

## ALLIED COURSE PAPER - I

### CONCEPTUAL ORGANIC CHEMISTRY

Marks: 150

Organic chemistry is the chemistry of carbon compounds and is probably the most active and important field of chemistry, due to its extreme applicability to both, life and industry. Organic chemistry involves few basic principles and many extensions and applications of these principles. After studying this paper one gets an insight of these principles. Many reactions would be discussed which are used in day to day life. Three dimensional structures of organic molecules will also be covered in this paper.

### THEORY

#### Unit 1: Stereochemistry

Writing of Fischer projection, Newmann and Sawhorse projection and Wedge formulae. Interconversion of one type of structural representation into another type of formulae.

**Conformations** : Restricted rotation about single bonds, Various conformations of ethane, butane, ethane-1,2-diol and cyclohexane. Relative stability of different conformations in terms of energy difference is to be discussed for all these compounds.

**Geometrical Isomerism** : Requirements for a molecule to show geometrical isomerism, Cis-Trans and E/ Z notation along with CIP rules for naming geometrical isomers.

**Optical Isomerism** : Optical activity, specific and molar rotation, chirality, enantiomerism, diastereoisomerism, racemic mixtures and their resolution by salt formation method.

**Relative and absolute configuration**: D / L nomenclature system for configuration of carbohydrates (difference between d/l and D/L notations). Threo and Erythro designation. R- and S- configuration (upto two chiral centers).

#### Unit 2: Addition Reactions

**Alkenes and Alkynes** : Hydrogenation, addition of halogens, Hydrohalogenation (Markovnikov's and antiMarkovnikov's addition), hydration, hydroxylation (cis and trans), oxymercuration-demercuration, hydroboration-oxidation, ozonolysis. Reactivity of alkenes vs alkynes.

**Aldehydes and ketones** : (formaldehyde, acetaldehyde, benzaldehyde, acetone)

Addition of sodium bisulphite, hydrogen cyanide and alcohols.

Addition- elimination reactions with ammonia and its derivatives

**Name reactions** : Aldol, cross Aldol, Claisen, Knoevenagel, Cannizzaro, cross Cannizzaro

### Unit 3: Substitution Reactions

**Free radical substitution reactions:** Halogenation of alkanes, allylic compounds and alkyl benzenes.

**Nucleophilic substitution reactions:** Alkyl, allyl and benzyl halides – substitution of halogen by some common nucleophiles. mechanism of  $S_N1$  and  $S_N2$  reactions (stereochemistry, nature of substrate, nucleophile and leaving group)

**Benzene diazoniumchloride:** replacement of diazo group

**Alcohols, amines and phenols:** substitution of active hydrogen, replacement of hydroxyl group in alcohols (using  $PCl_5$ ,  $SOCl_2$  and HI)

**Carboxylic acid derivatives:** hydrolysis

**Ethers:** cleavage by HI

**Electrophilic Substitution Reactions** (aromatic compounds) : General mechanism of electrophilic substitution reactions (nitration, halogenation, sulphonation, Friedel Crafts alkylation and acylation), directive influence of substituents.

### Unit 4: Elimination Reactions

Alkyl halides (dehydrohalogenation, Saytzeff's rule), vicinal dihalides (dehalogenation), alcohols (dehydration), Quaternary ammonium salts (Hofmann's elimination). Mechanism of  $E1$  and  $E2$  reactions (nature of substrate and base), elimination vs substitution

### Unit 5: Oxidation

**Aromatic side chain** : oxidation with potassium permanganate, potassium dichromate

**Alcohols** : oxidation with potassium permanganate, potassium dichromate, catalytic dehydrogenation and Oppenauer oxidation. Oxidation of 1,2 –diols with periodic acid and lead tetraacetate.

**Aldehydes** : oxidation with potassium permanganate, chromic acid and Tollen's reagent

**Ketones** : oxidation with potassium permanganate, sodium hypoiodite (iodoform reaction) and Baeyer – Villiger oxidation

### Unit 6: Reductions

**Aldehydes and ketones** : catalytic hydrogenation, reduction with sodium borohydride, lithium aluminium hydride, Clemmensen, and Wolff-Kishner reduction.

**Carboxylic acids and their derivatives** : Lithium aluminium hydride, sodium-ethanol and Rosenmund reduction.

**Nitro compounds** : Acidic, alkaline and neutral reducing agents, lithium aluminium hydride and electrolytic reduction.

### Recommended Texts:

1. I. L. Finar : *Organic Chemistry* (Vol. I & II), Pearson Education, VI Edition, 1973.

- R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Pearson Education, VI Edition, 1992,
- Arun Bahl and B. S. Bahl : *Advanced Organic Chemistry*, S. Chand & Co. Ltd. III Edition, 1987.
- Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry*, Pearson Education, VI Edition, 2003.
- Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*; Wiley: London, 1994.
- T. W. Graham Solomon's : *Organic Chemistry*, John Wiley and Sons, IX Edition, 2008
- P.S. Kalsi, *Stereochemistry, Conformation and Mechanism*, New Age International Publishers, VII Edition, 2008.
- D.Nasipuri, *Stereochemistry of Organic Compounds*, New Age International Publishers 2011.

## PRACTICAL

### PURIFICATION OF ORGANIC COMPOUNDS AND ORGANIC PREPARATION AND RELATED REACTIONS

- Purification of organic compounds by crystallization using the following solvents:
  - Water
  - Alcohol
- Determination of the melting points of organic compounds (by Kjeldahl method and electrically heated melting point apparatus).
- Determination of optical activity by using polarimeter  
**Organic preparations** : Carry out the following preparations using 0.5-1 g. of starting compound. Recrystallize the product and determine the melting point of the recrystallized sample.
  - To prepare acetanilide by the acetylation of aniline.
  - To prepare p-bromoacetanilide.
  - Benzoylation of aniline or  $\beta$ -naphthol by Schotten-Baumann reaction
  - Hydrolysis of benzamide or ethyl benzoate.
  - Semicarbazone derivative of one the following compounds: acetone, ethyl methyl ketone, diethylketone, cyclohexanone, benzaldehyde.
  - Nitration of nitrobenzene.
  - Oxidation of benzaldehyde by using alkaline potassium permanganate.

#### Recommended Texts:

- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry*, Pearson Education, V edition 2012.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Longman, London & New York, IV Edition 2009.
- Ahluwalia, V.K.; Dhingra, S. & Gulati, A. *College Practical Chemistry*, Universities Press 2005.