Semester	**1**
Programme	**CHEMISTRY**
Course	**MINOR: GENERAL CHEMISTRY 1**
Paper Code	**B1CH230112T / B1CH230112P**
Credits	**4 (THEORY : 3; PRACTICAL : 1)**
Hours/week	**5 (THEORY: 3; PRACTICAL: 2)**
Category: Core/MDC/SEC/VEC	**CORE**
Theory / Practical / Composite	**COMPOSITE**
Number of Modules	**4 (THEORY: 3; PRACTICAL: 1)**
Syllabus	**Theory** **Group A** **Module 1: Fundamentals of Organic Chemistry and Stereochemistry (12 Lectures)** **Fundamentals of Organic Chemistry (4 Lectures)** Electronic effects: Inductive effect, resonance and hyperconjugation; nucleophiles and electrophiles; Concept of acids and bases. reactive intermediates: carbocations, carbanions and free radicals. **Addition, Nucleophilic Substitution and Elimination Reactions (4 Lectures)** Nucleophilic substitutions: S_N1, S_N2 reactions, NGP, effect of solvents, substrate and nucleophile. Eliminations: E1 and E2 reactions (elementary mechanistic aspects); Saytzeff and Hofmann eliminations; elimination vs substitution. **Stereochemistry (4 Lectures)** Stereoisomerism, concept of chirality and optical activity, meso compounds. Projection methods: Fischer, Sawhorse, Newman projections and their interconversion; Configurational nomenclature: D/L, R/S and E/Z. **Group B** **Module 2: Chemical Thermodynamics (12 Lectures)** 1. Definition of systems, surroundings and types of systems (isolated, closed and open). 2. Extensive properties and intensive properties. 3. Concept of Thermodynamic equilibrium, concept of temperature. 4. Concept of heat and work, reversible work, irreversible work and maximum work. 5. First law of Thermodynamics, internal energy as a state function, properties of state function and path function. 6. Definition of isothermal and adiabatic processes. 7. Joule's experiment and its consequences. 8. Joule-Thomson experiment and enthalpy as a state function. 9. Calculation of work done, heat changes for isothermal and

	adiabatic changes involving ideal gas.
	10. Concept of Entropy as a state function, Entropy changes in various Physical processes. **Module 3: Chemical Kinetics (12 Lectures)** 1. Rate of a reaction, rate law 2. Temperature fluctuation and reactivity in gaseous phase 3. Crude approximation: all binary collision leads to product. 4. Calculation of binary collision frequency and collision number in gaseous state. 5. Refinement: concept of activation energy and Boltzmann distribution to introduce the effect of activation energy in the rate law 6. Rate constant and its variation with temperature: Arrhenius equation 7. Order of a reaction 8. Integrated rate laws and characteristic plots 9. Half-life and its significance 10. Determination of order of a reaction 11. Rate expression for complex reactions 12. Unimolecular reaction and reaction mechanism 13. Multi-step reactions 14. Rate determining step 15. Steady state approximation 16. Further refinement: steric requirements (Basic qualitative overview)
	Practical: Analytical Chemistry Practical. 1. Standardization of NaOH using oxalic acid. 2. Standardization of HCl/acetic acid using standardized NaOH. 3. Estimation of carbonate and hydroxide present together in mixture. 4. Estimation of carbonate and bicarbonate present together in a mixture. 5. Estimation of $NH_4{}^+$ by formol titration.
Course Overview	**Theory:** General Chemistry 1 (B1CH230112T / B1CH230112P) is a foundational composite course designed for Semester 1 undergraduate students. The course architecture integrates core organic, physical, and analytical chemistry principles into a single rigorous framework. Organic Chemistry & Stereochemistry (Module I): Focuses on inductive, resonance, and hyperconjugative effects, reactive intermediates, the mechanics of substitution/elimination pathways (S_N1, S_N2, NGP, E1, E2), and 3D molecular visualization

	through spatial projections and configurational nomenclature (D/L, R/S, E/Z). Chemical Thermodynamics (Module II): Covers basic thermodynamics parameters, the First Law of Thermodynamics, state vs. path functions, gas expansion calculations, and classical verification experiments like Joule's and Joule-Thomson effects. Chemical Kinetics (Module III): Explores reaction velocities, collision theory, activation barriers via the Arrhenius equation, integrated rate laws, and advanced steady-state approximations for multi-step mechanisms.. **Practical:** Analytical Chemistry Practical (Module IV): Develops benchmark laboratory competence through acid-base standardizations and quantitative component estimations of complex mixtures
Course Outcomes (COs)	Upon completion of this course, the student will be able to: CO1 [Organic Fundamentals]: Classify electronic displacements (inductive, resonance, hyperconjugation), distinguish nucleophiles from electrophiles and apply the concept of acids and bases, and identify the properties, electronic structures, and stability patterns of reactive intermediates (carbocations, carbanions, free radicals). CO2 [Aliphatic Mechanisms]: Differentiate and analyze the mechanisms, solvent/substrate effects, and competitive pathways of aliphatic nucleophilic substitutions (S_N1, S_N2, Neighboring Group Participation) and eliminations (E1, E2, Saytzeff vs. Hofmann). CO3 [Stereochemical Spatial Analysis]: Explain stereoisomerism, chirality, optical activity, and meso compounds, model 3D organic structures using Fischer, Sawhorse, and Newman projection metrics, successfully perform their interconversions, and accurately assign configurational nomenclature (D/L, R/S, E/Z) to chiral systems and geometric isomers. CO4 [Thermodynamic Foundations]: Identify open, closed, and isolated systems, separate extensive/intensive properties, apply the concepts of thermodynamic equilibrium and temperature, distinguish reversible, irreversible, and maximum work, and evaluate state versus path parameters using mathematical representations of the First Law of Thermodynamics. CO5 [Gas Expansions & Classical Laws]: Compute numerical values for work done, internal energy changes (ΔU), and heat transfers (q) during reversible, irreversible, isothermal, and adiabatic expansions of ideal gases, using insights from Joule and Joule-Thomson parameters. CO6 [Entropy & State Functions]: Explain entropy as a state function and evaluate entropy changes accompanying various physical processes. CO7 [Core Kinetics & Collision Theory]: Formulate differential rate expressions, solve integrated rate equations, and apply collision theory parameters (binary collision frequencies, activation energy, Boltzmann factor adjustments, and qualitative steric requirements) to model gas-phase reaction velocities. CO8 [Mechanistic Kinetics & Steady-State]: Evaluate multi-step,

	complex, and unimolecular reactions by identifying the rate-determining step and applying the steady-state approximation to map comprehensive kinetic models. CO9 [Analytical Lab Competencies]: Execute quantitative volumetric titrations to standardize working standard solutions and accurately estimate separate analytes within multi-component mixtures (hydroxide/carbonate, carbonate/bicarbonate, and ammonium ions via formol protocols).
Program Outcomes (POs)	PO1: Fundamental Knowledge: Demonstrate a comprehensive understanding of core concepts in chemistry, including organic, inorganic, physical, analytical, and biochemistry. PO2: Laboratory Skills: Acquire hands-on experience in laboratory techniques and instrumentation, applying safety protocols and proper methodologies to conduct experiments and analyse results. PO3: Problem Solving: Develop critical thinking and problem-solving skills by applying chemical principles to real-world scenarios, including the ability to design experiments and interpret data. PO4: Research Competency: Engage in independent and collaborative research projects, employing scientific methods to formulate hypotheses, conduct experiments, and communicate findings effectively. PO5: Interdisciplinary Applications: Understand the interdisciplinary nature of chemistry, exploring its applications in fields such as medicine, environmental science, materials science, and nanotechnology. PO6: Communication Skills: Effectively communicate scientific information, both verbally and in written form, to diverse audiences, demonstrating the ability to present complex ideas clearly and concisely. PO7: Ethics and Sustainability: Recognize the ethical implications and responsibilities of scientific research and practice in chemistry, emphasizing the importance of sustainability and environmental stewardship in chemical practices.

CO #	Core Curriculum Domain	Bloom's Taxonomy K-Level	Dominant Mapped POs	Pedagogical Justification for K-Level & PO Selection
CO1	Organic Fundamentals & Intermediates	**K2 (Understand), K3 (Apply)**	PO1, PO3	Students interpret fundamental electronic and acid-base properties and apply these conceptual guidelines to predict chemical intermediate stability behavior.
CO2	Aliphatic Substitution & Elimination	**K4 (Analyze)**	PO1, PO3	Requires students to break down substrate structures and solvent properties to predict substitution vs. elimination competition pathways.
CO3	Stereochemical Projection Transformations	**K2 (Understand), K3 (Apply)**	PO1, PO3	Requires explaining the origin of chirality and optical isomerism, alongside active calculation, 3D structure drawing, spatial conversion of projection formats, and assigning structural descriptors.
CO4	Thermodynamic State Functions & First Law	**K2 (Understand), K3 (Apply)**	PO1, PO3	Students translate abstract definitions of equilibrium, work, and energy conservation into clear thermodynamic balances distinguishing state and path functions.
CO5	Thermodynamic Ideal Gas Calculations	**K3 (Apply)**	PO1, PO3	Requires calculating explicit changes (w, q, ΔU, ΔH) across variable boundary limits using rigorous physical chemistry models.

CO6	Entropy as a State Function	**K2 (Understand), K4 (Analyze)**	PO1, PO3	Requires explaining entropy as a state function and computing entropy changes across reversible and irreversible physical processes.
CO7	Kinetics Rate Laws & Gaseous Collision Theory	**K4 (Analyze)**	PO1, PO3	Requires calculating collision frequencies and extracting order or rate constants using multi-variable characteristic plots, including qualitative steric corrections.
CO8	Steady-State & Complex Reaction Pathways	**K4 (Analyze)**	PO1, PO3	Students dissect complete complex pathways, eliminate reactive intermediate transients mathematically, and map experimental rate constraints.
CO9	Analytical Titrations & Mixture Estimations	**K3 (Apply), K4 (Analyze)**	PO2, PO4, PO6	Requires active manipulation of physical apparatus, execution of multi-indicator titrations, and analysis and reporting of multi-component mixture composition.

<table>
<tr><td>Reading/Reference Lists</td><td colspan="2">1. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
3. Nasipuri, D. Stereochemistry of Organic Compounds, Wiley Eastern Limited.
4. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Robinson, M. J. T., Stereochemistry, Oxford Chemistry Primer, Oxford University Press, 2005.
6. Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford
University Press
7. Castellan, G. W. Physical Chemistry, Narosa
8. McQuarrie, D. A. & Simons, J. D. Physical Chemistry: A Molecular Approach, Viva Press
9. Levine, I. N. Physical Chemistry, Tata McGraw-Hill.
10. Mortimer, R. G. Physical Chemistry, Elsevier.
11. Ball, D. W. Physical Chemistry, Thomson Press.</td></tr>
<tr><td>Evaluation</td><td>Theory: 60
Internal: 15 (CIA: 10; Other form of Assessment: 2; Attendance: 3)
Semester Exam: 45 (Gr. A: 15; Gr. B: 30)</td><td>Practical: 40
CA: 38, Attendance: 2</td></tr>
<tr><td>Paper Structure for Theory Semester Exam</td><td colspan="2">Gr. A: Attempt ONE out of TWO questions of 15 marks each.
Gr. B: Attempt TWO out of THREE questions of 15 marks each.</td></tr>
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