Syllabus for
4 Year B.Sc. Chemistry
Programme based on NEP – 2020

(2025 onwards)

Ewing Christian College, Prayagraj
(An Autonomous Constituent PG College of University of Allahabad)

SEMESTER-WISE COURSE DETAILS
CHEMISTRY – MAJOR

SEMESTER	PAPER	COURSE TITLE	CREDIT & HOURS			MARKS			
			CREDIT	HOURS	TOTAL CREDIT	THEORY		TOTAL	GRAND TOTAL
						END SEMESTER	C.I.A.		
I	I	INORGANIC CHEMISTRY	3	45 Hours	8	50	25	150	200
	II	ORGANIC CHEMISTRY	3	45 Hours		50	25		
	PRACTICAL	CHEMISTRY PRACTICAL - 1	2	60 Hours		40	10	50	
II	I	PHYSICAL CHEMISTRY	3	45 Hours	8	50	25	150	200
	II	INORGANIC CHEMISTRY	3	45 Hours		50	25		
	PRACTICAL	CHEMISTRY PRACTICAL - 2	2	60 Hours		40	10	50	

CHEMISTRY - MINOR

SEMESTER	PAPER	COURSE TITLE	CREDIT & HOURS			MARKS			
			CREDIT	HOURS	TOTAL CREDIT	THEORY		TOTAL	GRAND TOTAL
						END SEMESTER	C.I.A.		
I	I	CHEMISTRY - 1	3	45 Hours	4	50	25	75	100
	PRACTICAL	CHEMISTRY PRACTICAL - 1	1	30 Hours		20	5	25	
II	I	CHEMISTRY - 2	3	45 Hours	4	50	25	75	100
	PRACTICAL	CHEMISTRY PRACTICAL - 2	1	30 Hours		20	5	25	

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<tr><td colspan="3">B.Sc. Semester - I</td></tr>
<tr><td colspan="3">CHEMISTRY - MAJOR</td></tr>
<tr><td colspan="3">PAPER – I</td></tr>
<tr><td>COURSE CODE:
CHET101</td><td>INORGANIC CHEMISTRY</td><td>COURSE CREDIT: 3
HOURS: 3 x 15 Hours = 45 Hours
TOTAL MARKS: 75 | END SEMESTER: 50
C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="2">This course aims to provide students with a comprehensive understanding of fundamental concepts in atomic structure, periodic classification, periodic properties, and qualitative analysis. Through the study of classical models of the atom, students will develop a deep insight into the behaviour of electrons and their influence on chemical properties and trends in the periodic table. The course also emphasizes the principles governing electronic configurations, periodicity, and their applications in chemical reactivity and bonding. Additionally, students will acquire essential analytical skills through systematic qualitative analysis of inorganic mixtures, equipping them with the foundational knowledge required for advanced studies in chemistry and related fields.</td></tr>
<tr><td>Course Outcomes</td><td colspan="2">On completion of the course the student will be able to:
1.
• Understand atomic models and their applications in spectra, and explain fundamental quantum concepts like Rydberg’s equation, dual nature, de Broglie’s hypothesis, uncertainty principle, and atomic orbitals.
• Explain quantum numbers, their significance in defining orbitals, and analyse the shapes, orientation, nodes, and nodal planes of s, p, and d orbitals.
• Apply the principles governing electron filling (Pauli Exclusion, Aufbau, Hund’s Rule) to predict electronic configurations, explain orbital stability, and account for anomalous cases based on exchange energy and relative orbital energies.
2. Explain the historical development and evolution of the periodic table, including Mendeleev’s and IUPAC classifications, and apply the</td></tr>
</table>

	modern periodic law to understand periodicity, arrangement, and characteristics 3. Explain periodic properties such as atomic, ionic, van der Waal's, and metallic radii, ionization energy, electron affinity, and electronegativity, including their concepts, methods of determination, influencing factors, periodic trends, and significance in understanding chemical behavior. 4. Understand the fundamental principles of qualitative inorganic analysis, apply concepts like solubility product, common ion effect, and law of mass action, and develop skills to systematically identify, analyze, and interpret results for common cations and anions in mixtures.
Syllabus	**1. A) ATOMIC STRUCTURE: 15 Hours** Rutherford's, Bohr's, and Sommerfeld's Atomic models – their importance and applications, Absorption and Emission spectra, Rydberg's equation and its significance, Origin, Analysis and Explanation of Spectra, Spectral series, Dual nature of matter, de Broglie's hypothesis and matter waves, Heisenberg's uncertainty principle. **B) QUANTUM NUMBERS:** Definition, types, and determination of various QN, shapes & orientation of s-, p-, and d-orbitals, Nodes and nodal planes. **C) ELECTRONIC CONFIGURATION:** Rules for filling of electrons in orbit, sub-orbit and orbital - Pauli Exclusion Principle, Aufbau Principle, Hund's Rule of Maximum Multiplicity, their definition and importance, significance of these principles, stability of half-filled and fully-filled orbitals, Exchange energy, Pairing energy, Promotional energy. **2. PERIODIC CLASSIFICATION OF ELEMENTS: 8 Hours** Historical perspective of the periodic table, Evolution of Modern Periodic Classification, Mendeleev's Periodic Table, Mosley's Table, IUPAC recommendations in naming of groups, Periodic table, merits and limitations, Modern Periodic Law, Periodicity in properties with reference to electronic configuration, General description of the Long Form of the Periodic Table,

	Electronic configuration and distinguishing characteristics of members of s, p, d and f-block **3. PERIODIC PROPERTIES: 15 Hours** Atomic radii, Covalent radii, Ionic radii, Van der Waal's radii, Metallic radii, concept and methods of determination (Shoemaker and Stevenson's method for covalent radii), factors affecting size, trends of size in the periodic table, Iso-electronic species; Ionization Energy (IE) and successive IE - definition, factors influencing IE, trend of IE in the modern periodic table and significance; Electron affinity (EA) - concept, factors affecting EA, trend of EA in the modern periodic table and significance; Electronegativity (EN) - definition, factors influencing EN, trend of EN in the modern periodic table and significance and applications of electronegativity. **4. QUALITATIVE ANALYSIS: 7 Hours** Principles involved in qualitative analysis of inorganic mixtures, understanding semi-micro analysis: law of mass action, solubility product, common ion effect, chemical reactions involved in the qualitative analysis of inorganic mixtures – scheme of analysis, identification and confirmatory tests for some cations and anions, problems based on mixture analysis.
Recommended Books	1. J. D. Lee: A New Concise Inorganic Chemistry, ELBS Ed. 2. F.A. Cotton and G. Wilkinson: Basic Inorganic Chemistry, John-Wiley Publications 3. B.R. Puri and L.R. Sharma and K.C. Kalia: Principles of Inorganic Chemistry Milestone publishers. 4. G.S. Manku: Theoretical Principles of Inorganic Chemistry, TATA-McGraw Hil 5. Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch: Fundamentals of Analytical Chemistry, 9^{th} edition, Cengage Learning India Pvt. Ltd. 6. P.J. Durrant, B. Durrant: Introduction to Advanced Inorganic chemistry, ELBS

	7. R. Sarkar: General Inorganic Chemistry (Part I and II) , New Central Book Agency, Kolkata. 8. R. D. Madan: Modern Inorganic Chemistry, S. Chand & Company Ltd., New Delhi. 9. O.P. Pandey, D.N. Bajpai and S. Giri: Practical Chemistry, S. Chand & Company Ltd., New Delhi.

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<tr><td colspan="4">CHEMISTRY - MAJOR</td></tr>
<tr><td colspan="4">PAPER – 2</td></tr>
<tr><td>COURSE CODE:
CHET102</td><td colspan="2">ORGANIC CHEMISTRY</td><td>COURSE CREDIT: 3
HOURS: 3 x 15 Hours = 45 Hours
TOTAL MARKS: 75 | END SEMESTER: 50
C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="3">Introduce the fundamental concepts of structure, bonding, and reactivity in organic chemistry. Develop understanding of stereochemistry and molecular configurations. Provide knowledge of aliphatic and aromatic hydrocarbons with emphasis on reaction mechanisms and stability.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">By the end of this course, students will be able to:
On successful completion of this course, students will be able to:
1. Explain the concepts of structure, bonding, electronic effects, and reactive intermediates in organic compounds.
2. Apply stereochemical principles to analyse chirality, isomerism, and molecular configuration.
3. Demonstrate mechanisms of substitution, addition, elimination, and electrophilic substitution reactions.
4. Evaluate the stability and reactivity of aliphatic and aromatic hydrocarbons based on mechanistic reasoning.
5. Integrate theoretical knowledge of organic chemistry to solve problems and build a foundation for advanced studies.</td></tr>
<tr><td>Syllabus</td><td colspan="3"><u>UNIT-I Basic Concept of Organic Chemistry</u> (8 hours)
Structure and Bonding: Hybridization, bond length, bond angles and bond energy. Electronic displacement and their applications; Inductive effect, electromeric effect, Mesomeric effect and Hyperconjugation.
Homolytic and heterolytic fissions. Generation, Structure and relative stability of Carbocations, Carbanions and free radicals. Types of reagents: Electrophiles & Nucleophiles. Introduction to types of organic reactions.
<u>Unit II: Stereochemistry Of Organic Compounds</u> (14 hours)</td></tr>
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	Stereoisomerism: Optical activity and optical isomerism, elements of symmetry, molecular chirality, Stereocenter, enantiomers and diastereomers. Chirality in molecules with one and two stereocenters; meso configuration. Representation of organic molecules using Flying Wedge, Fischer, Sawhorse and Newman formula, Inter conversion of different representations. Relative and absolute configuration: D/L and R/S system, sequence rules (CIP rules) Erythro and Threo nomenclature. Geometric isomerism, elementary idea of cis and trans isomerism, E/Z system of nomenclature. **UNIT-III Aliphatic Hydrocarbons (18 hours)** ***Alkanes:*** Methods of formation with special reference to Wurtz reaction, Kolbe's reaction, Corey-House synthesis. Halogenation of alkanes. ***Alkenes and alkynes:*** Methods of formation alkenes using mechanisms of E1, E2, E1cb reactions, Saytzeff's and Hoffmann eliminations. Electrophilic addition reactions mechanism with suitable examples, (Markovnikov's/ AntiMarkovnikov's addition), syn and anti-addition; Addition of H_2, X_2, oxymercuration-demercuriation, Hydroboration-oxidation, ozonolysis, hydroxylation, reaction with NBS, reactions of alkynes; acidity, alkylation of terminal alkynes, electrophilic addition: hydration to form carbonyl compounds. ***Dienes:*** Stability of conjugated Dienes, Chemical reactions of Dienes with special reference to Electrophilic addition (Kinetically and Thermodynamically stable products) and Diel's Alder reaction. **Unit IV: Aromatic hydrocarbons (5 hours)** Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration and Friedel-Craft's alkylation/acylation with their mechanism. Directive effects of the groups
Recommended Books	1. Solomons, T. W. G., Fryhle, C.B., Snyder, S.A (2017), Organic Chemistry, 12th Edition, Wiley. 2. Bruice, P. Y. (2020), Organic Chemistry, 8th Edition, Pearson. 3. Clayden, J., Greeves, N., Warren, S. (2014), Organic Chemistry, Oxford 4. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Pearson, 2010.

	5. Eliel, E. L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000. 6. Finar, I. L. Organic Chemistry (Vol. I & II), E.L.B.S. 7. Nasipuri, D. Stereochemistry of Organic compounds: Principles and Applications. 8. Kalsi, P. S., Stereochemistry Conformation and Mechanism; 8thEdn, New Age International, 2015. 9. Dr Jagdamba Singh, Organic Chemistry Vol 1 and Vol 2, Pragati Prakashan, Edition: 2020. 10. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley Student Ed, 11th Edition (2013). 11. M. K. Jain and S. C. Sharma, Modern organic chemistry, Vishal Publication Co, 2024th edition 12. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications. Bahl, A. & Bahl, B. S. Advanced Organic Chemistry, S. Chand, 2010.

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B.Sc. Semester – I		
CHEMISTRY - MAJOR		
PRACTICAL		
COURSE CODE:	**TITLE: CHEMISTRY PRACTICAL-I**	**COURSE CREDIT: 2** **HOURS: 60 (2 x 30 Hours = 60)** **TOTAL MARKS: 50**
Course Objectives	• To introduce students to the principles and procedures of semi-micro qualitative inorganic analysis. • To develop systematic skills in identifying simple and interfering acid radicals. • To train students in eliminating interfering radicals and analyzing cations group-wise. • To familiarize students with the detection of elements in organic compounds through sodium extract preparation. • To cultivate analytical reasoning, careful observation, and laboratory discipline in qualitative analysis.	
Course Outcomes	After completing this course, students will be able to: • To introduce students to the principles and procedures of semi-micro qualitative inorganic analysis. • To develop systematic skills in identifying simple and interfering acid radicals. • To train students in eliminating interfering radicals and analyzing cations group-wise. • To familiarize students with the detection of elements in organic compounds through sodium extract preparation. • To cultivate analytical reasoning, careful observation, and laboratory discipline in qualitative analysis.	
Syllabus	**1. Semi-micro Qualitative Inorganic mixture analysis** a. Principles of semi-micro analysis b. Analysis of simple acid radicals - Carbonates, Sulphide, Sulphate, Chloride, Bromide, Iodide, Nitrate, Nitrite and interfering radicals – Oxalate, Borate and Phosphate. c. Elimination of interfering acid radicals and identifying the groups of basic radicals. d. Group wise analysis of basic radicals Group IIA, IIB and III – (Lead, Copper, Bismuth, Arsenic, Tin, Cadmium, Antimony, Aluminium, Iron and Chromium)	

	2. Element Detection in Organic compounds a. Preparation of Sodium extract for detection of elements (N, S, N+S, Cl, Br, I) in the given solid organic compound
Reference Books	1. A.I. Vogel: Vogel's Qualitative Inorganic Analysis – Prentice Hall, 7th Edition. 2. G. Svehla : Vogel's Qualitative Inorganic Analysis, Pearson 3. A.I. Vogel: Vogel's Textbook of Practical Organic Chemistry – Prentice Hall, 5th Edition. 4. Mann & Saunders : Practical Organic Chemistry, Longmans, Green and Co., London 5. O.P. Pandey, D.N. Bajpai, S. Giri: *Practical Organic Chemistry* – S. Chand & Company Ltd., New Delhi. 6. V.K. Ahluwalia & Sunita Dhingra : Practical Chemistry, Universities Press, Hyderabad 7. Gurtu & Gurtu : Advanced Experimental Chemistry, S. Chand & Company Ltd., New Delhi

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<tr><td colspan="4">PAPER – 1</td></tr>
<tr><td>COURSE CODE:
CHET201</td><td colspan="2">PHYSICAL CHEMISTRY</td><td>COURSE CREDIT: 3
HOURS: 3 x 15 Hours = 45 Hours</td></tr>
<tr><td></td><td colspan="2"></td><td>TOTAL MARKS: 75 | END SEMESTER: 50 | C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="3">The aim of the course is to:
1. Understand the theoretical foundations of ideal and real gases and apply gas laws to predict behavior under different physical conditions.
2. Explore the concept of critical phenomena and molecular velocity distribution using kinetic theory and van der Waals' equation.
3. Apply the principles of chemical and physical equilibrium to various homogeneous and heterogeneous systems.
4. Analyze ionic equilibria using modern acid-base theories and predict buffer behavior, salt hydrolysis, and solubility outcomes.
5. Apply the First Law of Thermodynamics to calculate internal energy, enthalpy changes, and relate heat and work to thermodynamic processes.
6. Interpret the Joule–Thomson effect, inversion temperature, and specific heat capacity relationships.
7. Calculate heat changes in chemical reactions using Hess's Law, bond energy, and Kirchhoff's equation.
Develop the ability to solve numerical problems related to all the above topics and apply theoretical knowledge to real-life chemical systems.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">By the end of this course, students will be able to:
1. explain the kinetic molecular theory of gases; apply gas laws and the ideal gas equation to solve quantitative problems; analyze deviations from ideal behavior using the van der Waals equation; and evaluate its applicability under varying pressures and temperatures.
2. determine critical constants from data and relate them to van der Waals constants; apply the law of corresponding states and the virial equation to assess real-gas behavior.
3. differentiate among most probable, average, and root-mean-square molecular velocities and interpret their significance within the context of Maxwell's distribution law.
4. derive and use law-of-mass-action expressions for homogeneous equilibria; and predict equilibrium shifts in response to changes in pressure, temperature, concentration, catalysts, or inert substances.</td></tr>
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	5. apply Le Chatelier's principle to heterogeneous systems and liquid-phase reactions; calculate the degree of dissociation using vapor-density methods. 6. explain how pressure and temperature affect melting point, boiling point, and solubility; and apply Le Chatelier's principle to forecast shifts in physical equilibria. 7. compare and evaluate Arrhenius, Bronsted-Lowry, and Lewis acid–base theories; calculate buffer pH using the Henderson–Hasselbalch equation; and analyze salt hydrolysis to select suitable indicators for titrations. 8. use solubility product principles to determine solubility and solve precipitation and analytical equilibrium problems. 9. apply the first law of thermodynamics—including state/path functions, exact/inexact differentials, and heat/work relationships—to calculate changes in internal energy and enthalpy; and determine Joule–Thomson coefficients and inversion temperatures. 10. calculate reaction enthalpies using Hess's Law, Kirchhoff's equation, bond energy, and resonance energy concepts.
Syllabus	**1. GASEOUS STATE** **Ideal Gases** Kinetic molecular theory of gases, postulates and basic concepts, Boyle's law, Charle's law, Graham's law, Avogadro's law, Ideal gas equation. **Real Gases** Deviations from ideal gas behavior, van der Waals equation of state (a) volume correction and (b) pressure correction; verification of van der Waals equation at different pressure and temperatures. **Critical Phenomenon** Continuity of state, Critical constants (P_c, V_c, T_c) and their determination. Relation of P_c, V_c, T_c with van der Waals constants a & b. Law of corresponding states, Qualitative treatment of Maxwell Law of distribution of velocities (most probable velocity, average velocity & root mean square velocity). **9 Hours** **2. EQUILIBRIUM** **Chemical Equilibria** Law of mass action, Significance of equilibrium constant, Relation between K_p, K_c, and K_x. Applications in homogeneous equilibrium when $\Delta n = 0$, Δn = +ve and Δn = –ve (with examples) Determination of degree of dissociation by vapor density method and expression. Applications in heterogeneous equilibria and reactions in liquid state. Effect of pressure,

	temperature, concentration, catalyst, and inert substances on the state equilibrium. Le Chatelier′s principle for chemical reactions. **Physical Equilibria** Application of Le Chatelier′s principle for physical equilibria, effect of pressure and temperature on fusion temperature of solids, boiling point, and solubility of solids in solvents. **9 Hours** **3. IONIC EQUILIBRIUM** Acid-Base theories: Arrhenius theory of electrolytic dissociation, Lowry Bronsted theoty of conjugate acid base pairs, and Lewis concept. Buffer solution and its pH determination by using Handerson-Hasselbalch equation, Hydrolysis of salts, Acid, Base indicators, Selection of suitable indicators in volumetric analysis, Ostwald and Quinonoid theories, Solubility product, Factors influencing solubility and Applications of solubility product principle. **10 Hours** **4. THERMODYNAMICS** Thermodynamic terms, statement of First law, State and path functions, exact and inexact differentials, Cyclic rule, Integration factor, Thermodynamic reversibility, work done in various processes and maximum work, Variation of Internal energy with temperature and volume and Enthalpy as function of temperature and pressure, Molar heat capacity, Relation between C_P and C_V, Joule Thomson experiment and determination of μ_J and inversion temperature. **10 Hours** 5. **THERMOCHEMISTRY** Heat of reaction at constant pressure and constant volume, q_p & q_v relation, Heat of combustion, Enthalpy of formation, neutralization, and phase change, Hess's law and its applications, Kirchoff's equation, Bond energy, Resonance energy. **7 Hours**
Recommended Books	1. Glasstone, S. (Latest Edition). Textbook of Physical Chemistry. Macmillan Publishers. 2. Mukerjee, R. C. (Latest Edition). Modern Approach to Physical Chemistry – Part 1. Bharati Bhawan Publishers & Distributors. 3. Puri, B. R., Sharma, L. R., & Pathania, M. S. Principles of Physical Chemistry (49^{th} ed.). Vishal Publishing Co.

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<tr><td colspan="4">CHEMISTRY - MAJOR</td></tr>
<tr><td colspan="4">PAPER – 2</td></tr>
<tr><td>COURSE CODE:
CHET202</td><td colspan="2">INORGANIC CHEMISTRY</td><td>COURSE CREDIT: 3
HOURS: 3 x 15 Hours = 45 Hours
TOTAL MARKS: 75 | END SEMESTER: 50
C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="3">This course is designed to provide students with a foundational understanding of chemical bonding, electrochemical principles, the chemistry of s-block and noble gas elements, and essential techniques in volumetric analysis. It aims to develop conceptual clarity on various types of chemical bonds, molecular geometry, hybridization, and the principles governing redox reactions and electrode potentials. Students will explore the periodic trends and chemical behavior of alkali, alkaline earth metals, and Group 18 elements, emphasizing their compounds and applications. The course also introduces students to the theoretical and practical aspects of volumetric analysis, equipping them with analytical skills essential for quantitative chemical experimentation and further studies in chemistry.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">On completion of the course the student will be able to:
1. Gain an understanding of different types of chemical bonding (ionic, covalent, coordinate, metallic, and hydrogen bonding), their underlying principles, characteristic features, and applications in explaining the physical and chemical properties of compounds.
2. Able to understand and predict the shapes and geometries of covalent molecules and ions using orbital concepts, VSEPR theory, and hybridization, and apply these principles to explain structural features and bond orientation in various inorganic compounds.
3. Able to explain the concepts of electrode and standard electrode potentials, interpret the electrochemical series to predict redox behaviour and reactivity, and analyze redox potential diagrams to assess stability, oxidizing/reducing strength, and reaction feasibility.</td></tr>
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	4. • Gain an understanding of the nuclear spin isomers of hydrogen, their interconversion behaviour, and acquire knowledge of hydrogen isotopes along with their preparation, separation techniques, and characteristic properties. • Understand the electronic configuration, periodic trends, and reactivity of s-block elements, along with the preparation, properties, and significance of their major compounds such as hydrides, halides, oxides, hydroxides, carbonates, and bicarbonates. • Gain knowledge of the electronic configuration, inertness, and isolation of noble gases, and understand the preparation, properties, and structural aspects of important xenon and krypton compounds. 5. Understand the fundamental principles of volumetric analysis, perform accurate solution concentration calculations, and apply complexometric titrations (with EDTA) to determine metal ions effectively.
Syllabus	**1. CHEMICAL BONDING-I** **13 Hours** Ionic bond – factors affecting, characteristic features of ionic compounds, concept of lattice energy and hydration energy, solubility of ionic compounds, Born–Haber cycle, Covalent bond – factors affecting covalent bonds, types of covalent bonds (σ and π bonds), polar and non-polar covalent bonds, characteristics of covalent compounds, partial covalent character in ionic bonds; Fajan's rules - factors affecting polarizing power and polarizability, Coordinate bond – Lewis acid base concept of coordination, characteristics features. Metallic bond – Electron–sea model, characteristic properties of metals such as electrical and thermal conductivity, malleability, ductility, silvery white colour and lustre, Hydrogen bond – Definition, types (intermolecular and intramolecular), examples illustrating effects of hydrogen bonding in physical and chemical properties of substances. **2. CHEMICAL BONDING –II** **13 Hours** Shape and orientation of orbitals, Directional nature of covalent bond, Sidgwick Powel theory, Valence Shell Electron Pair Repulsion (VSEPR)

theory, Effect of lone pair/lone pairs on the geometry and shape of the covalent molecule or ion, Effect of Electronegativity difference between participating atoms and effect of size of atoms on the geometry of covalent molecules and ions, determination of shapes of covalent molecules and ions having bond pairs and lone pairs using VSEPR theory, Hybridization - Concept of hybridization and its applications in determination of geometry of covalent molecules and ions. ($BeCl_2$, BF_3, CCl_4, PCl_3, NH_3, H_2O, OF_2, I_3^+, PCl_5, SF_4, I_3^-, ICl_3, IF_7)

3. ELECTRODE POTENTIAL 7 Hours

Definition – oxidation potential and reduction potential, measurement of Electrode Potential (E) using standard reference electrodes (Standard Hydrogen Electrode), Standard States used for determination of Electrode Potential values of a given half-cell, Standard Electrode Potential (E^0) – Definition and use, Electrochemical series – Definition, arrangement of elements based on standard reduction potential values, applications; prediction of redox reaction feasibility, displacement reactions, determination of metal reactivity, corrosion tendency, and electroplating suitability. Redox potential diagrams - Concept and construction of Latimer diagrams, interpretation of oxidation states – prediction of disproportionation reaction, identification of strong oxidizing and reducing agents, assessment of ion stability in various oxidation states.

4. CHEMISTRY OF s-BLOCK AND GROUP 18 ELEMENTS 7 Hours

Comparative Study of Groups I-A and II-A of the Modern Periodic Table:

Electronic configuration, Position in periodic table, Physical properties like Density, melting point, boiling point, etc., Hydration of ions, oxidation sates, Electropositive character, Reducing properties, response to flame, Chemical properties (reaction with air, water, acids, bases and action in ammonia), Chemical compounds viz. Hydrides - ionic, covalent, and complex hydrides, some preparations, properties, and uses; Halides – comparative properties and structures; Oxides and hydroxides – nature

	(basicity, amphoteric character), solubility and stability; Carbonates and bicarbonates – thermal stability and solubility) ***Inert gases:*** Electronic configuration, Position in the periodic table – Inertness – Structure of Xenon compounds. **5. VOLUMETRIC ANALYSIS** **5 Hours** Volumetric Analysis: General Principles – Fundamental concepts of volumetric analysis- Basic requirements of a titrimetric analysis, types of volumetric analysis – Basic concepts of calculation (Normality, Molarity, Molality, Mole fraction, Percentage solution, concept of equivalent weights)– Principle of complexometric titrations (with reference to EDTA) – Chelating structure of EDTA –Role of pH and buffer in the titration.
Recommended Books	4. J. D. Lee: A New Concise Inorganic Chemistry, ELBS Ed. 5. F.A. Cotton and G. Wilkinson: Basic Inorganic Chemistry, John-Wiley Publications 6. B.R. Puri and L.R. Sharma and K.C. Kalia: Principles of Inorganic Chemistry Milestone publishers. 7. G.S. Manku: Theoretical Principles of Inorganic Chemistry, TATA-McGraw Hil 8. Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch: Fundamentals of Analytical Chemistry, 9th edition, Cengage Learning India Pvt. Ltd. 9. P.J. Durrant, B. Durrant: Introduction to Advanced Inorganic chemistry, ELBS 10. R. Sarkar: General Inorganic Chemistry (Part I and II) , New Central Book Agency, Kolkata. 11. R. D. Madan: Modern Inorganic Chemistry, S. Chand & Company Ltd., New Delhi. 12. O.P. Pandey, D.N. Bajpai and S. Giri: Practical Chemistry, S. Chand & Company Ltd., New Delhi.

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B.Sc. Semester – II		
CHEMISTRY - MAJOR		
PRACTICAL		
COURSE CODE:	**TITLE: CHEMISTRY PRACTICAL-II**	**COURSE CREDIT: 2** **HOURS: 60 (2 x 30 Hours = 60)** **TOTAL MARKS: 50**
Course Objectives	• To provide a clear understanding of the principles of volumetric analysis and its applications in acid-base, redox, and iodometric titrations. • To train students in accurate preparation and standardization of solutions for quantitative analysis. • To familiarize students with the concepts of surface tension and viscosity and their experimental determination. • To develop laboratory skills in handling classical instruments such as the stalagmometer and Ostwald's viscometer. • To strengthen analytical reasoning, precision, and interpretation of experimental data.	
Course Outcomes	After completing this course, students will be able to: • Explain the general principles of titrimetry and perform volumetric analysis with precision. • Carry out acid-base titrations (Oxallic acid vs NaOH & NaOH vs HCl,) using suitable indicators. • Perform redox titrations * Single Titration: Oxalic acid vs $KMnO_4$, * Double Tittration: $K_2Cr_2O_7$ vs FAS * Iodometric titrations: $CuSO_4$ vs $Na_2S_2O_3$ (recognizing the role of intermediates and indicators.) • Understand the theoretical basis of surface tension and viscosity and their relation to molecular interactions. * Experimentally determine surface tension using a stalagmometer and viscosity using an Ostwald's viscometer.	

	*Estimate the concentration of unknown solutions based on surface tension and viscosity measurements. • Demonstrate improved accuracy, scientific recording, and data analysis in experimental chemistry.
Syllabus	**1. Volumetric analysis** a. General principles of Titrimetry (Volumetric analysis) b. Standardization of NaoH by titration with Oxalic acid using phenolphthalein indicator. c. Estimation of NaOH by titration with standard HCl solution using phenolphthalein indicator. d. Estimation of oxalic acid by titration with standard $KMnO_4$ solution ($KMnO_4$: a self-indicator) e. Estimation of $K_2Cr_2O_7$ by titration with standard Ferrous Ammonium Sulphate solution as an intermediate, using N-phenyl anthranilic acid as an external indicator **f.** Estimation of $CuSO_4$ solution by iodometric titration with Sodium thiosulphate solution taken as an intermediate, using starch as an indicator **2. Experiments on Surface tension and Viscosity** a. Principles of surface tension and viscosity b. Determination of relative surface tension of a given solution using a stalagmometer c. Determination of concentration (%) of a given unknown solution based on surface tension d. Determination of relative viscosity of a given solution using an Ostwald's viscometer e. Determination of concentration (%) of a given unknown solution based on viscosity
Reference Books	1. A.I. Vogel: Vogel's Quantitative Chemical Analysis – Prentice Hall, 6th Edition. 2. A.M. James & F.E. Prichard: Practical Physical Chemistry, Longman 3. O.P. Pandey, D.N. Bajpai, S. Giri: *Practical Organic Chemistry* – S. Chand & Company Ltd., New Delhi. 4. V.K. Ahluwalia & Sunita Dhingra: Practical Chemistry, Universities Press, Hyderabad 5. Gurtu & Gurtu : Advanced Experimental Chemistry, S. Chand & Company Ltd., New Delhi

Syllabus for
4 Year B.Sc. Chemistry
Programme based on NEP – 2020

(2025 onwards)

Ewing Christian College, Prayagraj
(An Autonomous Constituent PG College of University of Allahabad)

SEMESTER-WISE COURSE DETAILS
CHEMISTRY – MAJOR

SEMESTER	PAPER	COURSE TITLE	CREDIT & HOURS			MARKS			
			CREDIT	HOURS	TOTAL CREDIT	THEORY		TOTAL	GRAND TOTAL
						END SEMESTER	C.I.A.		
I	I	INORGANIC CHEMISTRY	3	45 Hours	8	50	25	150	200
	II	ORGANIC CHEMISTRY	3	45 Hours		50	25		
	PRACTICAL	CHEMISTRY PRACTICAL - 1	2	60 Hours		40	10	50	
II	I	PHYSICAL CHEMISTRY	3	45 Hours	8	50	25	150	200
	II	INORGANIC CHEMISTRY	3	45 Hours		50	25		
	PRACTICAL	CHEMISTRY PRACTICAL - 2	2	60 Hours		40	10	50	

CHEMISTRY - MINOR

SEMESTER	PAPER	COURSE TITLE	CREDIT & HOURS			MARKS			
			CREDIT	HOURS	TOTAL CREDIT	THEORY		TOTAL	GRAND TOTAL
						END SEMESTER	C.I.A.		
I	I	CHEMISTRY - 1	3	45 Hours	4	50	25	75	100
	PRACTICAL	CHEMISTRY PRACTICAL - 1	1	30 Hours		20	5	25	
II	I	CHEMISTRY - 2	3	45 Hours	4	50	25	75	100
	PRACTICAL	CHEMISTRY PRACTICAL - 2	1	30 Hours		20	5	25	

EWING CHRISTIAN COLLEGE, PRAYAGRAJ
DEPARTMENT OF CHEMISTRY

<table>
<tr><th colspan="4">B.Sc. Semester - I</th></tr>
<tr><th colspan="4">CHEMISTRY - MINOR</th></tr>
<tr><th colspan="4">THEORY</th></tr>
<tr><td>COURSE CODE:
CHET10M</td><td>CHEMISTRY - 1</td><td colspan="2">COURSE CREDIT: 3
HOURS: 3 x 15 Hours = 45 Hours</td></tr>
<tr><td colspan="2" rowspan="2"></td><td>TOTAL MARKS: 75</td><td>END SEMESTER: 50
C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="3">The objective of this course is to provide students with a foundational understanding of key concepts in Inorganic, Organic, and Physical Chemistry. Through a structured exploration of atomic structure, chemical bonding, reactivity, and the behavior of gases and chemical equilibria, the course aims to develop the students' ability to analyze chemical phenomena using scientific principles. Emphasis is placed on understanding atomic models, electronic effects in organic molecules, the nature and stability of reactive intermediates, and the laws governing physical states and chemical equilibrium. This foundational knowledge prepares students for more advanced studies in chemistry and related scientific disciplines.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">Upon successful completion of this course, students will be able to:
1. Explain the fundamental models of atomic structure, including Rutherford’s and Bohr’s models, and apply quantum mechanical principles such as quantum numbers, Hund’s rule, Aufbau principle, Heisenberg’s uncertainty principle and Pauli’s exclusion principle.
2. Analyze molecular structure and bonding using concepts of hybridization, bond parameters, and electronic effects such as inductive effect, resonance, hyperconjugation, and hydrogen bonding.
3. Identify and describe various types of reactive intermediates (carbocations, carbanions, free radicals, and carbenes), and classify organic reactions into substitution, addition, elimination, and rearrangement types.
4. Apply the kinetic molecular theory to explain the behavior of gases and evaluate deviations from ideal gas behavior using van der Waals equation.</td></tr>
</table>

	5. Apply the law of mass action and equilibrium concepts to homogeneous and heterogeneous chemical systems, and predict the effects of various factors on the state of equilibrium using Le Chatelier's principle.
Syllabus	**1. INORGANIC CHEMISTRY 15 Hours** **Atomic Structure:** Rutherford's**,** Bohr's Atomic Model, Quantum number, Hund's rule, Aufbau principle, Heisenberg Uncertainty principle, Pauli's exclusion principle. **2. ORGANIC CHEMISTRY 15 Hours** **A. Structure and Bonding: (10 Hours)** Hybridization, bond length, bond angles and bond energy. Electronic displacement and their applications; Inductive effect, electrometric effect, resonance, mesomeric effect and hyperconjugation; Dipole moment, H-bonding, acidity and basicity **B. Reactive Intermediates: (5 Hours)** Homolytic and heterolytic fissions. Generation, Structure and relative Stability of carbocations, carbanions, carbenes and free radicals. Electrophiles & Nucleophiles, introduction to types of organic reactions: Substitution, addition, elimination and rearrangement reactions. **3. PHYSICAL CHEMISTRY 15 Hours** **A. Gaseous State** Kinetic molecular theory of gases, postulates and basic concepts, Boyle's law, Charle's law, Graham's law, Avogadro's law, Ideal gas equation. Deviations from ideal gas behavior, van der Waals equation of state (a) volume correction and (b) pressure correction; verification of van der Waals equation at different pressure and temperatures. **B. Equilibrium** Law of mass action, Significance of equilibrium constant, Relation between K_p, K_c, and K_x. Applications in homogeneous equilibrium when $\Delta n = 0$, Δn = +ve and Δn = –ve (with examples) Determination of degree of dissociation by vapor density method and expression. Applications in heterogeneous

	equilibria and reactions in liquid state. Effect of pressure, temperature, concentration, catalyst, and inert substances on the state equilibrium. Le Chatelier′s principle for chemical reactions.
Recommended Books	1. J. D. Lee: A New Concise Inorganic Chemistry, ELBS Ed. 2. F.A. Cotton and G. Wilkinson: Basic Inorganic Chemistry, John-Wiley Publications 3. B.R. Puri and L.R. Sharma and K.C. Kalia: Principles of Inorganic Chemistry Milestone publishers. 4. Dr Jagdamba Singh, Organic Chemistry Vol 1, Pragati Prakashan, Edition: 2020. 5. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Pearson, 2010. 6. M. K. Jain and S. C. Sharma, Modern organic chemistry, Vishal Publication Co, 2024th edition. 7. Bruice, P. Y. (2020), Organic Chemistry, 8th Edition, Pearson. 8. Glasstone, S. (Latest Edition). Textbook of Physical Chemistry. Macmillan Publishers. 9. Mukerjee, R. C. (Latest Edition). Modern Approach to Physical Chemistry – Part 1. Bharati Bhawan Publishers & Distributors. 10. Puri, B. R., Sharma, L. R., & Pathania, M. S. Principles of Physical Chemistry (49th ed.). Vishal Publishing Co.

EWING CHRISTIAN COLLEGE, PRAYAGRAJ
DEPARTMENT OF CHEMISTRY

B.Sc. Semester – I		
CHEMISTRY – MINOR		
PRACTICAL		
COURSE CODE:	**TITLE: CHEMISTRY PRACTICAL-I**	**COURSE CREDIT: 1** **HOURS: 30 (1 x 30 Hours = 30)** **TOTAL MARKS: 25**

Course Objectives

- To enable students to acquire hands-on skills in detecting elements present in organic compounds.
- To develop an understanding of classical qualitative analysis techniques for halogens, nitrogen, and sulphur in organic substances.
- To provide practical exposure to physicochemical property measurements such as surface tension and viscosity.
- To strengthen students' conceptual knowledge of the principles behind colligative and molecular interactions through experimental methods.
- To train students in accurate experimental techniques, data interpretation, and error analysis.

Course Outcomes

By the end of this course, students will be able to:

- Prepare sodium extract and detect common elements (N, S, halogens) in organic compounds using qualitative tests.
- Analyze and confirm the presence of individual and combined elements (N, S, N+S, Cl, Br, I) in unknown samples.
- Understand the principles of surface tension and determine it experimentally using a stalagmometer.
- Gain knowledge of viscosity principles and determine relative viscosity using Ostwald's viscometer.
- Correlate theoretical concepts of intermolecular forces with practical measurements.
- Demonstrate improved laboratory skills, scientific recording, and interpretation of experimental results.

Syllabus

1. Preparation of Sodium extract for detection of elements in the given solid organic compound.
2. Detection of following elements: N, S, N+S, Cl, Br, I
3. Experiment on surface tension
    - Principles of surface tension

	• Determination of relative surface tension of the given solution using Stalagmometer. 4. Experiment on viscosity • Principles of viscosity • Determination of the relative viscosity of the given solution using ostwalds's viscometer.
Reference Books	1. A.I. Vogel: Vogel's Textbook of Practical Organic Chemistry – Prentice Hall, 5th Edition. 2. A.M. James & F.E. Prichard : Practical Physical Chemistry, Longman 3. O.P. Pandey, D.N. Bajpai, S. Giri: *Practical Organic Chemistry* – S. Chand & Company Ltd., New Delhi. 4. V.K. Ahluwalia & Sunita Dhingra : Practical Chemistry, Universities Press, Hyderabad 5. Gurtu & Gurtu : Advanced Experimental Chemistry, S. Chand & Company Ltd., New Delhi

EWING CHRISTIAN COLLEGE, PRAYAGRAJ
DEPARTMENT OF CHEMISTRY

<table>
<tr><th colspan="4">B.Sc. Semester - II</th></tr>
<tr><th colspan="4">CHEMISTRY - MINOR</th></tr>
<tr><th colspan="4">THEORY</th></tr>
<tr><td>COURSE CODE:
CHET20M</td><td>CHEMISTRY - 2</td><td colspan="2">COURSE CREDIT: 3
HOURS: 3 x 15 Hours = 45 Hours</td></tr>
<tr><td></td><td></td><td>TOTAL MARKS: 75</td><td>END SEMESTER: 50
C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="3">This course aims to develop a foundational understanding of core concepts in Inorganic, Organic, and Physical Chemistry. Students will explore periodic properties of elements, fundamental principles of stereochemistry, and the nature of aromatic compounds and their reactions. The course also introduces key physical chemistry concepts such as ionic equilibrium and chemical kinetics. Through theoretical insights and problem-solving approaches, students will gain the analytical skills necessary to understand chemical behavior, structure, and reactivity, preparing them for advanced studies in chemistry and related disciplines.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">Upon successful completion of this course, students will be able to:
1. Describe the structure and organization of the modern periodic table and explain periodic trends in atomic and ionic radii, ionization energy, electron affinity, and electronegativity.
2. Identify and distinguish different types of stereoisomers, including enantiomers and diastereomers, and determine absolute and relative configurations using D/L and R/S systems.
3. Apply Huckel’s rule to classify compounds as aromatic, anti-aromatic, or non-aromatic and explain the aromaticity of benzenoid and non-benzenoid compounds.
4. Describe the preparation methods of benzene and explain mechanisms of electrophilic aromatic substitution reactions, including halogenation, nitration, and Friedel-Crafts reactions, along with directive effects.</td></tr>
</table>

	5. Apply acid-base theories and calculate pH of buffer solutions using the Henderson-Hasselbalch equation; explain the concept and applications of solubility product. 6. Define and distinguish between molecularity and order of reaction, interpret rate laws, determine reaction order, and apply the Arrhenius equation to calculate activation energy.
Syllabus	**1. INORGANIC CHEMISTRY 15 Hours** **Periodic Table, Periodicity & Periodic Properties:** Modern periodic table, characteristics of s-, p-, d- and f- group elements. Introduction, properties and factors affecting – Atomic radii, Trends of Ionization energy (IE), Electron affinity (EA), Electronegativity (EN) with respect to size. **2. ORGANIC CHEMISTRY 15 Hours** **A. Stereochemistry of Organic Compounds: (9 hours)** Stereoisomerism: Optical activity and optical isomerism, elements of symmetry, molecular chirality, enantiomers and diastereomers. Representation of organic molecules using Flying Wedge, Fischer, Sawhorse and Newman formula, Relative and absolute configuration: D/L and R/S system, sequence rules (CIP rules) Erythro and Threo nomenclature. Geometric isomerism, elementary idea of cis and trans isomerism, E/Z system of nomenclature. **B. Aromatic hydrocarbons: (6 hours)** Applications of Huckel's rule to aromatic, anti-aromatic and non-aromatic compounds. Aromaticity of benzenoid (benzene, naphthalene and anthracene) non-benzenoid (furan, thiophene, pyrrole, pyridine) and other cyclic systems – cyclopropene and cyclopropenyl ions, cyclopentadiene and cyclopentadienyl ions, cycloheptatriene and tropylium ion Preparation of benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Electrophilic aromatic substitution: halogenation, nitration and Friedel-Craft's alkylation/acylation with their mechanism. Directive effects of the groups.

	3. PHYSICAL CHEMISTRY **15 Hours** **A. Ionic Equilibrium** Mole fraction, Molarity, Molality, Normality, Formality, Acid-Base theories: Arrhenius theory of electrolytic dissociation, Lowry Bronsted theory of conjugate acid base pairs, and Lewis concept. Buffer solution and its pH determination by using Handerson-Hasselbalch equation, Acid, Base indicators, Ostwald and Quinonoid theories, Solubility product, Factors influencing solubility and Applications of solubility product principle. **B. Chemical Kinetics** Molecularity and Order of reaction, Rate law, Rate constants; Zero, first, second and third order reactions and their characteristics. Determination of order of reaction. Arrhenius equation and energy activation.
Recommended Books	1. J. D. Lee: A New Concise Inorganic Chemistry, ELBS Ed. 2. F.A. Cotton and G. Wilkinson: Basic Inorganic Chemistry, John-Wiley Publications 3. B.R. Puri and L.R. Sharma and K.C. Kalia: Principles of Inorganic Chemistry Milestone publishers. 4. Dr Jagdamba Singh, Organic Chemistry Vol 1, Pragati Prakashan, Edition: 2020. 5. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Pearson, 2010. 6. M. K. Jain and S. C. Sharma, Modern organic chemistry, Vishal Publication Co, 2024th edition. 7. Bruice, P. Y. (2020), Organic Chemistry, 8th Edition, Pearson. 8. Glasstone, S. (Latest Edition). Textbook of Physical Chemistry. Macmillan Publishers. 9. Mukerjee, R. C. (Latest Edition). Modern Approach to Physical Chemistry – Part 1. Bharati Bhawan Publishers & Distributors. 10. Puri, B. R., Sharma, L. R., & Pathania, M. S. Principles of Physical Chemistry (49th ed.). Vishal Publishing Co.

EWING CHRISTIAN COLLEGE, PRAYAGRAJ
DEPARTMENT OF CHEMISTRY

B.Sc. Semester – II		
CHEMISTRY - MINOR		
PRACTICAL		
COURSE CODE:	**TITLE: CHEMISTRY PRACTICAL-II**	**COURSE CREDIT: 1** **HOURS: 30 (1 x 30 Hours = 30)** **TOTAL MARKS: 25**
Course Objectives	• To provide students with hands-on training in preparing standard solutions of various concentrations and performing accurate dilutions. • To familiarize students with the process of standardizing commonly used laboratory solutions. • To impart knowledge of the general principles of titrimetry and its applications in analytical chemistry. • To train students in performing acid-base and redox titrations with precision and accuracy. • To develop analytical and problem-solving skills through quantitative experiments.	
Course Outcomes	By the end of the course, students will be able to: • Prepare standard solutions of different concentrations (Molarity, Molality, Normality, Mole fraction) and carry out dilutions correctly. • Standardize solutions such as HCl and NaOH using primary standards. • Explain the general principles of titrimetric (volumetric) analysis. • Perform acid-base titrations (Oxalic acid vs NaOH & HCl vs NaOH,) with accuracy. • Carry out redox titrations using self-indicators (Oxalic acid vs $KMnO_4$). • Apply theoretical concepts of acid-base and redox chemistry to practical quantitative analysis.	
Syllabus	1. Preparation of standard solutions of different concentrations (Molarity, Molality, Normality, Mole fraction) and their dilutions. 2. Standardization of following solutions: HCl and NaOH, 3. General principles of Titrimetry (Volumetric analysis)	

	4. Acid Base titrations: Oxalic acid vs NaOH & HCl vs NaOH 5. Redox titration using self-indicator: Oxalic acid vs $KMnO_4$
Reference Books	1. A.I. Vogel: Vogel's Quantitative Chemical Analysis – Prentice Hall, 6th Edition. **2.** O.P. Pandey, D.N. Bajpai, S. Giri: *Practical Organic Chemistry* – S. Chand & Company Ltd., New Delhi. 3. V.K. Ahluwalia & Sunita Dhingra : Practical Chemistry, Universities Press, Hyderabad 4. Gurtu & Gurtu : Advanced Experimental Chemistry, S. Chand & Company Ltd., New Delhi

EWING CHRISTIAN COLLEGE, PRAYAGRAJ
DEPARTMENT OF CHEMISTRY

<table>
<tr><td colspan="4">B.Sc. Semester - III</td></tr>
<tr><td colspan="4">CHEMISTRY - MAJOR</td></tr>
<tr><td colspan="4">PAPER – 1</td></tr>
<tr><td>COURSE CODE:
CHET301</td><td>ORGANIC CHEMISTRY</td><td colspan="2">COURSE CREDIT: 3
HOURS: 45 (3 x 15 = 45 Hours)</td></tr>
<tr><td colspan="2"></td><td>TOTAL MARKS: 75</td><td>END SEMESTER: 50
C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="3">The aim of the course is to:
1. Understand the structure, classification, and preparation of alcohols, phenols, ethers, epoxides, aldehydes, and ketones.
2. Explore and interpret the mechanisms of key organic reactions, including nucleophilic substitutions and electrophilic aromatic substitutions.
3. Examine the chemical behaviour and reactivity of alcohols, halogen compounds, carbonyl compounds, and phenols.
4. Analyse stereo chemical outcomes and reaction pathways in organic synthesis, including rearrangements and condensation reactions.
5. Develop problem-solving skills through mechanism-based learning and reaction interconversion.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">Upon successful completion of this course, students will be able to:
1. Provide a comprehensive understanding of the structure, preparation, and properties of alcohols, phenols, ethers, halides, aldehydes, and ketones.
2. Develop knowledge of the mechanisms of organic reactions including substitution, addition, elimination, and rearrangement processes.
3. Explain the acidic and basic behaviour of organic compounds and the influence of structure on their reactivity.
4. Enable students to predict products and mechanisms of organic reactions based on electronic effects and stereo chemical factors.
5. Familiarize students with synthetic applications of important organic reactions in the preparation of functional derivatives.</td></tr>
</table>

	6. Build problem-solving and analytical skills necessary to correlate structure, mechanism, and reactivity in organic transformations
Syllabus	**1. ALCOHOLS (10hours)** **Monohydric alcohols**: General methods of preparation, distinction of primary secondary and tertiary alcohols, chemical reactions with special reference to acidic character, reaction with Grignard reagent and phosphorous halides, oxidation and dehydration. **Di-hydric alcohols:** Methods of formation, chemical reactions with special reference to HIO_4 cleavage and Pinacol –Pinacolone rearrangements. **Tri-hydric alcohols:** Constitution of glycerol, its methods of formation and chemical reactions **2. PHENOLS (7hours)** General methods of preparation, chemical reactions with special reference to acidic character, etherification, esterification, Riemer-Tiemann reaction, Kolbe-Schmidt reaction, Fries rearrangement, Claisen rearrangement and electrophilic substitution reactions. **3. ETHERS AND EPOXIDES (5hours)** Ether -Williamsons synthesis, reaction with HX Synthesis of epoxides, Acid and base catalysed ring opening of epoxide **4. MONO-HALOGEN COMPOUNDS (8hours)** Alkyl halides-method of formation, chemical reactions, mechanism of nucleophilic substitution reactions (SN2, SN1 & SNi mechanisms) and their effect on optically active alkyl halides with energy profile diagram. Comparative relativities of alkyl, allyl, vinyl and aryl halides towards nucleophilic substitution reactions. Aryl halides-The addition-elimination and the elimination-addition reaction of nucleophilic aromatic substitution reactions. **5. ALDEHYDES AND KETONES (15hours)** General methods of preparation with special reference to synthesis from acid chlorides, 1, 3-dithianes, cyanides and carboxylic acids and Oppenauer oxidation. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation. Condensation with ammonia and its derivatives. Wittig reaction, Cannizzaro reaction, Michael addition reaction, MPV reduction and Bayer-Villiger reaction
Recommended Books	1. Solomons, T. W. G., Fryhle, C.B., Snyder, S.A (2017), Organic Chemistry, 12th Edition, Wiley. 2. Bruice, P. Y. (2020), Organic Chemistry, 8th Edition, Pearson. 3. Clayden, J., Greeves, N., Warren, S. (2014), Organic Chemistry, Oxford 4. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Pearson, 2010.

	5. Finar, I. L. Organic Chemistry (Vol. I & II), E.L.B.S. 6. Dr Jagdamba Singh, Organic Chemistry, Vol 2, Pragati Prakashan, Edition: 2020. 7. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley Student Ed, 11th Edition (2013). 8. M. K. Jain and S. C. Sharma, Modern organic chemistry, Vishal Publication Co, 2024th edition 9. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications. 10. Bahl, A. & Bahl, B. S. Advanced Organic Chemistry, S. Chand, 2010. 11. McMurry, *J.E Fundamentals of Organic chemistry*, 7th Ed., Cengage Learning India Edition (2013)

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<table>
<tr><th colspan="4">B.Sc. Semester - III</th></tr>
<tr><th colspan="4">CHEMISTRY - MAJOR</th></tr>
<tr><th colspan="4">PAPER – 2</th></tr>
<tr><td>COURSE CODE:
CHET302</td><td>PHYSICAL CHEMISTRY</td><td colspan="2">COURSE CREDIT: 3
HOURS: 45 (3 x 15 = 45 Hours)</td></tr>
<tr><td colspan="2"></td><td>TOTAL MARKS: 75</td><td>END SEMESTER: 50
C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="3">The aim of the course is:
1. To introduce the fundamental concepts of reaction kinetics and the factors influencing reaction rates.
2. To explore various orders of chemical reactions and methods for determining reaction order.
3. To explain the theoretical basis of reaction mechanisms using models like collision theory and transition state theory.
4. To provide a conceptual understanding of the phase rule and its application to single and two-component systems.
5. To develop a foundational understanding of classical thermodynamics and its laws.
6. To describe the concepts of entropy, enthalpy, internal energy, and free energy in thermodynamic systems.
7. To examine the principles of electrochemistry, including electrolysis and conductivity.
8. To analyse electrolyte behaviour using theories such as Arrhenius and Debye-Hückel.
9. To understand the construction and functioning of electrochemical cells and their applications.
10. To equip students with the ability to calculate and interpret electrochemical parameters like EMF, pH, and solubility products.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">By the end of this course, students will be able to:
1. Identify and classify chemical reactions based on molecularity and order.
2. Apply integrated rate laws to calculate rate constants and reaction concentrations for zero, first, and second-order reactions.</td></tr>
</table>

	3. Interpret and analyse energy profiles using Arrhenius, collision, and transition state theories. 4. Use the phase rule to predict the degrees of freedom in single and binary component systems. 5. Calculate entropy and enthalpy changes in physical and chemical processes using thermodynamic relationships. 6. Analyse the efficiency of heat engines using Carnot cycle and second law of thermodynamics. 7. Measure and interpret conductivity and transport number in electrolytic solutions using experimental methods. 8. Apply Kohlrausch's Law and Debye-Hückel theory to explain electrolyte behavior at infinite dilution. 9. Calculate the EMF of galvanic cells and use the Nernst equation to determine cell potentials under non-standard conditions. 10. Determine pH, solubility products, and equilibrium constants from EMF and conductivity measurements.
Syllabus	**1. CHEMICAL KINETICS (10 Hours)** Molecularity and Order of reaction, Rate law, Rate constants; Zero, first, second and third order reactions and their characteristics. Determination of order of reaction. Arrhenius equation and energy activation, Collision theory for bimolecular reactions, Lindemann theory for unimolecular reactions, Qualitative treatment of transition state theory. **2. PHASE RULE (6 Hours)** Phase, Component and Degree of freedom, Monocomponent system (water and sulphur), Bicomponent system (Ag +Pb). **3. THERMODYNAMICS (10 Hours)** Carnot cycle, Statement of second law, Concept of Entropy, Combined form of first and second law of thermodynamics, Entropy change in isolated system, Relationship between Internal energy and Entropy, Enthalpy and Entropy, Clausius inequality theorem, Variation of entropy with temperature and volume, Entropy change in chemical reaction. Helmholtz and Gibbs free energies, Properties of Gibbs Helmholtz equation, thermodynamic criteria of equilibrium, Clapeyron- Clausius equation and its application. **4. ELECTRO CHEMISTRY – I (9 Hours)** Electrolysis, Faraday's laws of electrolysis, Conductivity, Equivalent and Molar conductivity and their properties, Kohlrasch law and its applications, Arrhenius theory of Electrolytic dissociation, Debye Huckel interionic attraction theory, Transport number, Determination of transport number: Hittorf's method and Moving boundary method. Application f conductance.

	5. ELECTRO CHEMISTRY – II (10 Hours) Reversible and irreversible cells, E.M.F. of Galvanic cells and free energy change, Nernst equation, Equilibrium constant, Standard electrode potential, Types of reversible electrode, Application of E.M.F. measurements, Determination of solubility product, pH, Dissociation constants, Solubility of sparingly soluble salts.
Recommended Books	1. Glasstone, S. (Latest Edition). Textbook of Physical Chemistry. Macmillan Publishers. 2. Mukerjee, R. C. (Latest Edition). Modern Approach to Physical Chemistry – Part 1. Bharati Bhawan Publishers & Distributors. 3. Puri, B. R., Sharma, L. R., & Pathania, M. S. Principles of Physical Chemistry (49^{th} ed.). Vishal Publishing Co. 4. Bajpai, D. N. Advanced Physical Chemistry, S Chand Publishing. 5. Kundu, N. & Jain, S. K. Physical Chemistry, S Chand Publishing. 6. Bahl, A. Essentials of Physical Chemistry, S Chand Publishing.

EWING CHRISTIAN COLLEGE, PRAYAGRAJ
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B.Sc. Semester – III		
CHEMISTRY - MAJOR		
PRACTICAL		
COURSE CODE:	**TITLE: CHEMISTRY PRACTICAL-III**	**COURSE CREDIT: 2** **HOURS: 60 (2 x 30 Hours = 60)** **TOTAL MARKS: 50**
Course Objectives	• To provide a comprehensive understanding of semi-micro qualitative inorganic analysis of mixed radicals. • To train students in the systematic identification of combinations of acid radicals and acid-insoluble substances. • To impart practical skills in the group-wise analysis of basic radicals including transition and alkaline earth metals. • To introduce students to the confirmatory tests and chemical reactions involved in the detection of functional groups in organic compounds. • To develop problem-solving and critical-thinking skills through systematic laboratory experimentation.	
Course Outcomes	After completing this course, students will be able to: • Perform the systematic analysis of combinations of acid radicals such as nitrate-nitrite, nitrate-halides, sulphide-sulphite-sulphate, chloride-bromide-iodide, and carbonate-sulphite mixtures. • Identify basic radicals such as Zn, Mn, Ni, Ca, Sr, Ba, Mg, and NH_4^+ by applying group analysis principles. • Analyze acid-insoluble substances including $PbSO_4$, CaF_2, Al_2O_3, $BaSO_4$, $CaSO_4$, and $SrSO_4$. • Detect and confirm functional groups in organic compounds such as –OH (aliphatic & aromatic), $–NH_2$ (aromatic primary amine), –CHO, >C=O (ketone), –COOH, $–CONH_2$, and $–NO_2$ (aromatic). • Apply theoretical knowledge to design logical experimental schemes for qualitative analysis. • Gain confidence in systematic inorganic and organic qualitative analysis.	
Syllabus	**1. Semi-micro Qualitative Inorganic mixture analysis** a. Combination of acid radicals-Nitrate-Nitrite, Nitrate-Bromide, Nitrate-Iodide, Sulphide-Sulphite-Sulphate, Chloride-Bromide-Iodide, Carbonate-Sulphite	

	b. Group wise analysis of basic radicals Group IV, V, VI and Zero - (Zinc, Manganese, Nickel, Cobalt, Barium, Strontium, Calcium, Magnesium, Ammonium) c. Analysis of insoluble compounds - Lead sulphate, Calcium Fluoride, Aluminium oxide, Barium sulphate, Calcium Sulphate, Strontium Sulphate. **2. Functional group analysis in Organic compounds** Various confirmatory tests and chemical reactions involved in the detection of the following functional groups in the solid organic compounds: -OH (aromatic and aliphatic), $-NH_2$ (Aromatic primary amine), -CHO (aldehyde), >C=O (Ketone), -COOH (carboxylic acid), $-CONH_2$ (amide), $-NO_2$ (Aromatic nitro group)
Reference Books	1. A.I. Vogel: Vogel's Qualitative Inorganic Analysis – Prentice Hall, 7th Edition. 2. G. Svehla : Vogel's Qualitative Inorganic Analysis, Pearson 3. A.I. Vogel: Vogel's Textbook of Practical Organic Chemistry – Prentice Hall, 5th Edition. 4. Mann & Saunders: Practical Organic Chemistry, Longmans, Green and Co., London 5. O.P. Pandey, D.N. Bajpai, S. Giri: *Practical Organic Chemistry* – S. Chand & Company Ltd., New Delhi. 6. V.K. Ahluwalia & Sunita Dhingra : Practical Chemistry, Universities Press, Hyderabad 7. Gurtu & Gurtu : Advanced Experimental Chemistry, S. Chand & Company Ltd., New Delhi

EWING CHRISTIAN COLLEGE, PRAYAGRAJ
DEPARTMENT OF CHEMISTRY

<table>
<tr><td colspan="4">B.Sc. Semester - IV</td></tr>
<tr><td colspan="4">CHEMISTRY - MAJOR</td></tr>
<tr><td colspan="4">PAPER – 1</td></tr>
<tr><td>COURSE CODE:
CHET401</td><td>INORGANIC CHEMISTRY</td><td colspan="2">COURSE CREDIT: 3
HOURS: 45 (3 x 15 = 45 Hours)</td></tr>
<tr><td></td><td></td><td>TOTAL MARKS: 75</td><td>END SEMESTER: 50
C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="3">By the end of this course, students should be able to:

1. Develop a systematic understanding of the general characteristics, trends, and anomalies of the p-block and d-block elements.

2. Analyse how electronic configuration, periodic position, and orbital interactions influence chemical behaviour (oxidation states, bonding, reactivity).

3. Understand and explain the principles underlying coordination compounds: formation, structure, nomenclature, and isomerism.

4. Apply bonding theories (σ bonding, pπ–pπ, pπ–dπ, EAN rule) and key concepts (inert pair effect, middle row anomaly) to rationalize the properties and reactivity of inorganic species.

5. Compare and contrast the properties (e.g. atomic/ionic radii, variable oxidation states, stability trends) among the 3d, 4d, and 5d transition series, including the effect of lanthanide contraction.

6. Provide a conceptual and procedural understanding of gravimetric analysis: precipitation, nucleation, filtering, washing, drying, and weighing, as well as sources of error and strategies for improving accuracy.

7. Strengthen problem-solving skills in inorganic chemistry, especially via worked examples and numerical problems related to oxidation states, complexes, and quantitative analysis.

8. Cultivate critical thinking about limitations, anomalies, and exceptions in periodic trends, bonding models, and analytical methods.</td></tr>
</table>

Course Outcomes	**After completing this course, students will be able to:** 1. Explain the general characteristics of p-block elements (electronic configurations, oxidation states, metallic vs nonmetallic behavior, inert pair effect, bonding types). 2. Analyze and compare the properties of 3d, 4d, and 5d transition series (e.g. ionic radii, ionization energies, densities, stability of oxidation states), and explain the influence of lanthanide contraction. 3. Discuss the variable oxidation states, color, magnetism, catalytic tendencies, and complex formation behavior of transition (d-block) elements. 4. Apply bonding theories (σ bonding, pπ–pπ, pπ–dπ, EAN rule) to predict and rationalize molecular structure, stability, and reactivity of coordination compounds. 5. Use IUPAC nomenclature rules and differentiate among isomer types (structural, stereoisomerism) for coordination compounds. 6. Design or interpret gravimetric procedures for quantitative determination of metallic analytes, understanding sources of error (co-precipitation, post-precipitation, particle size, washing etc.). 7. Solve numerical problems involving yields, purity, concentration, and stoichiometry in gravimetric analysis. 8. Critically assess anomalies, exceptions, and limitations in periodic trends and bonding models, and reconcile them in light of experimental data. 9. Integrate concepts across p-block, d-block, coordination chemistry, and gravimetry to tackle synthetic or analytical problems.
Syllabus	**1. GENERAL CHARACTERISTICS OF p-BLOCK ELEMENTS** **5 Hours** **Characteristic Properties:** Electronic Configuration, position in periodic table, metallic and non-metallic properties, middle row anomaly, inert pair effect, oxidation states, oxidizing states, oxidizing behaviour, bonding (sigma bonding, pπ – pπ bonding and pπ – dπ bonding) **2. GENERAL CHARACTERISTICS OF d-BLOCK ELEMENTS** **10 Hours**

	a. Electronic configuration: Placement of transition elements in the d-block; general electronic configuration and distinguishing features from s- and p-block elements. Overview of the 3d, 4d, and 5d transition series, their periodic trends, and characteristic similarities arising from partially filled d-orbitals. **b. Comparative accounts of 3d, 4d, and 5d transition series:** Variation in atomic and ionic radii, ionization energies, and density; stability of oxidation states and occurrence of higher oxidation numbers in heavier congeners; lanthanide contraction and its influence on the properties of 4d and 5d elements. **c. General Characteristics of transition metals** Variable oxidation states, complex formation, colour, magnetic and catalytic properties of transition metals. Explanation of variable valency in terms of (n–1)d and ns orbitals. **3. CHEMISTRY OF COORDINATION COMPOUNDS 12 Hours** Distinction between complexes and double salts; types and formation of coordination compounds. Werner's coordination theory – postulates, primary and secondary valencies, and experimental verification. Concept of Effective Atomic Number (EAN) rule. IUPAC nomenclature of coordination compounds and introduction to isomerism in coordination compounds – structural and stereoisomerism illustrated with representative examples. **4. COMPARATIVE GROUP STUDY OF p-BLOCK ELEMENTS 15 Hours** **Group 13 (Boron Group):** Hydrides, oxides, and halides of B, Al, Ga, In, Tl – preparation, structure, bonding, and stability; electron-deficient boranes; acidic to amphoteric oxides; Lewis acidity and dimerization of trihalides. **Group 14 (Carbon Group):** Hydrides, oxides, and halides of C, Si, Ge, Sn, Pb – catenation, oxidation states (+2, +4), anomalous behaviour of carbon, acid–base nature of oxides, stability and hydrolysis of tetrahalides, inert pair effect. **Group 15 (Nitrogen Group):** Hydrides, oxides, and halides of N, P, As, Sb, Bi – variation in basicity, bonding, and stability; reducing nature of hydrides; acidic/amphoteric oxides; hydrolysis and bonding in halides; inert pair effect.

	Group 16 (Oxygen Group): Hydrides, oxides, and halides of O, S, Se, Te – acidity, reducing property, and volatility of hydrides; types and acid–base nature of oxides; structure and hydrolysis of halides; anomalous behavior of oxygen. **Group 17 (Halogen Group):** Hydrides, oxides, and halides of F, Cl, Br, I – bond energy, acidity, oxidizing power; interhalogen and pseudohalogen compounds; structure and stability of oxides and oxyacids; electronegativity trends. **5. GRAVIMETRIC ANALYSIS** **3 Hours** Principles of precipitation – super saturation, nucleation, crystal growth; Co-precipitation and post-precipitation; Factors affecting precipitates – particle size, temperature, concentration; General procedure – precipitation, filtration, washing, drying, ash treatment, weighing; Applications – quantitative determination of metals, simple numerical problems on yield, concentration, and purity.
Recommended Books	1. J.D. Lee: Concise Inorganic Chemistry, 5th Edition, Blackwell Science Ltd, 1996. 2. B.R. Puri, L.R. Sharma & K.C. Kalia: Principles of Inorganic Chemistry, Milestone Publishers, 2017. 3. F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, 3rd Edition, John Wiley & Sons, 1995. 4. A.I. Vogel: Textbook of Quantitative Inorganic Analysis, 5th Edition, Pearson Education, 1989.

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<table>
<tr><td colspan="4">B.Sc. Semester - IV</td></tr>
<tr><td colspan="4">CHEMISTRY - MAJOR</td></tr>
<tr><td colspan="4">PAPER – 2</td></tr>
<tr><td>COURSE CODE:
CHET402</td><td>ORGANIC CHEMISTRY</td><td colspan="2">COURSE CREDIT: 3
HOURS: 45 (3 x 15 = 45 Hours)</td></tr>
<tr><td colspan="2"></td><td>TOTAL MARKS: 75</td><td>END SEMESTER: 50
C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="3">Course Objective Summary
The course aims to provide a clear understanding of the structure, formation, and reactivity of cycloalkanes, conformational isomers, nitrogen compounds, carboxylic acids, and their derivatives. It focuses on reaction mechanisms, functional group transformations, and structure–reactivity relationships, enabling students to predict outcomes of organic reactions and apply fundamental principles in synthesis and analysis.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">After successful completion of this course, students will be able to:
1. Explain the formation, structure, and ring strain in cycloalkanes using Baeyer’s strain theory and identify stability factors in cyclic systems.
2. Analyse conformational isomerism of ethane, butane, and cyclohexane, interpreting stability through Newman and Fischer projections.
3. Describe the preparation and chemical behaviour of aliphatic and aromatic nitro compounds and amines, including rearrangements and separation methods.
4. Evaluate the basic character and electrophilic substitution reactions of aromatic amines and explain diazotization and coupling reactions.
5. Illustrate the synthesis, acidity, and reaction mechanisms of carboxylic acids, highlighting substituent effects and the Ortho effect.
6. Explain the formation, properties, and reactivity of carboxylic acid derivatives, and compare their tendencies toward nucleophilic substitution.</td></tr>
<tr><td>Syllabus</td><td colspan="3">1. CYCLOALKANES (7hours)
Methods of formation, chemical reactions, Baeyer’s strain theory and its limitations. Theory of strainless rings. The case of cyclopropane ring: banana bonds.
2. CONFOMATIONAL ISOMERISM (8 hours)
Conformational analysis of ethane, butane, ethylene glycol and cyclohexane, Axial and equatorial bonds Newman projection formula and Fischer formula, conformation stability of mono and di substituted cyclohexane derivatives.

3. NITROGEN COMPOUNDS (15hours)
Preparation and properties of nitroalkanes, nitroarenes with special reference to reduction in mediums of different pH, Preparation and properties of</td></tr>
</table>

	aliphatic and aromatic amines with special reference to Gabriel's Phthalimide, Hoffmann rearrangement, Curtius rearrangement, Lossen rearrangement and Reductive amination. Hinsberg and Hoffmann methods for separation of primary, secondary and tertiary amines. Basic character of aliphatic and aromatic amines with elementary concept of steric inhibition of resonance, Electrophilic substitution in aryl amines. Diazo reaction and properties of diazonium salts. **4. CARBOXYLIC ACIDS (8 hours)** Synthesis of acids with special reference to hydrolysis of nitrile and Arndt-Eistert synthesis, strength of acids, effect of substituent on acid strength, and effect of substituent position on acid strength. An elementary idea of Ortho effect. Reactions of carboxylic acids with special reference to HVZ reaction and mechanism of decarboxylation. Halogen acids: Synthesis and reactions. Hydroxy acids: Synthesis and reactions. **5. CARBOXYLIC ACID DERIVATIVES (7 hours)** Synthesis and properties of acid chlorides, acid anhydrides, esters and amides with special reference to mechanism of esterification, ester hydrolysis, Hofmann-Bromamide reaction. Comparative tendency to undergo nucleophilic substitution reactions.
Recommended Books	1. Solomons, T. W. G., Fryhle, C.B., Snyder, S.A (2017), Organic Chemistry, 12th Edition, Wiley. 2. Bruice, P. Y. (2020), Organic Chemistry, 8th Edition, Pearson. 3. Clayden, J., Greeves, N., Warren, S. (2014), Organic Chemistry, Oxford 4. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Pearson, 2010. 5. Eliel, E. L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000. 6. Finar, I. L. Organic Chemistry (Vol. I & II), E.L.B.S. 7. Nasipuri, D. Stereochemistry of Organic compounds: Principles and Applications. 8. Kalsi, P. S., Stereochemistry Conformation and Mechanism; 8thEdn, New Age International, 2015. 9. Dr Jagdamba Singh, Organic Chemistry Vol 1 and Vol 2, Pragati Prakashan, Edition: 2020. 10. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley Student Ed, 11th Edition (2013). 11. M. K. Jain and S. C. Sharma, Modern organic chemistry, Vishal

	Publication Co, 2024th edition 12. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications. Bahl, A. & Bahl, B. S. Advanced Organic Chemistry, S. Chand, 2010.

EWING CHRISTIAN COLLEGE, PRAYAGRAJ
DEPARTMENT OF CHEMISTRY

B.Sc. Semester – IV		
CHEMISTRY – MAJOR		
PRACTICAL		
COURSE CODE:	**TITLE: CHEMISTRY PRACTICAL-IV**	**COURSE CREDIT: 2** **HOURS: 60 (2 x 30 Hours = 60)** **TOTAL MARKS: 50**
Course Objectives	• To familiarize students with **the** principles and procedures of gravimetric analysis, including precipitation, digestion, and co-/post-precipitation. • To train students in the proper use of glassware and laboratory equipment essential for gravimetric experiments. • To impart hands-on experience in the **estimation of metals** such as barium and zinc through gravimetric methods. • To introduce the principles of organic synthesis and familiarize students with standard laboratory procedures for the preparation and purification of organic compounds. • To cultivate precision, accuracy, and good laboratory practices through systematic inorganic and organic practical work.	
Course Outcomes	After completing this course, students will be able to: • Identify and correctly use common glassware and laboratory tools (desiccators, crucibles, wash bottles, policemen, filter papers, etc.). • Understand and explain the principles of gravimetric analysis, including precipitation, co-precipitation, post-precipitation, super saturation, digestion, and ash treatment. • Perform gravimetric estimations such as barium as barium sulphate and zinc as zinc oxide with accuracy. • Acquire skills in organic synthesis and purification of compounds like 1-phenylazo-2-naphthol, naphthalene picrate, methyl orange, and acetanilide. • Demonstrate competence in connecting theoretical chemical principles with practical experimental techniques. • Develop problem-solving, critical observation, and data analysis skills in both inorganic and organic practical chemistry.	
Syllabus	**1. Gravimetric Analysis** a. Description of various glasswares and other labware used in gravimetric analysis (as dessicators, crucible, wash bottle, policeman, filter paper etc.) b. Principles of gravimetric analysis • Precipitation • Co-precipitation • Post-precipitation	

	• Super saturation • Digestion • Washing • Filtration • Ignition • Ash treatment c. Estimation of Barium as Barium sulphate d. Estimation of Zinc as Zinc oxide. **2. Organic compound Preparation** Organic synthesis and purification of organic compounds • 1-phenylazo-2-naphthol • Naphthalene picrate • Methyl orange • Acetanilide
Reference Books	1. A.I. Vogel: Vogel's Quantitative Chemical Analysis – Prentice Hall, 6th Edition. **2.** A.I. Vogel: Vogel's Textbook of Practical Organic Chemistry – Prentice Hall, 5th Edition. **3.** O.P. Pandey, D.N. Bajpai, S. Giri: *Practical Organic Chemistry* – S. Chand & Company Ltd., New Delhi. 4. V.K. Ahluwalia & Sunita Dhingra : Practical Chemistry, Universities Press, Hyderabad 5. Gurtu & Gurtu : Advanced Experimental Chemistry, S. Chand & Company Ltd., New Delhi

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<table>
<tr><th colspan="4">B.Sc. Semester - III</th></tr>
<tr><th colspan="4">CHEMISTRY - MINOR</th></tr>
<tr><th colspan="4">THEORY</th></tr>
<tr><td>COURSE CODE:
CHET30M</td><td>CHEMISTRY - 1</td><td colspan="2">COURSE CREDIT: 3
HOURS: 3 x 15 Hours = 45 Hours</td></tr>
<tr><td></td><td></td><td>TOTAL MARKS: 75</td><td>END SEMESTER: 50
C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="3">This course aims to provide a comprehensive understanding of the fundamental principles of inorganic, organic, and physical chemistry. It focuses on explaining the nature of chemical bonding, the structure and reactivity of hydrocarbons and halogenated compounds, and the laws of thermodynamics and thermochemistry. The objective is to develop students' ability to relate theoretical concepts to practical chemical behaviour, interpret reaction mechanisms, and perform basic thermodynamic and energetic calculations relevant to chemical systems.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">Upon successful completion of this course, students will be able to:
1. Understand the nature of ionic and covalent bonding, lattice and hydration energies, and factors influencing bond strength and solubility.
2. Explain the formation, reactions, and mechanisms of aliphatic hydrocarbons including alkanes, alkenes, alkynes, and dienes.
3. Interpret elimination and substitution mechanisms (E1, E2, E1cb, SN1, SN2, SNi) with their stereochemical aspects.
4. Describe the reactivity and stability of conjugated systems and halogenated hydrocarbons.
5. Apply the First Law of Thermodynamics to various processes and calculate energy, work, and enthalpy changes.
6. Evaluate enthalpy relations, heats of reaction, and bond energies using Hess's and Kirchhoff's laws.</td></tr>
<tr><td>Syllabus</td><td colspan="3">1. INORGANIC CHEMISTRY 15 Hours
Chemical Bonding: Ionic bonding, Lattice energy, Hydration energy, Born Haber cycle, Solubility of ionic compounds, Covalent bonding, σ and π bonds, Fajan's Rule, Hydrogen bond.</td></tr>
</table>

	2. ORGANIC CHEMISTRY **15 Hours** ***Alkanes:*** Methods of formation with special reference to Wurtz reaction, Kolbe's reaction, Corey-House synthesis. Halogenation of alkanes. ***Alkenes and alkynes:*** Methods of formation alkenes using mechanisms of E1, E2, E1cb reactions, Saytzeff's and Hoffmann eliminations. Electrophilic addition reactions mechanism with suitable examples (HX, H_2O, HOX), Markovnikov's/ AntiMarkovnikov'saddition); Anti-Addition of X_2, ozonolysis, reaction with NBS, reactions of alkynes; acidity, electrophilic addition: hydration to form carbonyl compounds. ***Dienes:*** Stability of conjugated Dienes, Chemical reactions -Diel's Alder reaction. **B. CHEMISTRY OF HALOGENATED HYDROCARBONS** ***Alkyl Halides***: Methods of preparation and properties, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects; Inversion, retention, racemisation. Comparative reactivities of alkyl, allyl, vinyl and aryl halides towards nucleophilic substitution reactions. **3. PHYSICAL CHEMISTRY** **15 Hours** **A. THERMODYNAMICS** Thermodynamic terms, statement of First law, State and path functions, exact and inexact differentials, Cyclic rule, Integration factor, Thermodynamic reversibility, work done in various processes and maximum work, Variation of Internal energy with temperature and volume and Enthalpy as function of temperature and pressure, Molar heat capacity, Relation between C_P and C_V. **B. THERMOCHEMISTRY** Heat of reaction at constant pressure and constant volume, q_p & q_v relation, Heat of combustion, Enthalpy of formation, neutralization, and phase change, Hess's law and its applications, Bond energy, Resonance energy.
Recommended Books	1. J. D. Lee: A New Concise Inorganic Chemistry, ELBS Ed. 2. F.A. Cotton and G. Wilkinson: Basic Inorganic Chemistry, John-Wiley Publications

	3. B.R. Puri and L.R. Sharma and K.C. Kalia: Principles of Inorganic Chemistry Milestone publishers. 4. Dr Jagdamba Singh, Organic Chemistry Vol I & II, Pragati Prakashan, Edition: 2020. 5. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Pearson, 2010. 6. M. K. Jain and S. C. Sharma, Modern organic chemistry, Vishal Publication Co, 2024th edition. 7. Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc. 8. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications. 9. Bahl, A. & Bahl, B. S. Advanced Organic Chemistry, S. Chand, 2010. 10. Glasstone, S. (Latest Edition). Textbook of Physical Chemistry. Macmillan Publishers. 11. Mukerjee, R. C. (Latest Edition). Modern Approach to Physical Chemistry – Part 1. Bharati Bhawan Publishers & Distributors. 12. Puri, B. R., Sharma, L. R., & Pathania, M. S. Principles of Physical Chemistry (49th ed.). Vishal Publishing Co.

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B.Sc. Semester – III		
CHEMISTRY – MINOR		
PRACTICAL		
COURSE CODE:	**TITLE: CHEMISTRY PRACTICAL-III**	**COURSE CREDIT: 1** **HOURS: 30 (1 x 30 Hours = 30)** **TOTAL MARKS: 25**
Course Objectives	• To develop a clear understanding of the principles of semi-micro qualitative analysis and its advantages over macro methods. • To impart practical knowledge for the systematic identification of simple acid radicals including common and interfering anions. • To train students in the elimination of interfering radicals and the application of proper confirmatory tests. • To enable learners to carry out group-wise systematic analysis of basic radicals (cations), with focus on Groups IIA and IIB. • To cultivate careful laboratory skills, analytical reasoning, and the ability to record and interpret experimental observations systematically.	
Course Outcomes	On successful completion of this course, students will be able to: • Explain the theoretical principles underlying semi-micro inorganic qualitative analysis. • Identify common acid radicals (carbonate, sulphide, sulphate, chloride, bromide, iodide, nitrate, nitrite) and interfering radicals (oxalate, borate, phosphate) with suitable confirmatory tests. • Apply systematic procedures to eliminate interfering anions during analysis. • Detect and analyze Group IIA and IIB basic radicals (Pb, Cu, Bi, As, Sn, Cd, Sb) accurately through group-wise separation. • Demonstrate improved laboratory skills in handling small quantities of chemicals, maintaining safety, and ensuring minimal wastage. • Interpret observations and draw logical inferences, thereby strengthening problem-solving ability in qualitative chemical analysis.	
Syllabus	**Semi-micro Qualitative Inorganic mixture analysis** a. Principles of semi-micro analysis b. Analysis of simple acid radicals - Carbonates, Sulphide, Sulphate, Chloride, Bromide, Iodide, Nitrate, Nitrite and interfering radicals – Oxalate, Borate and Phosphate. c. Elimination of interfering acid radicals and identifying the groups of basic radicals.	

	d. Group wise analysis of basic radicals Group IIA and IIB – (Lead, Copper, Bismuth, Arsenic, Tin, Cadmium and Antimony)
Reference Books	1. A.I. Vogel: Vogel's Qualitative Inorganic Analysis – Prentice Hall, 7th Edition. 2. G. Svehla : Vogel's Qualitative Inorganic Analysis, Pearson 3. O.P. Pandey, D.N. Bajpai, S. Giri: *Practical Organic Chemistry* – S. Chand & Company Ltd., New Delhi. 4. V.K. Ahluwalia & Sunita Dhingra : Practical Chemistry, Universities Press, Hyderabad 5. Gurtu & Gurtu : Advanced Experimental Chemistry, S. Chand & Company Ltd., New Delhi.

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<table>
<tr><th colspan="4">B.Sc. Semester - IV</th></tr>
<tr><th colspan="4">CHEMISTRY - MINOR</th></tr>
<tr><th colspan="4">THEORY</th></tr>
<tr><td>COURSE CODE:
CHET40M</td><td>CHEMISTRY - 2</td><td colspan="2">COURSE CREDIT: 3
HOURS: 3 x 15 Hours = 45 Hours</td></tr>
<tr><td></td><td></td><td>TOTAL MARKS: 75</td><td>END SEMESTER: 50
C.I.A.: 25</td></tr>
<tr><td>Course Objectives</td><td colspan="3">The course is designed to provide students with a clear understanding of the fundamental principles of inorganic, organic, and physical chemistry. It aims to explain the concepts of molecular structure and bonding through VSEPR theory and hybridization, explore the conformational analysis of aliphatic and cyclic compounds, and study the structure, preparation, and reactions of carbonyl compounds. The course also introduces the basic principles of electrochemistry, including electrolysis, conductivity, transport numbers, and electrode potentials. Overall, it seeks to develop the students' ability to apply theoretical concepts to practical chemical systems and enhance their analytical and problem-solving skills.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">Upon successful completion of this course, students will be able to:
1. Explain and predict molecular shapes and geometries using VSEPR theory and hybridization concepts.
2. Illustrate and compare conformational isomers of alkanes and cyclohexane through energy profile diagrams.
3. Describe the synthetic methods and mechanisms of key reactions of aldehydes and ketones.
4. Apply electrochemical principles to calculate conductivity, transport number, and electrolysis parameters.
5. Use the Nernst equation to determine EMF, pH, solubility product, and equilibrium constants.
6. Correlate theoretical concepts of bonding and electrochemistry with experimental observations and applications.</td></tr>
<tr><td>Syllabus</td><td colspan="3">1. INORGANIC CHEMISTRY 15 Hours
Molecular Structure: Valence Shell Electron Pair Repulsion (VSEPR) theory, Effect of lone pair/lone pairs on the geometry and shape of the covalent</td></tr>
</table>

	molecule or ion, determination of shapes of covalent molecules and ions having bond pairs and lone pairs using VSEPR theory, Hybridization - Concept of hybridization and its applications in determination of geometry of covalent molecules and ions. ($BeCl_2$, BF_3, CCl_4, PCl_3, NH_3, H_2O, OF_2, I_3^+, PCl_5, SF_4, I_3^-, ICl_3, IF_7). **2. ORGANIC CHEMISTRY 15 Hours** **A. Conformational Analysis:** Conformational Isomerism: Conformations – Conformational analysis of ethane and n-butane, including energy diagrams. Baeyer's strain theory. Conformations of cyclohexane (chair, half chair, boat and twist) - Axial and equatorial bonds. **B. Carbonyl Compounds (Aldehydes and Ketones):** Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitrites and from carboxylic acids. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on aldol condensation, Benzoin condensation. Wittig reaction, Bayer-Villiger oxidation and Cannizzaro reactions. **3. PHYSICAL CHEMISTRY 15 Hours** **A. ELECTRO CHEMISTRY - I** Electrolysis, Faraday's laws of electrolysis, Conductivity, Equivalent and Molar conductivity and their properties, Kohlrasch law and its applications, Arrhenius theory of Electrolytic dissociation, Transport number, Determination of transport number: Hittorf's method and Moving boundary method. **B. ELECTRO CHEMISTRY - II** Reversible and irreversible cells, E.M.F. of Galvanic cells and free energy change, Nernst equation, Equilibrium constant, Standard electrode potential, Types of reversible electrode, Application of E.M.F. measurements, Determination of solubility product, pH, Dissociation constants, Solubility of sparingly soluble salts.
Recommended Books	1. J. D. Lee: A New Concise Inorganic Chemistry, ELBS Ed. 2. F.A. Cotton and G. Wilkinson: Basic Inorganic Chemistry, John-Wiley Publications 3. B.R. Puri and L.R. Sharma and K.C. Kalia: Principles of Inorganic Chemistry Milestone publishers. 4. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley Student Ed, 11th Edition (2013)

	5. Dr Jagdamba Singh, Organic Chemistry Vol 1& 2, Pragati Prakashan, Edition: 2020. 6. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Pearson, 2010. 7. M. K. Jain and S. C. Sharma, Modern organic chemistry, Vishal Publication Co, 2024th edition. 8. Bruice, P. Y. (2020), Organic Chemistry, 8th Edition, Pearson. 9. Glasstone, S. (Latest Edition). Textbook of Physical Chemistry. Macmillan Publishers. 10. Mukerjee, R. C. (Latest Edition). Modern Approach to Physical Chemistry – Part 1. Bharati Bhawan Publishers & Distributors. 11. Puri, B. R., Sharma, L. R., & Pathania, M. S. Principles of Physical Chemistry (49th ed.). Vishal Publishing Co.

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DEPARTMENT OF CHEMISTRY

B.Sc. Semester – IV		
CHEMISTRY – MINOR		
PRACTICAL		
COURSE CODE:	**TITLE: CHEMISTRY PRACTICAL-IV**	**COURSE CREDIT: 1** **HOURS: 30 (1 x 30 Hours = 30)** **TOTAL MARKS: 25**
Course Objectives	• To introduce students to the theory and practice of functional group detection in solid organic compounds. • To impart knowledge of the chemical basis of confirmatory tests and reactions used for identifying specific functional groups. • To train students in the systematic identification of organic functional groups such as alcohols, amines, aldehydes, ketones, carboxylic acids, amides, and nitro compounds. • To develop experimental skills in handling organic compounds, performing tests with accuracy, and interpreting results correctly. • To cultivate logical thinking and analytical reasoning in correlating observations with molecular structure.	
Course Outcomes	On successful completion of this course, students will be able to: • Explain the principles underlying the detection of functional groups in organic compounds. • Perform confirmatory tests to identify –OH (aliphatic and aromatic), $–NH_2$ (aromatic primary amine), –CHO (aldehyde), >C=O (ketone), –COOH (carboxylic acid), $–CONH_2$ (amide), and $–NO_2$ (aromatic nitro group). • Differentiate between similar functional groups by applying specific chemical tests. • Analyze experimental observations and correlate them with the presence of a particular functional group. • Demonstrate safe and efficient laboratory practices while handling organic reagents and performing functional group analysis. • Interpret results systematically to reach logical conclusions about the identity of unknown organic compounds.	
Syllabus	**Functional group analysis in Organic compounds** • Various confirmatory tests and chemical reactions involved in the detection of the following functional groups in the solid organic compounds: -OH (aromatic and aliphatic), $-NH_2$ (Aromatic primary	

	amine), -CHO (aldehyde), >C=O (Ketone), -COOH (carboxylic acid), $-CONH_2$ (amide), $-NO_2$ (Aromatic nitro group)
Reference Books	1. A.I. Vogel: Vogel's Textbook of Practical Organic Chemistry – Prentice Hall, 5th Edition. 2. Mann & Saunders: Practical Organic Chemistry, Longmans, Green and Co., London 3. O.P. Pandey, D.N. Bajpai, S. Giri: *Practical Organic Chemistry* – S. Chand & Company Ltd., New Delhi. 4. V.K. Ahluwalia & Sunita Dhingra: Practical Chemistry, Universities Press, Hyderabad 5. Gurtu & Gurtu : Advanced Experimental Chemistry, S. Chand & Company Ltd., New Delhi

Ewing Christian College, Allahabad

DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry – Semester V

Theory Paper I

Inorganic Chemistry

Duration: 3 Hours **Marks: 75**

Core Course Code: 5CHETH1 **Course Credit: 2 (30 Hours)**

1. UNIT-1

a) Wave mechanical concept of atom and simple molecules (Elementary treatment only).

b) Nature of covalent bond; Heitler-London, Pauling-Slater and Hunds- Mullikan's theories, Molecular Orbital energy level diagrams and M.O. electronic configuration of diatomic species, bond order.

2. UNIT-2

Study of ionic solids:

Crystalline and Amorphous solids and their characteristics, types of crystalline solids, unit cell and its characteristics, ionic crystalline solids, Gouldschmidt coordination number, Radius ratio, crystal systems and their characteristics, Acquintance with structure of Rock salt, Caesium chloride, Rutile, Calcium Flourite, Zinc blende and Wurzite.

3. UNIT-3

Statistical Evaluation of Data:

Errors, classification of errors, Precision and accuracy, Deviations, Standard deviations, significant figures, minimization of errors.

4. UNIT-4

Environmental pollution:

(i) Air pollutants, their sources, toxic effects, control measures. Particular matter- their sources, toxic effects and control measures. Acid rain and Greenhouse effect.

(ii) Water Pollution- water pollutants, sources, toxic effects, control measures

(iii) Remediation.

5. UNIT-5

Seminar/workshop- Review of literature, preparation of review article and power point presentation. (review article submission on seminar topic is mandatory for each student).

Ewing Christian College, Allahabad

DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry – Semester V

Theory Paper II

Organic Chemistry

Duration: 3 Hours **Marks: 75**
Core Course Code: 5CHETH2 **Course Credit: 2 (30 Hours)**

1. ELECTROMAGNETIC SPECTRUM: ABSORPTION SPECTRA

Ultraviolet (UV) absorption spectroscopy: absorption laws (Beer-Lambert law) molar absorptivity, presentation and analysis of uv spectra, types of electronic transitions, effect of conjugation. Concept of Chromophore and auxochrome, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones.

Infrared (IR) absorption spectroscopy: molecular vibrations, Hooke's law selection rules, intensity and position of IR bands, measurement of IR spectrum fingerprint region, characteristic absorption of various functional groups and interpretation of IR spectra of simple organic compounds.

2. **HETEROCYCLIC COMPOUNDS**

Introduction: Molecular orbital picture and aromatic characteristics of Pyrrole, Furan Thiophene and Pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reaction in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed six membered heterocyclic compounds. Preparation of quinoline and isoquinoline. Skraup synthesis and Bischler-Napier synthesis. Mechanism of electrophilic substitution reaction s of quinoline and isoquinoline.

3. ORGANOMETTALIC COMPOUNDS

Organomegnisium compounds: The Grignard reagents-formation, structure and chemical reactions.

Organozinc ompounds: formation chemical reactions

Organolithium compounds: formation chemical reactions

Ewing Christian College, Allahabad

DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry – Semester V

Theory Paper III

Physical Chemistry

Duration: 3 Hours **Marks: 75**

Core Course Code: 5CHETH3 **Course Credit: 2 (30 Hours)**

1. **ELECTROCHEMISTRY**

   Concept of Galvanic cells (chemical and concentration). E.M.F. determination: electrode concentration cells without transference reversible w.r.t cations and anions (L.J.P. eliminated by salt bridge and also by chemical cells). Liquid junction potential, cause of L.J.P, determination of L.J.P of electrolyte concentration of cell with transference reversible w.r.t. cations and anions. Determination of transport number by E.M.F. measurement, chemical cells without transference. Fuel cells and their applications.

2. **KINETICS OF CATALYZED REACTIONS**

   Steady state approximation, kinetics of homogenous acid base catalysis, enzyme catalysis, negative catalysis and inhibition, kinetics of gaseous reaction on solid surface. Uni and bi molecular surface reaction. Effect of temperature on surface reaction. Primary salt effect.

3. **THERMODYNAMICS - I**

   Partial molar quantities, chemical potential, Gibbs-Duhem equation, relationship between chemical potential with energy, enthalpy, work function etc. effect of temperature and pressure on chemical potential. Chemical potential of pure substances, chemical potential of real gases and fugacity, chemical potential in ideal gas mixture, thermodynamic treatment of colligative properties, lowering of vapour pressure, osmotic pressure.

4. **RADIOCHEMISTRY**

   Definition and measurement of radioactivity, rate of atomic disintegration, radioactive equilibrium, theory of radio activity, artificial transmutation of elements, induced radio activity and Nuclear energy, nuclear fission and fusion, radioactive isotopes.

Ewing Christian College, Allahabad
DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry – Semester V
PRACTICALS – LAB COURSE

Duration: 6 Hours **Marks: 75**
Core Course Code: 5CHEPR1 **Course Credit= 03 (90 Hours)**

1. To determine that the acid catalyzed acetone-iodine reaction is a zero order with respect to iodine.

2. To determine the heat of neutralization of a strong acid by a strong base.

3. To determine the heat of solution by solubility method.

4. a) determination of permanent and temporary hardness of water
   b) To determination the degree of hardness of water by estimating Ca^{+2} and Mg^{+2} using EDTA solution.

5. Organic synthesis: synthesis and purification of various organic compounds
   - Naphthalene picrate
   - 1-Phenylazo-2-Naphthol
   - Methyl Orange
   - Acetanilide

6. To determine the saponification value of vegetable oil.

7. To determine the molecular weight of a volatile substance by Duma's method.

8. To experimentally perform the distinction between primary, secondary and tertiary alcohols.

VIVA VOCE

PRACTICAL RECORDS

Ewing Christian College, Allahabad

DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry – Semester VI

Theory Paper I

Inorganic Chemistry

Duration: 3 Hours **Marks: 75**

Core Course Code: 6CHETH1 **Course Credit: 2 (30 Hours)**

1. UNIT-1

Theories of coordination linkage: valance bond theory, outer and inner orbital (high and low spin) complexes, general ideas about crystal field theory (crystal field splitting in octahedral and tetrahedral fields only), stereochemistry of coordination number 6 and 4 coordinated compounds

2. UNIT-2

Chemistry of transition element: comparative study of the chemistry of d-block elements and their important compounds. Sc, Y, La; Ti, Zr, Hf; V, Nb, Ta; Cr, Mo, W; Mn, Tc, Te; Fe, Co, Ni and Pt metals (application of reduction potential diagram wherever necessary)

3. UNIT-3

General chemistry of lanthanide:

General characteristics and chemistry of f-block elements with special reference to lanthanides including lanthanide contraction and modern techniques of their separation

4. UNIT-4

Material chemistry:

Introduction, principles, important discoveries and some application of Nanomaterial, liquid crystals, polymers.

5. UNIT-5

Metal Ions of Biologically Significance: Essential and trace elements, chemistry of chlorophyll, haemoglobin, Myoglobin and cyanocobalamin.

Ewing Christian College, Allahabad

DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry – Semester VI

Theory Paper II

Organic Chemistry

Duration: 3 Hours **Marks: 75**

Core Course Code: 6CHETH2 **Course Credit: 2 (30 Hours)**

1. CARBOHYDRATES

Classification and nomenclature, monosaccharide's, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosacharides. Erythro and threo diastereomers. Conversion of glucose to mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharide. Cyclic structure of D(+)-glucose. Mechanism of mutarotation. Structure of ribose and deoxyribose

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides(starch and cellulose) without involving structure determination.

2. **AMINO ACIDS, PEPTIDES, PROTEINS AND NUCLEIC ACID**

Classification, structure and stereochemistry of amino acids, acid base behavior, isoelecric point and electrophoresis. Preparation and reaction of a- amino acids. Structure and nomenclature of peptides and protein classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptide. Classical peptide synthesis, solid phase peptide synthesis. Structure of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation.

Nucleic acids**:** Constituents of nucleic acids. Ribonucleosides and Ribonucleotides. The double helical structure of DNA.

3. SYNTHESIS POLYMERS

Addition or chain growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler- Natta polymerization and vinyl polymers.

Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.

4. NUCLEAR MAGNETIC RESONANCE (NMR) SPECTROSCOPY

Proton magnetic resonance (^{1}H-NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structures, spin -spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribroethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

Ewing Christian College, Allahabad

DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry – Semester VI

Theory Paper III

Physical Chemistry

Duration: 3 Hours **Marks: 75**

Core Course Code: 6CHETH3 **Course Credit: 2 (30 Hours)**

1. **Atomic structure:**

Bohr's theory. Somerfield's model, dual nature of electron, de-broglies equation. Experimental verification of the wave nature of electron (Davisson and Germer experiments). Heisenberg's uncertainty principle, Schrodinger's wave equations and physical significance of the wave function. Particle in a box (one dimension only).

2. Photochemistry:

Photochemical and thermal reactions, chain reaction, free radicals chains. Thermal decomposition of acetaldehyde and ethane. Lambert and beers law, Grothus Draper's law. Einstein law of photochemical equivalence, kinetics of photochemical reactions viz., decomposition of hydrogen iodide, hydrogen bromide, acetaldehyde, ethane etc. and combination of hydrogen-chlorine, hydrogen-bromine and hydrogen –iodine reactions. Dimerisation of anthracene, fluorescence, photosensitization, phosphorescence, chemiluminescence.

3. THERMODYNAMICS-II

Colligative properties: Elevation of boiling point, depression of freezing point, chemical equilibrium and thermodynamic derivation of law of mass action, variation of equilibrium constant with temperature, van't Hoff equation, condition for equilibrium between phases, thermal, mechanical and chemical equilibrium, derivation of phase rule.

Ewing Christian College, Allahabad
DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry – Semester V
SKILL DEVELOPMENT COURSE RESEARCH METHODOLOGY
SPECTROSCOPIC METHODS OF CHEMICAL ANALYSIS

Duration: 1 Hour **Marks: 100**
Core Course Code: 6SEC004 **Course Credit: 2 (30 Hours)**

1. INTRODUCTION TO SPECTROSCOPY

a. Spectroscopy and Electromagnetic Radiations
b. Characteristics of Electromagnetic Radiations
c. Electromagnetic Spectrum
d. Absorption and Emission Spectra.

2. ULTRA VIOLET AND VISIBLE SPECTROSCOPY

a. Introduction
b. The nature of Electronic Excitation
c. Principles of Absorption Spectroscopy
d. Instrumentation
e. Sample Handling
f. Presentation of Spectra
g. Certain Terms used in Electronic Spectrocopy
    i. Chromophore
    ii. Auxochrome
    iii. Bathochromic Shift
    iv. Hypsochromic Shift
    v. Hyperchromic Shift
    vi. Hypochromic Shift
h. The Effect of Conjugation
i. The Woodward-Fieser Rules for Dienes and Enones
j. Solvent Effect.

3. APPLICATIONS OF UV AND VISIBLE SPECTROSCOPY (EXPERIMENTS)

a. Distinction between conjugated and non-conjugated compounds
b. Determination of Extent of Conjugation
c. Determination of the Absorption Curve and Concentration of a Substance
d. Deviation of Beers Law using UV-Vis Spectrophotometer
e. Estimation of Phosphoric acid in cola drinks by Molybdenum blue method using Spectrophotometer.

Ewing Christian College, Allahabad
DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry – Semester VI
PRACTICALS – LAB COURSE

Duration: 6 Hours **Marks: 75**
Core Course Code: 6CHEPR1 **Course Credit= 03 (90 Hours)**

1. To determine that the acid catalyzed hydrolysis of methyl acetate is a first order reaction.
2. To determine the effect of the concentration of HCl or H_2SO_4 on the rate constant for the hydrolysis of methyl acetate.
3. To determine the strength of the given HCl solution conductometrically.
4. Determination the concentration of unknown $K_2Cr_2O_7$ and $CuSO_4$ by calibration graph method, colorimetrically
5. To perform the one step preparation of some organic compounds.
6. To determine the iodine value of given vegetable oil.
7. To determine the iodine number of given vegetable oil.
8. To perform the synthesis of the following addition and coordinate compounds

   a. Na-Trioxalato ferrate
   b. Potash alum
   c. Carnalite.
   d. Potassium hexa cyano ferrate.

VIVA VOCE

PRACTICAL RECORDS

EWING CHRISTIAN COLLEGE, PRAYAGRAJ
DEPARTMENT OF CHEMISTRY

B.Sc. Semester - III		
SKILL ENHANCEMENT COURSE (SEC)		
COURSE CODE:	**WATER ANALYSIS**	**COURSE CREDIT: 2** **THEORY: 1 (15 HOURS)** **PRACTICAL: 1 (30 HOURS)**
Course Objectives	By the end of this course, students will be able to understand the fundamentals of water quality, including sources and types of water contamination, and water quality standards. They will gain knowledge of physical, chemical, and biological water quality parameters, learn appropriate sampling, preservation, and analytical techniques. Students will be proficient in various water purification and treatment methods, including recent advances and household applications. Additionally, students will develop skills in interpreting water quality data, preparing analysis reports, and conducting practical laboratory tests and fieldwork for water sample collection and assessment.	
Course Outcomes	**On completion of the course the student will be able to:** • Understand the significance of pure water, sources of water contamination, and the key challenges related to water pollution. • Identify and analyse physical, chemical, and biological parameters of water quality using proper sampling and preservation techniques. • Demonstrate proficiency in various water purification and treatment methods including modern technologies and household applications. • Collect, analyse, and interpret water quality data in accordance with standards and prepare comprehensive reports with recommendations. • Perform practical laboratory tests such as pH, conductivity, hardness, dissolved oxygen, BOD and COD on water samples.	

Syllabus	**THEORY**

UNIT – I: FUNDAMENTALS OF WATER QUALITY

- Definition and significance of pure water
- Sources and categories of water contamination.
- Water resources: groundwater, surface water, municipal systems.
- Water pollution: causes, effects, and modern challenges.
- Water quality standards (BIS, WHO, CPCB).

UNIT – II: WATER QUALITY PARAMETERS

- Sampling methods and preservation techniques.
- Physical parameters: temperature, colour, turbidity, taste, pH, conductivity.
- Chemical parameters: acidity, alkalinity, hardness, total dissolved solids (TDS), chlorides, sulphates, phosphates, nitrates, fluorides, metals.
- Biological parameters: dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD).
- Use of analytical instruments in water analysis.

UNIT – III: WATER PURIFICATION AND TREATMENT

- Boiling, filtration, distillation, chlorination, reverse osmosis.
- Recent advances in treatment and water quality management (e.g., membrane technology).
- Household water treatment and safe storage.

UNIT – IV: DATA INTERPRETATION AND REPORTING

- Comparing obtained values to standards.
- Preparing analysis reports and recommendations.
- Understanding lab management and routine analysis procedures.

	PRACTICAL • Determination of pH and conductivity. • Estimation of acidity, alkalinity, and total hardness. • Measurement of TDS, chloride, calcium, iron, magnesium, phosphates, sulphates. • Tests for DO, BOD, COD in water samples. • Detection and quantification of residual chlorine. • Project work: Collection and analysis of water samples from various sources (field visits).
Recommended Books	1. Hand Book of Methods in Environmental Studies" by S.K. Maiti. 2. "Instrumental Methods of Chemical Analysis" by Chatwal and Anand. 3. "Environmental Science: Principle & Practice" by Das & Behera.