



# Fundamentals of Organic Chemistry

## CHEM 109

*For Students of Health Colleges*

Credit hrs.: (2+1)

*King Saud University*

College of Science, Chemistry Department

# Syllabus

## Introduction

Types of chemical bonds: (*Ionic and covalent bonds*) - Atomic and molecular orbital: (*sigma and pi bond*) - Hybridization ( $sp^3$ ,  $sp^2$ ,  $sp$ ) - Inductive effect, polarization, and Stability of carbocations - Classification of organic compounds and functional groups - Types of chemical reactions: (Substitution (*Free radical - electrophilic - nucleophilic*), *Elimination, Oxidation and reduction reactions*).

## Aliphatic Hydrocarbons

Classes of hydrocarbons: (*saturated and unsaturated*) – Nomenclature: (*IUPAC and common names*) – Isomerism: (*Structural and Geometrical*) - Physical properties of aliphatic hydrocarbons - Preparation of saturated hydrocarbons (Alkanes): (*Hydrogenation of unsaturated hydrocarbons - Hydrolysis of alkyl Grignard reagent - Reaction of lithium dialkyl cuprates with alkyl halides*) - Reactions of saturated hydrocarbons: (*Halogenations*) - Preparation of Unsaturated hydrocarbons: (Alkenes and Alkynes): (*Elimination reactions (Dehydration, dehydrohalogenation and dehalogenation reactions) and Saytzeff rule*) - Reactions of Unsaturated hydrocarbons: (*Electrophilic addition reactions (Markovnikov's rule), hydrogenation, halogenation, hydrohalogenation, and hydration - Oxidation reactions - Acidity of alkynes*).

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## Aromatic compounds

Aromaticity: structure and bonding requirements and Hückel's rule - Nomenclature of aromatic compounds - Electrophilic aromatic substitution reactions: (*Alkylation, acylation, halogenations, nitration and sulfonation*) - Effects of substituents on electrophilic aromatic substitution reactions - Side-chain reactions: (*Oxidation of alkylbenzenes*).

## Alcohols, Phenols and Ethers

Structure, classifications and nomenclature - Physical properties - Preparation of alcohols and phenols: (*Hydration of alkenes - Nucleophilic substitution reaction of alkyl halides - Reduction of aldehydes, ketones and acids - Addition of Grignard compounds to aldehydes and ketones*) - Preparation of Phenols: (*Benzene sulfonic acids*) - Preparation of ethers (*Williamson synthesis*) - Reactions of Alcohols, Phenols and Ethers: (*Salt formation of alcohols and phenols (Acidity of phenols and Reaction of Alcohols with Sodium metal) - Reactions of Alcohols and Ethers with Hydrogen halides - Conversion of Alcohols to alkyl halides - Oxidation of alcohols - Electrophilic substitution reactions of phenols*) - Alcohols with More Than One Hydroxyl Group; glycols.

**1<sup>st</sup> Midterm Exam 15 Marks**

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## Aldehydes and Ketones

Structure and Nomenclature - Physical properties - Preparation of aldehydes and ketones: (*Hydration of alkynes - Ozonolysis of alkynes - Friedel-Crafts acylation - Oxidation of alcohols*) - Reactions of aldehydes and ketones: (*Nucleophilic addition reaction (addition of hydrogen cyanide, Reduction, Grignard addition, addition of Alcohol (hemiacetal and acetal Formation), addition of ammonia and amine derivatives*).

## Carbohydrates

Definitions and Classification (*monosaccharides, disaccharides and polysaccharides*) – Monosaccharides: (*Nomenclature - Structure (Optical isomerism, cyclic structure, Fischer Projection, Haworth Formulas)*) - Reactions of Monosaccharides: (*Reduction and oxidation of monosaccharides*) – Disaccharides: (*Maltose, Cellobiose, Sucrose and Lactose*) – Polysaccharides: (*Cellulose and Starch*)

## Carboxylic acids and Their Derivatives

Structure and Nomenclature - Physical properties - Acidity of Carboxylic acids - Preparation: (*Hydrolysis of nitrile - Carbonation of Grignard reagents*) - Reactions of carboxylic acids: (*Salt Formation - Ester, amide, anhydride, and acid chloride formation*).

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## Amines

Structure of amines - Nomenclature of amines - Physical properties of amines - Basicity of amines - Preparation of amines: (*Reduction of nitro compounds, nitriles and amides - Alkylation of ammonia*) - Reactions of amines: (*Sulfa drugs - Diazonium salts (Formation and Replacement reactions)*)

**2<sup>nd</sup> Midterm Exam. 15 Marks**

## Amino Acids, Peptides ,and Proteins

-Sources, classification and Structure - The acid–base Properties of Amino Acids - Reactions of amino acids: (*The Ninhydrin Reaction, Peptides - Sanger reaction - Formation of an amide linkage (The peptide bond: Proteins)*) - Structure of proteins.

## - Nucleic Acids

Chemical Structure: (*General structure (Nucleoside, Nucleotide and Nucleic acids) - DNA; structure - RNA; structure and types*).

**Final Exam.40 Marks**

# References

- ❑ **Organic chemistry: A short course by I Harold Hart, David J. Hart and Leslie E. Craine, Houghton Mifflin Company, USA, 2012.**
- ❑ **Elements of Organic Chemistry (second edition) is written by Isaak Zimmerman and Henry Zimmerman and published by Macmillan Publishing Co., Inc. New York in 1983.**

❑ أسس الكيمياء العضوية - أ.د./ سالم بن سليم الذياب - الناشر: مؤسسة نافثة

