Semester	**1**
Programme	**CHEMISTRY**
Course	**MAJOR (ORGANIC CHEMISTRY 1)**
Paper Code	**C1CH230112T / C1CH230112P**
Credits	**4 (THEORY: 3; PRACTICAL 1)**
Hours/week	**6 (THEORY: 3; PRACTICAL 3)**
Category: Core/MDC/SEC/VEC	**CORE**
Theory / Practical / Composite	**COMPOSITE**
Number of Modules	**4 (THEORY: 3; PRACTICAL: 1)**
Syllabus	**Theory: 36 Lectures** **Module 1: Stereochemistry 1 (12 Lectures)** ***Projection of organic molecules****:* Fischer, Sawhorse, Flying-wedge and Newman projection formulae and interconversions. ***Chirality in molecules and optical activity****:* Stereoisomerism, chiral centre, stereogenic centre, molecular chirality, meso-compounds, pyramidal inversion; plane polarised light and polarimeter, optical rotation, specific rotation and molar rotation; racemic compounds, optical purity and enantiomeric excess. Symmetry elements in molecules. ***Configurational nomenclature****:* D/L and *R/S* configuration; *erythro/threo*, *pref/parf prefixes*, *syn/anti*, *E/Z* nomenclature, combination of *R/S*- and *E/Z*- isomerism. *Stereogenicity*, chirotopicity and pseudoasymmetry. ***Racemization and Resolution:*** Racemization through cationic, anionic, radical intermediates etc. Resolution of racemic acids, bases and alcohols. **Module 2: Chemistry of intermediates, polymerization and physical properties (12 Lectures)** ***Chemistry of intermediates:*** carbocations (carbenium and carbonium ions), carbanions, carbenes and nitrenes: generation and stability, structure using orbital picture and electrophilic/nucleophilic behavior of reactive intermediates (elementary idea). Chemistry of benzyne: generation and stability, structure using orbital picture and electrophilic & nucleophilic behavior of reactive intermediates (elementary idea). Carbon radicals: structure, generation, stability and reactivity. ***Polymerization:*** Introduction to polymerization, radical, cationic, anionic, backbiting, step growth and chain growth polymerization. ***Physical properties:*** Relative stabilities of isomeric hydrocarbons in terms of heat of hydrogenation, heat of combustion and heat of

	formation. Melting point/boiling point and solubility of common organic compounds in terms of covalent & non-covalent intermolecular forces. **Module 3: Substitution and Elimination Reactions** **(12 Lectures)** ***Nucleophilic substitution reactions:*** substitution at sp^3 centre: mechanisms (with evidence), relative rates & stereochemical features: S_N1, S_N2, S_N2', S_N1' (allylic rearrangement) and S_Ni; effects of solvent, substrate structure, leaving group and nucleophiles (including ambident nucleophiles, cyanide & nitrite); substitutions involving NGP; [systems: alkyl halides, allyl halides, benzyl halides, alcohols, ethers, epoxides]. ***Elimination reactions:*** E1, E2, E1cB and Ei (pyrolytic *syn* eliminations); formation of alkenes and alkynes; mechanisms (with evidence), reactivity, regioselectivity (Saytzeff/Hofmann) and stereoselectivity; comparison between substitution and elimination; importance of Bredt's rule relating to the formation of C=C. **Practical:** ***Identification of Pure Organic Compound*** Solid compounds: oxalic acid, tartaric acid, citric acid, succinic acid, resorcinol, urea, glucose, cane sugar, benzoic acid and salicylic acid. Liquid Compounds: formic acid, acetic acid, methyl alcohol, ethyl alcohol, acetone, aniline, dimethylaniline, benzaldehyde, chloroform and nitrobenzene. ***Determination of boiling point*** of common organic liquid compounds e.g., ethanol, cyclohexane, chloroform, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide, *etc*. [Boiling point of the chosen organic compounds should preferably be less than 160 °C]
Course Overview	**Theory:** To have basic knowledge about the 1. This major course offers an in-depth exploration of organic structure and reactivity. 2. Stereochemistry of Organic molecules 3. It covers advanced stereochemical concepts, including chirality, symmetry elements, and resolution techniques. 4. Reactive intermediates, polymerization and physical properties 5. The curriculum investigates the generation and behavior of complex reactive intermediates (carbenes, nitrenes, benzyne) and introduces the principles of polymerization. 6. Aliphatic substitution reactions and elimination reactions. 7. Students will analyze the mechanics and stereochemical features of diverse substitution (S_N1, S_N2, S_Ni, NGP) and elimination (E1, E2, E1cB) pathways. **Practical:** The practical module focuses on the systematic identification of pure solid and liquid organic compounds. Identification of pure solid and liquid organic compounds and determination of boiling point of solid and melting point of liquid organic compounds

Course Outcomes (COs)	Upon completion of this course, the student will be able to: CO1: Execute interconversions between Fischer, Sawhorse, Flying-wedge, and Newman projection formulae for given organic molecules. CO2: Analyze molecular symmetry elements to determine molecular chirality, optical activity, pseudoasymmetry, and configurational nomenclature D/L, R/S, E/Z, erythro/threo, pref/parf, syn/anti) CO3: Calculate optical purity and enantiomeric excess from experimental polarimetry data, and formulate chemical methodologies for the racemization and resolution of racemic mixtures. CO4: Explain the generation, structural orbital frameworks, relative stability, and reactivity profiles of reactive intermediates (carbocations, carbanions, carbenes, nitrenes, benzyne, and carbon radicals). CO5: Differentiate mechanisms of radical, cationic, anionic, backbiting, step-growth, and chain-growth polymerization processes. CO6: Evaluate the physical properties (melting/boiling points, solubilities) and thermodynamic stabilities of organic compounds utilizing intermolecular forces, heats of hydrogenation, combustion, and formation. CO7: Predict the products, relative rates, and stereochemical pathways of nucleophilic substitution reactions at sp3 carbons. CO8: Analyze the mechanisms, regioselectivity (Saytzeff vs. Hofmann), and stereoselectivity of elimination reactions (E1, E2, E1cB, Ei) while accounting for structural constraints like Bredt’s rule. CO9: Apply laboratory safety protocols and interpret experimental kinetic/stereochemical data to differentiate competing substitution and elimination pathways.

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.

Module	**Course Outcome (CO)**	**Cognitive Domain (Bloom's K-Values)**	**Mapped Program Outcomes (POs)**
Module I: Stereochemistry 1	**CO1:** Execute interconversions between Fischer, Sawhorse, Flying-wedge, and Newman projection formulae for given organic molecules.	**K3** (Applying)	**PO1:** Fundamental Knowledge **PO3:** Problem Solving
	CO2: Analyze molecular symmetry elements to determine molecular chirality, optical activity, pseudoasymmetry, and configurational nomenclature D/L,	**K2** (Understanding) **K4** (Analyzing)	**PO1:** Fundamental Knowledge **PO3:** Problem Solving

	R/S, E/Z, *erythro*/*threo*, *pref*/*parf*, *syn*/*anti*)		
	CO3: Calculate optical purity and enantiomeric excess from experimental polarimetry data, and formulate chemical methodologies for the racemization and resolution of racemic mixtures.	**K3** (Applying) **K6** (Creating)	**PO1:** Fundamental Knowledge **PO3:** Problem Solving **PO4:** Research Competency
Module II: Intermediates, Polymerization & Physical Properties	**CO4:** Explain the generation, structural orbital frameworks, relative stability, and reactivity profiles of reactive intermediates (carbocations, carbanions, carbenes, nitrenes, benzyne, and carbon radicals).	**K2** (Understanding) **K4** (Analyzing)	**PO1:** Fundamental Knowledge **PO3:** Problem Solving
	CO5: Differentiate mechanisms of radical, cationic, anionic, backbiting, step-growth, and chain-growth polymerization processes.	**K2** (Understanding) **K4** (Analyzing)	**PO1:** Fundamental Knowledge **PO5:** Interdisciplinary Applications
	CO6: Evaluate the physical properties (melting/boiling points, solubilities) and thermodynamic stabilities of organic compounds utilizing intermolecular forces, heats of hydrogenation, combustion, and formation.	**K4** (Analyzing) **K5** (Evaluating)	**PO1:** Fundamental Knowledge **PO3:** Problem Solving

Module III: Substitution and Elimination Reactions	**CO7:** Predict the products, relative rates, and stereochemical pathways of nucleophilic substitution reactions at sp3 carbons.	**K3** (Applying) **K4** (Analyzing)	**PO1:** Fundamental Knowledge **PO3:** Problem Solving
	CO8: Analyze the mechanisms, regioselectivity (Saytzeff vs. Hofmann), and stereoselectivity of elimination reactions (E1, E2, E1cB, Ei) while accounting for structural constraints like Bredt's rule.	**K4** (Analyzing)	**PO1:** Fundamental Knowledge **PO3:** Problem Solving
Cross-Cutting / Experimental	**CO9:** Apply laboratory safety protocols and interpret experimental kinetic/stereochemical data to differentiate competing substitution and elimination pathways.	**K3** (Applying) **K5** (Evaluating)	**PO2:** Laboratory Skills **PO3:** Problem Solving **PO6:** Communication Skills

Reading/Reference Lists	**Theory:** 1. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012. 2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003. 3. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited. 4. Carey, F. A., Guiliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012. 5. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.

	6. Nasipuri, D. Stereochemistry of Organic Compounds, Wiley Eastern Limited. 7. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 8. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education) 9. Fleming, I. Molecular Orbitals and Organic Chemical Reactions, Reference/Student Edition, Wiley, 2009. 10. James, J., Peach, J. M. Stereochemistry at a Glance, Blackwell Publishing, 2003. 11. Peacock, A. J., Calhoun, A. Polymer Chemistry: Properties and Applications, Hanser Gardner Publications, 2006. 12. Robinson, M. J. T., Stereochemistry, Oxford Chemistry Primer, Oxford University Press, 2005. **Practical:** Nad, Mahapatra, Ghosal-Practical Chemistry	
Evaluation	Theory: 60 Internal: 15 (CIA: 10; Other form of Assessment: 2; Attendance: 3) Semester Exam: 45	Practical: 40 CA: 30; Attendance 2 Semester Exam: 08
Paper Structure for Theory Semester Exam	Answer THREE out of FOUR, 15 marks of each questions.	