isolation of terpenes, General methods of structure determination of terpenes, structure elucidation of citral, menthol and camphor.	15
IV	**Steroids:** Isolation, nomenclature, structural elucidation with special reference to Cholesterol, ergosterol and cardiac glycosides Methods for the following conversions: i) Cholesterol → Testosterone ii) Cholesterol → Progesterone **Porphyrins** Structures elucidation of chlorophyll, General structural features of haemoglobin (not structure elucidation).	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
● Class Participation:	05	Written Examination	
● Seminar/presentation/assignment/quiz/class test etc.:	10		
● Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Organic Chemistry, Vol 2, I. L. Finar, ELBS.
2. Natural Products: Chemistry and Biology Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Inorganic Chemistry Special Practical-III		
Course Code	M24-CHE-411A		
Course Type	PC-9		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : To know about the basic aspects of spectrophotometric, flame photometric and turbidimetric techniques and also able to perform experiments based on these techniques		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	I Spectrophotometric analysis i) To validate the Beer's Lambert law spectrophotometrically ii) To determine the unknown amount of following metal ions present in the given sample spectrophotometrically 1. Fe 2. Ni 3. Mo 4. V 5. Cu iii) To find out the stoichiometry of the complex by Job's Method **II Flame photometric analysis** To determine the unknown amount of Na/K ions present in the given sample by Flame photometry **III Turbidimetric analysis** To determine the unknown amount of Cl^- and sulphate ions present in the given sample by turbidimetry method **IV Any other experiments related to these techniques**	120
	Total Contact Hours	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practical**	**30**	➢ **Practical:**	**70**
● Class Participation:	5	Marks Distribution:	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10	

● Mid-Term Exam:	15	Viva-voce Marks : 10

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. A Text Book of Quantitative Analysis: A. I. Vogel, ELBS, London.
2. Practical Chemistry, A.M. James and F.E. Prichard, Longman.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Physical Chemistry Special Practical-III		
Course Code	M24-CHE-411B		
Course Type	PC-9		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : To learn pH-metry and interferrometry techniques, and analyse kinetics data and perform quantum chemical calculations.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	pH-Metry 1. pH-titrations of: (i) Acetic acid vs. NaOH, (ii) hydrochloric acid vs. NaOH, (iii) acetic acid vs. ammonium hydroxide and (iv) HCl vs. NH_4OH. 2. Preparation of buffer solution of various pH and the determination of their pH values. 3. Determination of the buffer capacity of different buffer solutions. 4. To find dissociation constants of weak acids. 5. Determine the Hammett constant of a given substituted benzoic acid by pH measurements. **Chemical Kinetics** 1. Determine the relative strength of the acids by studying the hydrolysis of methyl acetate. 2. Determination of velocity constant of the reaction of ethyl acetate with NaOH and activation energy and temperature coefficient of the reaction. 3. Determination of the velocity constant and energy of activation of the reactions between H_2O_2 and HI. 4. Investigation of the reaction between acetone and iodine (with respect to H^+, I_2 and acetone). 5. Determination of the order and velocity of the reaction between potassium persulphate and potassium iodide. **Interferrometry** 1. Determination of speed of sound of pure liquids / mixtures using interferrometer.	120

	Note: Any experiment may be introduced/deleted in the practical class based on the availability / non-availability of the instruments / chemicals.	
		Total Contact Hours 120

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practical**	**30**	➢ **Practical:**	**70**
● Class Participation:	5	Marks Distribution:	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10	
● Mid-Term Exam:	15	Viva-voce Marks : 10	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B.P. Levitt and Zindley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Garland, McGraw Hill.
6. Systematic experimental Physical Chemistry, T.K. Chandershekhar & S.K. Rajbhoj.
7. Experimental Physical Chemistry, V.D. Athawale and Parul Mathur, New Age International.
8. Senior Practical Physical Chemistry, B. D. Khosla, V. C. Garg, A. Gulati, R. Chand & Co.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Organic Chemistry Special Practical-III		
Course Code	M24-CHE-411C		
Course Type	PC-9		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To acquire the knowledge of the preparation of organic compounds in two or three steps, check the progress of reaction and purity through chromatography, and purification of synthessied compounds, CLO 2: To understand the application of structural drawing tools such as ChemAxon, ChemDraw, etc., for drawing the mechanism of reactions and structures of organic compounds and finding IUPAC nomenclature, 1H NMR prediction, etc and to develop the ability to compile the obtained results in the form of a lab record.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	I. Preparations of organic compounds involving two and three stages: Typical preparations from which the two and three-stage preparations can be chosen are: 1. Toluene - p-nitrotoluene — p-nitrobenzoic acid — p-amino benzoic acid 2. Hydroquinone — Benzoquinone — 5- Hydroxy benzoxathiole-2-one —5- Acetoxy benzoxathiol-2-one 3. Acetopheneone — Acetophenone oxime — Acetanilide-p-Nitroacetanilide 4. Benzaldehyde — Benzoin — Benzil — Benzillic acid 5. Acetylacetone — 4,6-dimethylpyridine-2-mercaptopyrimidine — 4,6- dimethyl-2-hydrazinpyrimidine — 1-(4'-6'-dimethylpyridine-2'yl) 3,5-dimethylpyrazole	120

	6. Nitrobenzene — m-dinitrobenzene — m-nitroaniline — m-nitrophenol 7. Phthalic acid — phthalic anhydride – phthalimide — Anthranilic acid 8. Acetophenone — Benzalacetophenone — epoxide 9. Cyclohexanone —Cyclohexanone oxime—caprolactam 10. Phthalic anhydride—o-benzolylbenzoic acid—anthraquinone. 11. O-Cholobenzoinc acid —N-phenylanthranilic acid — acridone. 12. Cholrobenzene—2,4-dinitrochlorobenzene —2,4-dinitrophenol 13. Bromobenzene—triphenylcarbinol-tritylchloride 14. Resorcinol—resacetophenone — 4-ethyl resorcinol 15. Resorcinol-4-methyl-7-hydroxycoumarin-6 and 8- nitro-4-methyl- 7-hydroxycoumarin 16. Phenol — salicylaldehyde —coumarin 17. Aniline — 2,4,6-tribromaniline — 1,3,5-tribromobenzene 18. Resorcinol—resacetophenone — Chalcone **Any other multi-step reaction as per the requirement.** **II.** All the students must check the progress of the reaction and purity of the final products for all the stages of preparation by thin-layer chromatography. Demonstration of different software useful in chemistry for drawing the structure of organic compounds as well as for the computational studies of small organic molecules. Draw the scheme used for a multi-step preparation (two or three) using any structural drawing tool & get the IUPAC name and predicted 1H-NMR spectrum for each compound involved in multi-step preparation. Brief idea of given terms: Molecular graphics, Molecular minimization, Molecular Docking, Pharmacophore, QSAR, Optimization, Single point energy and Spectral analysis.	
	Total Contact Hours	120

Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
Practical	30	Practical:	70
● Class Participation:	5	Marks Distribution:	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10	
● Mid-Term Exam:	15	Viva-voce Marks : 10	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Mohrig, J. R., Hammond, C. N., & Schatz, P. F. (2024). Techniques in organic chemistry: Advanced laboratory course (5th ed.). W.H. Freeman.
2. Zweifel, G. S., & Nantz, M. H. (2023). Modern organic synthesis: An introduction (2nd ed.). University Science Books.
3. Jensen, F. (2022). Molecular modeling basics: Computational tools for chemical discovery. CRC Press.
4. Kürti, L., & Czakó, B. (2025). Strategic applications of named reactions in multi-step synthesis. Elsevier.

5. Loudon, G. M., & Parise, J. (2021). Organic chemistry: Structure and function with spectroscopy guide (8th ed.). Macmillan.
6. Bachrach, S. M. (2014). Computational organic chemistry (2nd ed.). Wiley.
7. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (1996). Vogel's textbook of practical organic chemistry (6th ed.). Prentice Hall.
8. Leonard, J., Lygo, B., & Procter, G. (2013). Advanced practical organic chemistry (3rd ed.). CRC Press.
9. Roy, K., & Gramatica, P. (2015). QSAR and molecular modeling in drug design. Springer.
10. Schlick, T. (2010). Molecular modeling and simulation: An interdisciplinary guide (2nd ed.). Springer.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Pharmaceutical Chemistry Special Practical-III		
Course Code	M24-CHE-411D		
Course Type	PC-9		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : To understand the concept of separation and identification of binary organic mixture(s), applications related to spectroscopic and chromatographic techniques.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	16	16
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	5) Separations and identification of components of binary organic mixture using chemical methods and spectral data. 6) Applications of IR, UV, ^{1}H NMR, ^{13}C NMR, Mass spectroscopy in drug analysis. 7) Chromatographic separations: TLC, paper and column.	120
	Total Contact Hours	120

Suggested Evaluation Methods

Internal Assessment: 30		End Term Examination: 70
● Class Participation:	05	Marks Distribution:
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10
● Mid-Term Exam:	15	Viva-voce Marks : 10

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B. Maynes, Edward Arnold (Pub.), Ltd. London, 1975).
2. "Systematic Qualitative Organic Analysis" by H. Middleton, Edward Arnold (Publishers) Ltd., London 1959.
3. "A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis" by Arthur I. Vogel, Longmans Green and Co., Ltd., London 1966.
4. "Elementary Practical Organic Chemistry" by Arthur I. Vogel, CBS Publishers & Distributors.
5. "A Guide to spectroscopy in Organic Chemistry' by PAVY

6.	"Spectrometric Identification of Organic Compounds", Fifth Ed., R.M. Silverstein, G.S. Bassler and T.C. Morrile, John Wiley and Sons, New York.
7.	"Organic Spectroscopy', 3rd Ed., by William Kamp. John Wiley & Sons.
8.	"Spectroscopic" Methods in Organic Chemistry, D.H. William & Ian Fleming.
9.	Vogel's Text Book of Practical Organic Chemistry by B.S. Furners et. al., Longman Group Ltd.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Inorganic Chemistry Special Practical-IV		
Course Code	M24-CHE-412A		
Course Type	PC-10		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : To learn about the various quantitative techniques like i.e., Gravimetric, complexometric titrations and about Back titrations, also able to perform experiments related to these techniques		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time (Spread over two sessions)		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	I Quantitative analysis: Determination of triple elements in the mixtures, ores, alloys etc. by available analytical techniques. i) Volumetrically ii) Gravimetrically iii) Instrumentation methods **II Complexometric analysis** i) Estimation of calcium content in chalk sample as calcium oxalate by permanganometry ii) Estimation of Hardness (Temporary as well as permanent) of water sample by EDTA iii) To determine the strength of $ZnSO_4$ and $MgSO_4$ present in the given solution by complexometric titration **III Back Titrations** i) Basic concept of back Titration ii) Determination of alkali content- present in the given antacid sample using HCl iii) Determination of acetic acid in commercial vinegar using NaOH **IV Any other experiments related to these techniques**	120
	Total Contact Hours	120

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practical**	**30**	➢ **Practical:**	**70**
● Class Participation:	5		

<table>
<tr><td>● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:</td><td>10</td><td rowspan="2">Marks Distribution:
Experiment Marks: 50
Lab record Marks : 10
Viva-voce Marks : 10</td></tr>
<tr><td>● Mid-Term Exam:</td><td>15</td></tr>
<tr><td colspan="3">Part C-Learning Resources</td></tr>
<tr><td colspan="3">Recommended Books/e-resources/LMS:
1. A Text Book of Quantitative Analysis: A. I. Vogel, ELBS, London.
2. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.</td></tr>
</table>

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Physical Chemistry Special Practical-IV		
Course Code	M24-CHE-412B		
Course Type	PC-10		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : Learning techniques like refractometry, flame photometry, quantum chemical calculations and apply distribution law, along with effective data analysis and graphical representation tools.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	Refractometry 1. Determine the refractive index of simple organic liquids like methyl acetate, ethyl acetate, methanol, ethanol, n-hexane, chloroform. 2. Determine the refractivity and molar refractivity of some organic liquids like methyl acetate, ethyl acetate, methanol, ethanol, n-hexane, chloroform and hence find out the molar refractivities for CH_2, C, H and Cl. 3. Determine the composition of mixture of two liquids by refractive index measurements. **Flame Photometry** 1. Determination of Na^+, K^+, Ca^{2+} and Mg^{2+} in tap water, juice, electral etc. **Distribution Law** 1. Determine distribution coefficient of ammonia between chloroform and water. 2. Determine the formula of the complex formed between copper (II) ion and ammonia using distribution method. **Data-Handling/Representation** 1. Using origin-Lab draw data in different styles of graphs. 2. Linear Curve fitting and calculation of regression coefficient by using EXCEL worksheet. 3. Calculate activation energy using thermal analysis data by single/multiple heating rate methods using EXCEL worksheet.	120

	Quantum Chemical Calculations 1. Study the effect of size of basis-set on ground state geometry of F_2O_2. Use three different basis set for your calculations. Compare the results and draw inference. [Suggested Basis Set: 6-31G(d), 6-311+G(d) and 6-311+G(3df)]. 2. Study the normal modes of vibrations for formaldehyde (Apply the required scaling) using basis sets: **(i)** 6-31++G(d, p) **(ii)** 6-311++G(d, p) 3. Determine energy barrier for C-C rotation in case of **(i)** Ethane **(ii)** Butane. Compare the results obtained for (i) and (ii) and draw the inferences. Use different basis set like 6-31G(d), 6-31G(d,p), 6-31+G(d, p) and draw a comparison table. 4. Determine HOMO-LUMO gap through quantum chemical calculations for **(i)** 1,3 butadiene **(ii)** 1,3,5 hexatriene. Compare the results obtained with particle-in-a-box model. Use different basis sets for calculations. [Suggested Basis Set: 6-31G, 6-31G(d,p), 6-31++G(d,p)] **Note:** Any experiment may be introduced/deleted in the practical class based on the availability / non-availability of the instruments / chemicals.	

Total Contact Hours	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practical**	**30**	➢ **Practical:**	**70**
● Class Participation:	5	Marks Distribution:	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10	
● Mid-Term Exam:	15	Viva-voce Marks : 10	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B.P. Levitt and Zindley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Gailand, McGraw Hill.
6. Systematic experimental Physical Chemistry, T.K. Chandershekhar & S.K. Rajbhoj.
7. Experimental Physical Chemistry, V.D. Athawale and Parul Mathur, New Age International.
8. Senior Practical Physical Chemistry, B. D. Khosla, V. C. Garg, A. Gulati, R Chand & Co.
9. https://gaussian.com/basissets/
10. https://gaussian.com/man/

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Organic Chemistry Special Practical-IV		
Course Code	M24-CHE-412C		
Course Type	PC-10		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Perform quantitative analysis of biomolecules (carbohydrates, proteins, amino acids, cholesterol, urea) and ascorbic acid using colorimetric methods and interpret experimental data to determine concentrations. CLO 2: Apply laboratory techniques (e.g., solvent extraction, distillation, chromatography) to isolate natural products from raw materials, and document experimental procedures, results, and conclusions in a structured lab report adhering to scientific writing standards.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	1. **Colorimetric determination of the following:** Carbohydrates, ascorbic acid, amino acids, proteins, cholesterol, urea. 2. **Extraction of organic compound from natural products:** Any one of the following:– Caffeine from tea leaves. Isolation of β-carotene from carrot. Isolation of limonene from citrus rind. Isolation of nicotine from tobacco. Isolation of lactose from milk. Isolation of Casein from milk.	120
	Total Contact Hours	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practical**	**30**	➢ **Practical:**	**70**
● Class Participation:	5	Marks Distribution: Experiment Marks: 50	
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10		

● Mid-Term Exam:	15	Lab record Marks : 10 Viva-voce Marks : 10

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (2023). Vogel's textbook of practical organic chemistry (6th ed.). Pearson Education.
2. Mann, F. G., & Saunders, B. C. (2018). Practical organic chemistry (3rd ed.). Wiley.
3. Harris, D. C., & Lucy, C. A. (2020). Quantitative chemical analysis (10th ed.). W. H. Freeman.
4. Ahluwalia, V. K., & Dhingra, S. (2019). Advanced practical chemistry (2nd ed.). CRC Press.
5. Mohrig, J. R., Hammond, C. N., & Schatz, P. F. (2020). Modern Projects and Experiments in Organic Chemistry (2nd ed.). W.H. Freeman. New York, NY.
6. Doxsee, K. M., & Hutchison, J. E. (2021). Green Organic Chemistry: Strategies, Tools, and Laboratory Experiments (1st ed.). Cengage Learning. Boston, MA.
7. Leonard, J., Lygo, B., & Procter, G. (2019). Advanced Practical Organic Chemistry (3rd ed.). CRC Press. Boca Raton, FL.
8. Harwood, L. M., & Moody, C. J. (2020). Experimental Organic Chemistry (2nd ed.). Oxford University Press. Oxford, UK.
9. Lehman, J. W., & Morrill, T. B. (2021). Techniques in Organic Chemistry (4th ed.). Springer. Chem, Switzerland.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Pharmaceutical Chemistry Special Practical-IV		
Course Code	M24-CHE-412D		
Course Type	PC-10		
Level of the course	500-599		
Pre-requisite for the course (if any)	Chemistry as a subject at UG level		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO : To develop the understanding related to different assay of drugs, their volumetric and spectrophotometric analysis, friability and disintegration test for tablets.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	16	16
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time		6 hours	

Part B- Contents of the Course

Unit	Topics	Contact Hours
	1. Determination of specific rotation of ibuprofen and determination of its percentage in the unknown sample. 2. Volumetric determination of ibuprofen in the given tablet. 3. Spectrophotometer determination of aspirin content in the soluble aspirin table. 4. Spectrophotometer determination of Paracetamol in the tablet. 5. Determination of Vitamin C in given formulation. 6. Determination of phenobarbilone in the given cough syrup. 7. To perform I.P. monograph of tablet. 8. To perform I.P. monograph of hard gelatine capsule. 9. Determination of Chloramphenicol in given capsule.	120
	Total Contact Hours	120

Suggested Evaluation Methods

Internal Assessment: 30		End Term Examination: 70
● Class Participation:	05	Marks Distribution:
● Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	10	Experiment Marks: 50 Lab record Marks : 10
● Mid-Term Exam:	15	Viva-voce Marks : 10

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B.Maynes, Edward Arnold (Pub.)., Ltd. London, 1975).
2. "Systematic Qualitative Organic Analysis" by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.

3.	"A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis" by Arthur I. Vogel, Longmans Green and Co., Ltd., London 1966.
4.	"Elementary Practical Organic Chemistry" by Arthur I. Vogel, CBS Publishers & Distributors.
5.	"A Guide to spectroscopy in Organic Chemistry' by PAVY
6.	"Spectrometric Identification of Organic Compounds", Fifth Ed., R.M. Silverstein, G.S. Bassler and T.C.Morrile, John Wiley and Sons, New York.
7.	"Organic Spectroscopy', 3rd Ed., by William Kamp. John Wiley & Sons.
8.	"Spectroscopic" Methods in Organic Chemistry, D.H. William & Ian Fleming.
9.	Vogel's Text Book of Practical Organic Chemistry by B.S. Furners et. al., Longman Group Ltd.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Chemistry		
Semester	IV		
Name of the Course	Skills in Chemistry		
Course Code	M24-CHE-413		
Course Type	EEC		
Level of the course	500-599		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To know about the Safety aspects of Handling the Chemicals and gases in chemical laboratories & industries CLO 2: To know how the most commonly used products are manufactured in industries. CLO 3*: To perform entrepreneurship-oriented practicals		
Credits	Theory	Practical	Total
Teaching Hours per week	1	2	3
Internal Assessment Marks	10	5	15
End Term Exam Marks	20	15	35
Max. Marks	30	20	50
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 5 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of 6 parts covering the entire syllabus. The examinee will be required to attempt 3 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	**Handling of Chemicals:** Safety aspects in chemical laboratories & industries, emergency procedures, safe handling of glassware, Safety in storage and handling of chemicals & precautions. Large scale production, uses, storage & hazards in handling gases like oxygen, nitrogen, dry-ice, hydrogen, acetylene etc.	7
II	**Industrial Product Chemistry** Chemistry in manufacture of paper, sugar, fertilizers, daily use products (Soap, detergent, disinfectant, cosmetics etc), distillery.	8
III*	**Practicals** 1. Extract essential oils from natural sources. 2. Determination of total active content in detergent. 3. Preparation of cosmetic cream or lip balm naturally. 4. To measure the acidity / alkalinity of a soil sample. 5. To estimate total organic content / total organic carbon in soil. 6. To prepare a low-cost adsorbent from organic waste (e.g., orange peel, banana peel, sugarcane bagasse, or sawdust) and evaluate its	30*

	potential for removing pollutants (like dyes or heavy metals) from aqueous solutions. 7. To construct a simple solar cell using black tea or hibiscus extract as a natural dye, Titanium dioxide (TiO_2) as a semiconductor, and simple kitchen materials to understand solar energy conversion. Note: Any experiment may be introduced/deleted in the practical class based on the availability / non-availability of the instruments / chemicals.	
	Total Contact Hours	45 (15+30*)

Suggested Evaluation Methods			
Internal Assessment:		**End Term Examination:**	
➢ **Theory**	**10**	➢ **Theory:**	**20**
• Class Participation:	4	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	--		
• Mid-Term Exam:	6		
➢ **Practical***	**5**	➢ **Practical***	**15**
• Class Participation:	NA		
• Seminar/Demonstration/Viva-Voce/Lab Record, etc.:	5		
• Mid-Term Exam:	NA		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Chemical Laboratory: Safety and Techniques, Mohamed Elzagheid; Walter de Gruyter GmbH & Co KG.
2. Safety in the Chemical Laboratory and Industry by Muhammad Raza Shah.
3. Surfactants, Disinfectants, Cleaners, Toiletries, Personal Care Products Manufacturing and Formulations by NPCS Board of Consultants & Engineers .
4. Soaps, Detergents and Disinfectants Technology Handbook (3rd Revised Edition) by Ajay Kumar Gupta.
5. Industrial Chemistry, B. K. Sharma.