Semester III

# COURSE: CCCH6A: Organic Chemistry (Theory)

Credit 4 ; Lecture 60

## Alcohols, Phenols, Ethers and Epoxides: 8 Lectures

*Alcohols:* preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement.

*Phenols:* Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe’s–Schmidt Reactions, Fries and Claisen rearrangements with mechanism.

*Ethers and Epoxides:* Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH4

## Carbonyl Compounds: 20 Lectures

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH4, NaBH4, MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds: Michael addition. Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

## Carboxylic Acids and their Derivatives: 10 Lectures

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of

dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids;

Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmannbromamide degradation and Curtius rearrangement.

## Nitrogen and Sulphur containing compounds: 10 Lectures

Preparation and important reactions of nitro and nitroso compounds, nitriles and isonitriles. Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann’s exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.

Diazonium Salts: Preparation and their synthetic applications.

Preparation and reactions of thiols, thioethers and sulphonic acids.

## Organometallic compounds of Mg, Li, Cu, B, Si\**:*\*12 Lectures

Grignard reagent; Organolithiums; Gilman cuprates: preparation and reactions (mechanism with evidence); addition of Grignard and organolithium to carbonyl compounds; substitution on -COX; directed ortho metalation of arenes using organolithiums, conjugate addition by Gilman cuprates; Corey-House synthesis; abnormal behavior of Grignard reagents; comparison of reactivity among Grignard, organolithiums and organocopper reagents; Reformatsky reaction; Blaise reaction; concept of umpolung and base-nucleophile dichotomy in case of organometallic reagents.

# COURSE: CCCH6B (Organic Practical)

## Practical Organic Chemistry: Credit: 2: 60 Lecture

Identification with general reaction and tests of the following compounds

1. Methyl alcohol b) Ethyl alcohol c) Glycerol d) Acetone
2. Formic acid f) Acetic acid g) Aniline h) Nitrobenzene
3. Benzyl alcohol j) Tartartic acid k) Succinic acid l) Salicylic acid
4. Cane sugar n) Glucose m) Resorcinol

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## Learning objectives

1. To be acquainted with alcohols, phenols, ethers, epoxides and to know their chemical and physical properties.

2. To be acquainted with aldehydes, ketones and carboxylic acid derivatives and to know their chemical and physical properties.

1. To gain knowledge on the behaviour of seleveral nitrogenous compounds.
2. To get knowledge on the utility of differenct organo metallic reagents.

5. To understand the reactivity of different carbonyl compounds (aldehydes, ketones and their α,β-unsaturated analogs) towards various types of nucleophillic addition and nucleophilic addition-elimination reactions.

6. How to convert alcohols phenols, aldehydes and ketones, carboxylic acids to other derivatives and *vice-versa*.

7. How to write mechanisms of various nucleophilic addition, nucleophilic addition-elimination, nucleophilic substitution and other reactions of oxygenated and nitrogenated derivatives.

8. To understand how to use protecting group chemistry in multistep organic synthesis.

1. To identify practically some common organic compounds.

# Learning outcomes

By the end of this course, students will be able to:

1. Recognize various functional groups related to oxygenated and nitrogenated organic compounds.

2. Explain the structure and properties of oxygenated and nitrogenated compounds.

3. Predict mechanism of different reactions characteristic to oxygenated and nitrogenated compounds.

4. Identify practically some common organic compounds by exploiting their physical properties and characteristic chemical reactions.

# Recommended Texts

1. Clayden J., Greeves N., Warren S. & Wothers P. “Organic Chemistry”
2. Sykes, P. “Mechanism in Organic Chemistry” (6th ed.)

3. Dickens, T. K. and Warren, S. "Chemistry of the Carbonyl Group: A Step-by-Step Approach to Understanding Organic Reaction Mechanisms"

1. Finar, I. L. "Organic Chemistry"

5. Nad, A. K., Mahapatra, B., Ghoshal, A. "An Advanced Course in Practical Chemistry".