Principles of Industrial Organic Chemistry

(Chemical Engineering)

Course Code: 22BC1108	L	T	P	C
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Course outcomes:

At the end of the Course the student shall be able to

CO1: Illustrate the basic principles of organic chemistry (L3).
CO2: Apply the basic concepts of stereochemistry in the synthesis of biologicallyactive compounds (L3).
CO3: Predict the mechanism and applications of some named reactions (L3).
CO4: Use the methods of preparation and synthetic applications of active methylenecompounds and dyes (L3).
CO5: Explain the significance of biomolecules (L2).

UNIT-I **8 Lectures**

ELECTRON DISPLACEMENT EFFECTS

Inductive effect - definition, types and applications - stability of carbocation, carbanions, carbon free radicals, comparison of acid strength of carboxylic acids and basic strength of amines.
Mesomeric effect - definition, types and applications with reference to strength and reactivity of organic compounds.
Electromeric effect - definition, types and applications in alkenes and carbonyl compounds Hyperconjugation - definition and applications with respect to stability of carbocations, carbon free radicals and stability of alkenes.

Learning outcomes:

At the end of the module the student will be able to

1. explain the stability of reaction intermediates (L2)
2. compare the strength of acidity and basicity of organic compounds(L3)
3. explain the reactivity of organic compounds (L2)

UNIT-II **10 Lectures**

STEREOCHEMISTRY

Configurational isomerism: Optical isomerism, Criteria for an optically active compound; Optical activity of Lactic acid and Tartaric acid. Relative and Absolute configuration-Sequence rules, R-S nomenclature; Geometrical isomerism - E -Z nomenclature.
Conformational isomerism: Conformations of ethane and n-butane; Bayer's strain theory-limitations, Sachey and Mohr theory, conformations of cyclohexane.

Learning outcomes
At the end of the module the student will be able to

1. illustrate the importance of stereochemistry (L3)
2. identify optically active compounds (L2)
3. describe configurational isomerism and conformational isomers(L2)

UNIT-III

NAME REACTIONS **10 Lectures**

Mechanism and applications of the following named reactions

a) Friedel-Crafts reaction b) Aldol condensation c) Riemer-Timer reaction d) Perkin's reaction e)Diels-Alder Reaction f) Grignard reagent- Reactions with active hydrogen molecules, carbonyl compounds, esters, cyanides, carbon dioxide and acid chlorides

Learning outcomes
At the end of the module the student will be able to

1. explain the mechanisms of the reactions (L2)
2. identify the intermediates of the reactions (L2)
3. apply the reactions in the synthesis of drug intermediates (L3)

UNIT – IV

ACTIVE METHYLENE COMPOUNDS AND DYES **14 Lectures**

Preparation of Malonic ester, isomerism- Acid hydrolysis of Malonic ester. Synthetic uses malonic ester with reference to synthesis of mono carboxylic acids (n-butyric acid isobutyric acid, and isovaleric acid), dicarboxylic acids (succinic acid and adipic acid), α,β-unsaturated carboxylicacids (crotonic acid), amino acid(glycine), ketocarboxylic acid (acetoacetic acid) ketones (ethylmethylketone), alicyclic acids(cyclopropanecarboxylic acid) and heterocyclics (Barbituric acid).

Preparation of Acetoacetic ester, isomerism-tautomerism, and Ketonic and Acid hydrolysis. Synthetic usesof acetoacetic ester with reference to synthesis of mono alkyl carboxylic acids (n-butyric acid and isobutyric acid), dicarboxylic acids(succinic and adipic acids), α,β - unsaturated acid(crotonic acid), amino acid(glycine), ketones (3-methyl-2-pentanone), 1,3 & 1,4diketones(acetylacetone and acetonylacetone) and alicyclic acids (acetycyclohexane) and heterocyclics (4-methyluracil).

DYES: Definition of dye, Classification based on chemical structure and method of application. Witt's theory of color and chemical constitution. Synthesis and uses of Congo red, Malachite green and Fluorescein.

Learning outcomes:
At the end of the module the student will be able to

1. identify the active methylene compounds (L2)
2. extend the applications of active methylene compounds(L2)
3. apply the synthetic strategy in synthesis of new molecules(L3)
4. classify various types of dyes (L2)

UNIT-V **8 Lectures**

BIOMOLECULES

Carbohydrates: Introduction-definition and classification, structural elucidation of glucose and fructose.Conversions: Kiliani-Fischer synthesis, Ruff's degradation.

Amino acids: Introduction-structure, configuration, preparation of amino acids, properties- zwitterion andisoelectric point; reactions of amino acids with ninhydrin and cupric oxide.

Proteins- Peptide linkage, structure of protein.

Learning outcomes:

At the end of the module the student will be able to

1. explain the structures of glucose and fructose (L2)
2. discuss the significance and synthesis of amino acids (L3)
3. identify the peptide linkage in proteins (L2)

Text Books:

1. Arun Bahl & B.S. Bahl, *Advanced Organic Chemistry*, Rev. Edition, S.Chand & Company Ltd, New Delhi, 2012
2. T. Morrison and Robert.N. Boyd, Organic Chemistry, 7th Edition, Pearson Education Publishers, 2011.
3. P.S. Kalsi, *Stereochemistry*: *Conformation and Mechanism*; 10th Edition, Newage international publishers, 2019.

Reference Books:

1. I.L Finar , *organic chemistry*, Volume I 6th Edition, Pearson Education Publishers, 2013.
2. I.L Finar, *organic chemistry*, Volume II, 5th Edition, Pearson Education Publishers, 2013.
3. O.P.Agrawal, *Reaction and Reagents*, Rev. Edition, Goel Publishing house, Meerut, India, 2018.