

## Semester II

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### CHE-HC-2016: ORGANIC CHEMISTRY I

(Credits: Theory-04, Lab-02)

Theory: 60 Lectures

**Course Objectives:** This course is inducted to apprise students with introduction to organic compounds, electron displacement, type of reagents and reaction intermediates. The chemistry of aliphatic and aromatic hydrocarbon, conformational analysis of cycloalkanes and basic stereochemical phenomena are included.

Students are expected to learn different classes learn, explain, describe and analyze different classes of organic compounds, their reactivities and mechanisms along with stereo chemical considerations.

**Learning Outcome:** Students will be able to identify different classes of organic compounds, describe their reactivity and explain/analyze their chemical and stereo chemical aspects.

#### Basics of Organic Chemistry

*Organic Compounds:* Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.

*Electronic Displacements:* Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

(8 Lectures)

#### Stereochemistry:

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis-trans and, syn-anti isomerism E/Z notations with C.I.P rules.

*Optical Isomerism:* Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

(16 Lectures)

#### Chemistry of Aliphatic Hydrocarbons

### **A. Carbon-Carbon sigma bonds**

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

### **B. Carbon-Carbon pi bonds:**

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

*Reactions of alkenes:* Electrophilic additions and their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

*Reactions of alkynes:* Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

### **C. Cycloalkanes and Conformational Analysis**

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

**(24 Lectures)**

### **Aromatic Hydrocarbons**

*Aromaticity:* Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

**(12 Lectures)**

### **Recommended Books:**

1. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London, 1994.
4. Nasipuri, D. *Stereochemistry of Organic Compounds*, Wiley Eastern Limited.
5. Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, New Age International, 2005.
6. Subrata Sen Gupta, *Basic Stereochemistry of Organic Molecules*, Oxford Higher Education.
7. Dhillon, R. S.; Singh, I. P. & Baskar, C. *Stereochemistry*, Narosa.
8. Loudon, G. M. *Organic Chemistry*, Oxford.

9. Sykes, P. *A guidebook to Mechanism in Organic Chemistry*, Pearson Education, 2003.
  10. Clayden, J., Greeves, N. & Warren, S. *Organic Chemistry*, Second edition, Oxford University Press, 2012.
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## LAB

### 60 Lectures

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents:
  - a. Water
  - b. Alcohol
  - c. Alcohol-Water
3. Determination of the melting points of above compounds and unknown organic Compounds.
4. Effect of impurities on the melting point – mixed melting point of two unknown organic Compounds.
5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and use of thiele tube method)
6. Chromatography
  - a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
  - b. Separation of a mixture of two sugars by ascending paper chromatography
  - c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

### Recommended Books

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009).
  2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5<sup>th</sup> Ed.*, Pearson (2012)
  3. Vogel, A. I. *Elementary Practical Organic Chemistry, Part 2: Qualitative Organic Analysis*, CBS Publishers and Distributors.
  4. Bhattacharyya, R. C, *A Manual of Practical Chemistry*.
  5. Dutta, S, B. *Sc. Honours Practical Chemistry*, Bharati Book Stall.
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