Semester-IV

# CHEMISTRY-BCHC-42 (ORGANIC CHEMISTRY-IV) CCCH9A

Theory (credit: 4, 60 lectures)

## Dynamic Stereochemistry of acyclic and cyclic compounds: 14 Lecture

Conformation, reactivity and mechanism of acyclic and cyclic systems, Asymmetric synthesis and asymmetric induction, Acyclic stereoselection, Addition of nucleophiles to carbonyl compounds: 1,2-asymmetric induction, Cram's open chain, cyclic(chelate) and dipolar model, Prelogs rule. The aldol reaction. Neighbouring group participation and molecular rearrangements.

Conformation and reactivity of alicyclic compounds, effect of substituent stereochemistry on reactivity of cyclohexane derivatives, steric effect, stereoelectronic effects, reduction of cyclic ketones and reaction of cyclic epoxides, neighbouring group effects, effect of conformation on rearrangment and transannular reactions in alicyclic system, lactonization reactions of cyclohexane systems, oxidation of cyclohexanols with chromic acid, steric assistance and steric hindrence. Diastereoselection in cyclic systems: Nucleophilic addition to cyclic ketones, formation of axial and equatorial alcohols.

## Heterocyclic Compounds: 12 Lectures

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of:

Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander’s synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch Reaction; Derivatives of furan: Furfural and furoic acid.

## Alkaloids &Terpenes: 6 Lectures

Natural occurrence, General structural features, Isolation and their physiological action Hoffmann’s exhaustive methylation, Emde’s modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neral and α-terpineol.

## Carbohydrates: 12 Lectures

Occurrence, classification and their biological importance.

Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani- Fischer synthesis and Ruff degradation;

Disaccharides – Structure elucidation of maltose, lactose and sucrose.

Polysaccharides – Elementary treatment of starch, cellulose and glycogen.

## Polynuclear Hydrocarbons: 8 Lectures

Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.

## Amino Acids, Peptides and Proteins: 8 Lecture

Amino acids, Peptides and their classification. α-Amino Acids -Synthesis, ionic properties and reactions. Zwitterions, p*K*a values, isoelectric point and electrophoresis;

Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups -Solid-phase synthesis

# COURSE: CCCH9B ; Organic Practical (credit: 2, 60 lectures)

## Practical

1. Organic preparations:
   * Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*toluidines and *o*-, *m*-, *p*-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method:
     1. Using conventional method.
     2. Using green approach
   * Benzolyation of one of the following amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-, *m*-, *p*-anisidine) and one of the following phenols (β-naphthol, resorcinol, pcresol) by Schotten-Baumann reaction.
   * Oxidation of ethanol/ isopropanol (Iodoform reaction).
   * Bromination of any one of the following:
     1. Acetanilide by conventional methods
     2. Acetanilide using green approach (Bromate-bromide method)
   * Nitration of any one of the following:
     1. Acetanilide/nitrobenzene by conventional method
     2. Salicylic acid by green approach (using ceric ammonium nitrate).
   * Selective reduction of *meta* dinitrobenzene to *m*-nitroaniline.
   * Reduction of *p*-nitrobenzaldehyde by sodium borohydride.
   * Hydrolysis of amides and esters.
   * Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
   * *S*-Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).
   * Aldol condensation using either conventional or green method.
   * Benzil-Benzilic acid rearrangement.
2. Extraction of caffeine from tea leaves.

# Learning Objective

* To learn the conformational and configurational effects on the reactivity of acyclic and cyclic compounds.
* The course aims at giving a fundamental theoretical understanding of heterocyclic chemistry, including alternative general methods for ring synthesis and application of such methods for the preparation of specific groups of heterocyclic systems.
* Moreover, it gives the quantitative ideas about the synthesis, properties and uses of such heterocyclic compounds like pyrole, pyridine qunolene, thiophene, furan etc.
* The student will get familiar with particular properties and reactions for the most important heterocycles as well as different systems of nomenclature.
* To make students familier with the structure, properties and activities of several polynuclear hydrocarbon.
* To gain knowledge on the chemistry of several primary and secondary metabolites.

# Learning Outcome

By the end of this course the students will be able to understand the effect of 3-D structure on the reactivity of a molecule. They can understand the importance of heterocyclic moieties in chemistry. In addition they understand the structure and function of several primary and secondary metabolites obtained from plant and animals.

# Recommended Texts

1. Clayden J., Greeves N., Warren S. & Wothers P. “Organic Chemistry”
2. Eliel, E. L., "Stereochemistry of Carbon Compounds"
   1. March, "Advanced Organic Chemistry: Reactions, Mechanisms, and Structure"
3. Vogel's Textbook of Practical Organic Chemistry