

T.Y.B.Sc, CHEMISTRY
(Three Units)
Choice Based Credit System

SEMESTER V

ORGANIC CHEMISTRY

COURSE CODE: USCH503

CREDITS: 02

LECTURES: 30

Unit I

1.1 Mechanism of organic reactions (10 L)

- 1.1.1 The basic terms & concepts: bond fission, reaction intermediates, electrophiles & nucleophiles, ligand, base, electrophilicity vs. acidity & nucleophilicity vs basicity.
- 1.1.2 Neighbouring group participation in nucleophilic substitution reactions: participation of lone pair of electrons, kinetics and stereochemical outcome.
- 1.1.3 Acyl nucleophilic substitution (Tetrahedral mechanism): Acid catalysed esterification of carboxylic acids ($A_{AC}2$) and base promoted hydrolysis of esters ($B_{AC}2$).
- 1.1.4 Pericyclic reactions, classification and nomenclature
 - 1.1.4.1 Electrocyclic reactions (ring opening and ring closing), cycloaddition, sigma tropic rearrangement, group transfer reactions, cheletropic reaction (definition and one example of each type)
 - 1.1.4.2 Pyrolytic elimination: Cope, Chugaev, pyrolysis of acetates

References:

1. A guidebook to mechanism in Organic Chemistry, 6th edition, Peter Sykes, Pearson education, New Delhi
2. Organic Reaction Mechanism, 4th edition, V. K. Ahluvalia, R. K. Parashar, Narosa Publication.
3. Organic reactions & their mechanisms, 3rd revised edition, P.S. Kalsi, New Age International Publishers.
4. M.B.Smith and J. March, advanced organic chemistry- reactions mechanism and structure, 5th edition.

1.2 Photochemistry (5 L)

- 1.2.1 Introduction: Difference between thermal and photochemical reactions. Jablonski diagram, singlet and triplet states, allowed and forbidden transitions, fate of excited molecules, photosensitization.
- 1.2.2 Photochemical reactions of olefins: photoisomerisation, photochemical rearrangement of 1,4-dienes (di- π methane)
- 1.2.3 Photochemistry of carbonyl compounds: Norrish I, Norrish II cleavages. Photoreduction (e.g. benzophenone to benzpinacol)

References:

1. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.
2. Organic chemistry, 8th edition, John McMurry

Unit II

2.1 Stereochemistry I

(5 L)

- 2.1.1 Recapitulation
- 2.1.2 Molecular chirality and elements of symmetry: Mirror plane symmetry, inversion center, rotation-reflection (alternating) axis.
- 2.1.3 Chirality of compounds without a stereogenic centre: cumulenes and biphenyls.

References:

1. L. Eliel, stereochemistry of carbon compounds, Tata McGrawHill
2. Stereochemistry P.S.Kalsi, New Age International Ltd., 4th Edition
3. Stereochemistry by Nassipuri.

2.2 Agrochemicals

(4 L)

- 2.2.1 General introduction & scope, meaning & examples of insecticides, herbicides, fungicide, rodenticide, pesticides, plant growth regulators.
- 2.2.2 Advantages & disadvantages of agrochemical
- 2.2.3 Synthesis & application of IAA (indole Acetic acid) & Endosulphan,
- 2.2.4 Biopesticides – Neem oil & Karanj oil.

References:

1. Insecticides & pesticides : Saxena A. B., Anmol publication.
2. Growth regulators in Agriculture & Horticulture: Amarjit Basra, CRC press 2000

2.3 Heterocyclic chemistry:

(6 L)

- 2.3.1 Reactivity of pyridine-N-oxide, quinoline and iso-quinoline.
- 2.3.2 Preparation of pyridine-N-oxide, quinoline (Skraup synthesis) and iso-quinoline (Bischler-Napieralski synthesis).
- 2.3.3 Reactions of pyridine-N-oxide: halogenation, nitration and reaction with $\text{NaNH}_2/\text{liq. NH}_3$, $n\text{-BuLi}$.
- 2.3.4 Reactions of quinoline and isoquinoline; oxidation, reduction, nitration, halogenation and reaction with $\text{NaNH}_2/\text{liq. NH}_3$, $n\text{-BuLi}$.

References

1. Name Reactions in Heterocyclic Chemistry, Jie-Jack Li, Wiley-Interscience publications, 2005.
2. Handbook of Heterocyclic Chemistry, 2nd Edition, Alan R. Katritzky and Alexander F. Pozharskii, Elsevier Science Ltd, 2000.
3. Heterocyclic Chemistry, 5th Edition, John A. Joule and Keith Mills, Wiley publication, 2010.
4. Heterocyclic chemistry, 3rd Edition, Thomas L. Gilchrist, Pearson Education, 2007.

Practicals

SEMESTER V

ORGANIC CHEMISTRY

COURSE CODE: USCHP11

CREDITS: 01

A) Separation of solid-solid mixture.

5. 1. Minimum 4 mixtures to be given to the students.
6. 2. Components of the mixture should include water soluble and water insoluble acids
7. (carboxylic acid), water insoluble phenols(2-naphthol, 1-naphthol), water insoluble bases
8. (nitroanilines) , water soluble neutral (Thiourea) and water insoluble neutral compounds
9. (anilides, amides, m-DNB, hydrocarbons)
10. 3. After correct determination of chemical type, the separating reagent should be decided by the
11. student for separation.
12. 4. After separation into component A and component B, drying, weighing & melting point to be taken (No identification).

References:

1. Practical organic chemistry – A. I. Vogel
2. Practical organic chemistry – Middleton.
3. Practical organic chemistry – O.P.Aggarwal.

SEMESTER VI

ORGANIC CHEMISTRY

COURSE CODE: USCH603

CREDITS: 01

LECTURES: 30

Unit I

1.1 Stereochemistry II

(10 L)

- 1.1.1 Stereoselectivity and stereospecificity : Idea of enantioselectivity (ee) and diastereoselectivity (de) , Topicity : enantiotopic and diastereotopic atoms, groups and faces.
- 1.1.2 Stereochemistry of –
 - i) Substitution reactions : $S_{\text{N}}1$ (reaction of alcohol with thionyl chloride)
 - ii) Elimination reactions: E_2 -Base induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane.
 - iii) Addition reactions to olefins:
 - a) bromination (electrophilic anti addition)
 - b) syn hydroxylation with OsO_4 and KMnO_4

c) epoxidation followed by hydrolysis.

References:

Refer Stereochemistry –I (Sem-V, Unit-II)

1.2 Amino acids & Proteins

(5 L)

1.2.1 α -Amino acids: General Structure, configuration, and classification based on structure and nutrition. Properties: pH dependency of ionic structure, isoelectric point and zwitter ion. Methods of preparations: Strecker synthesis, amidomalonnate synthesis, Erlenmeyer azalactone synthesis.

1.2.2 Polypeptides and Proteins: Polypeptides: Peptide bond. Nomenclature and representation of polypeptides (di- and tri-peptides) with examples.

References:

1. Biochemistry, 8th Ed., Jeremy Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto Pub. W. H. Freeman Publishers
2. Lehninger Principles of Biochemistry 7th Ed., David Nelson and Michael Cox, Publisher W. H. Freeman
3. Name Reactions – Jie Jack Li, 4th Edition, Springer Pub.

Unit II

2.1 Molecular Rearrangements

(5 L)

Mechanism of the following rearrangements with examples and stereochemistry wherever applicable.

2.1.1 Migration to the electron deficient carbon: Pinacol-pinacolone rearrangement.

2.1.2 Migration to the electron deficient nitrogen: Beckmann rearrangement.

2.1.3 Migration involving a carbanion :Favorski rearrangement.

2.1.4 Name reactions: Michael addition, Wittig reaction.

References:

Refer Mechanism of organic reaction (Sem-V, Unit-I)

2.2.1 Carbohydrates

(10 L)

2.2.2 Introduction: classification, reducing and non-reducing sugars, DL Notification

2.2.3 Structures of monosaccharides: Fischer projection (4-6 carbon monosaccharides) and Haworth formula (furanose and pyranose forms of pentoses and hexoses)

Interconversion: open chain and Haworth forms of monosaccharides with 5 and 6 carbons. Chair conformation with stereochemistry of D-glucose, Stability of chair form of D-glucose

2.2.4 Stereoisomers of D-glucose: enantiomer, diastereomers, anomers, epimers.

2.2.5 Mutarotation in D-glucose with mechanism

2.2.6 Chain lengthening of shortening reactions: Modified Kiliani-Fischer synthesis (D-arabinose to D-glucose and D-mannose), Wohl method (D-glucose to D-arabinose)

2.2.7 Reactions of D-glucose and D-fructose:

(a) Osazone formation (b) reduction: H_2/Ni , NaBH_4 (c) oxidation: bromine water, HNO_3 , HIO_4 (d) acetylation (e) methylation: (d) and (e) with cyclic pyranose forms

2.2.8 Glycosides: general structure

References:

1. Organic chemistry (fourth edition), G. Marc Loudon, Oxford University press.

2. Introduction to Organic Chemistry (Third edition), Andrew Streitwieser, Jr. Clayton H. Heathcock, Macmilan publishing.
3. Organic chemistry fourth edition, Morrison and Boyd.
4. Introduction to Organic chemistry, John McMurry.
5. Organic chemistry volume-1&2 (fifth and sixth edition) IL Finar.

Practicals

SEMESTER VI

ORGANIC CHEMISTRY

COURSE CODE: USCHP12

CREDITS: 01

Preparations: Drying, weighing & melting point (No Purification)

1. Aniline / p-toluidine → *N*-Acetyl derivative
2. Salicylic acid / nitrobenzene / Acetanilide → Nitro derivative
3. Hydrolysis of *p*-nitroacetanilide
4. Methyl salicylate / ethyl benzoate → Acid derivative (Hydrolysis)

References:

4. Practical organic chemistry – A. I. Vogel
5. Practical organic chemistry – Middleton.
6. Practical organic chemistry – O. P. Aggarwal.