

DISCIPLINE SPECIFIC ELECTIVE COURSE - 16 (DSE-16): Reactive Intermediates of Organic Chemistry

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
Reactive Intermediates of Organic Chemistry (DSE-16)	04	02	--	02	Class 12 th with Physics, Chemistry	-

Course Objectives

The objectives of this course are as follows:

To learn and understand the involvement of intermediates, their role in reaction mechanisms, predict their behavior, and apply this knowledge to organic synthesis. Also, to learn and understand the orbital interactions (Woodward-Hoffmann rules) in concerted reactions.

Learning outcomes

By studying this course, the students will be able to:

- Understand the structure-reactivity pattern of reactive intermediates involved in organic reactions.
- Analyse the mechanism of organic reactions involving reactive intermediates and apply these reactions in organic synthesis

Unit 1: Carbocations and Carbanions (11 Hours)

Difference between classical and non-classical carbocations. Introduction of neighboring group participation (NGP), ion-pairs, molecular rearrangements in acyclic, monocyclic, and bicyclic systems, stability and reactivity of bridgehead carbocations.

Generation, structure and stability, ambident ions and their general reactions; HSAB principle and its applications.

Unit 2: Carbenes and Nitrenes (12 Hours)

Structure of carbenes, generation of carbenes, addition and insertion reactions, rearrangement reactions of carbenes such as Wolff rearrangement, generation and reactions of ylid by carbenoid decomposition. Examples of inter/intramolecular insertions.

Structure of nitrene, generation and reactions of nitrene and related electron-deficient nitrogen intermediates, Curtius, Hoffmann, Schmidt, Beckmann rearrangement reactions.

Unit 3: Ylides (2 Hours)
Chemistry of Phosphorus and Sulfur ylides – Wittig and related reactions, Peterson olefination.

Unit 4: Radicals (5 Hours)
Generation of radical intermediates and their addition to: i) on alkenes, alkynes (inter & intramolecular) for C-C bond formation and Baldwin's rules. ii) fragmentation and rearrangements. Name reactions involving radical intermediates, such as Barton deoxygenation and decarboxylation, McMurry coupling.

Practicals: Credits: 02

(Laboratory periods: 15 classes of 4 hours each)

(Experiments 1 and 2 are compulsory)

1. Separation, purification, and identification of binary mixtures of organic compounds (neutral and acidic; neutral and basic) using chemical methods and preparation of a suitable crystalline derivative for both the components.

2. **Two-step synthesis**

2.1 *To carry out the synthesis of triacetoxybenzene*

Step 1: Synthesis of *p*-benzoquinone from hydroquinone using KBrO₃ and

Step 2: Synthesis of Triacetoxybenzene from *p*-benzoquinone.

2.2 *To carry out the synthesis of p-acetamido benzene sulphonamide*

Step 1: Synthesis of *p*-Acetamido benzene sulfonyl chloride from acetanilide and

Step 2: Synthesis of *p*-Acetamido benzene sulphonamide from *p*-Acetamido benzene sulfonyl chloride.

2.3 *To carry out the synthesis of benzopinacolone*

Step 1: Synthesis of benzopinacol from benzophenone

Step 2: Synthesis of benzopinacolone from benzopinacol *via* pinacol-pinacolone rearrangement.

Essential/recommended readings

Theory:

1. Carey and R. A. Sundberg, Advanced Organic Chemistry, Part B: Reactions and Synthesis, 5th edition, Springer, New York, 2007.
2. Carruthers and I. Coldham, Modern Methods of Organic Synthesis, First South Asian Edition 2005, Cambridge University Press.
3. March and M. B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 6th Edition, Wiley, 2007.

Practical:

1. Vogel, A. I. (2012), Quantitative Organic Analysis, Part 3, Pearson Education.
2. Mann, F. G., Saunders, B.C. (2009), Practical Organic Chemistry, Pearson Education.
3. Furniss, B. S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. (2012), Vogel's Textbook of Practical Organic Chemistry, Fifth Edition, Pearson.
4. Ahluwalia, V.K., Dhingra, S. (2004), Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press.
5. Ahluwalia, V. K., Aggarwal, R. (2004), Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press
6. Pasricha, S., Chaudhary, A. (2021), Practical Organic Chemistry: Volume-I, I K International Publishing house Pvt. Ltd, New Delhi

7. Pasricha, S., Chaudhary, A. (2021), Practical Organic Chemistry: Volume-II, I K International Publishing house Pvt. Ltd, New Delhi

Assessment Methods: All examination and assessments methods shall be in line with the University of Delhi guidelines issued from time to time.