

**Soran University–Faculty of Science, Chemistry Department**

Program for 2nd year Chemistry

Subject: Organic Chemistry

Course Code: 2Y-1S-ORGCHEM

Contact hours a week: 2 hours theoretical + 3 hours practical

Total Credit: 3 units

Academic year 2014-2015

Designed by: Dr Kamal Hsanzadeh

**Introduction:**

Organic chemistry is the study of the structure, properties, composition, reactions, and preparation of carbon-containing compounds, which include not only hydrocarbons but also compounds with any number of other elements, including hydrogen (most compounds contain at least one carbon–hydrogen bond), nitrogen, oxygen, halogens, phosphorus, silicon, and sulfur. This branch of chemistry was originally limited to compounds produced by living organisms but has been broadened to include human-made substances such as plastics. The range of application of organic compounds is enormous and also includes, but is not limited to, pharmaceuticals, petrochemicals, food, explosives, paints, and cosmetics.

**Objective:**

a) A study of the fundamental concepts and basic physical and chemical properties of the major classes of the compounds of carbon.  Structure and reaction mechanisms will be introduced in relation to these properties and concepts.

a) To learn and master how to name (IUPAC nomenclature) the different classes of organic compounds.   
b) To introduce the different functional groups and to study their reactions.   
c) Study of reaction mechanisms, as a tool, to understand the reactivity of the different functional groups.   
d) To introduce and perform organic synthesis: making of molecules.   
e) To study the chemistry and reactivity of biomolecules.

**The practical works aim:**

In the laboratory the main objective is to learn all the basic techniques, such as reduction, oxidation condensation, nitration and sulfonation of aromatic compound, etc., and their application to more complex experiments.

**Unit 1: Benzene and Aromaticity**

Study of structure and bonding of benzene; nomenclature of aromatic compounds; electrophilic aromatic substitution: mechanism, different reactions, reactivity and orientation, activating and deactivating groups; Hückels rule; heterocyclic aromatic compounds.

**1.1** Sources and Names of Aromatic Compounds

**1.2** Structure and Stability of Benzene

**1.3** Aromaticity and the Hückel 4*n* + 2 Rule

**1.4** Aromatic Heterocycles: Pyridine and Pyrrole

**1.5** Other Aromatic Substitutions

**1.6** Electrophilic Aromatic Substitution Reactions: Bromination

**1.7** Alkylation and Acylation of Aromatic Rings: The Friedel–Crafts Reaction

**Unit 2: Alcohols, Ethers and Phenols.**

Study of Natural sources of alcohols; reactions that yields alcohols; reactions of alcohols; alcohols as Brønsted acids; oxidation of alcohols; ethers: nomenclature, and preparation; Epoxides and chemical carcinogenesis; phenols: nomenclature, acidity, and reactions.

**2.1** Naming Alcohols and Phenols and properties

**2.2** Preparation of Alcohols:

**2.2.1** Alcohols from Carbonyl Compounds: Reduction

**2.2.2** Alcohols from Carbonyl Compounds: Grignard Reaction

**2.3** Reactions of Alcohols

**2.4** Oxidation of Alcohols

**2.5** Phenols and Their Uses and reactions

**2.6** Names and Properties of Ethers

**2.7** Synthesis of Ethers

**2.8** Reactions of Ethers: Acidic Cleavage

**2.9** Reactions of Ethers: Claisen Rearrangement

**2.10** Cyclic Ethers: Epoxides

**2.11** Reactions of Epoxides: Ring-Opening

**Unit 3: Aldehydes and Ketones**

Kinds of carbonyl compounds: structure and properties of carbonyl groups; nomenclature of aldehydes and ketones; physical properties of aldehydes and ketones; sources of aldehydes and ketones; reactions of aldehydes and ketones; the Grignard reagents; the α-carbon and its hydrogens; enols and enolates; the Aldol condensation.

**3.1** Naming Aldehydes and Ketones

**3.2** Preparing Aldehydes and Ketones

**3.3** Oxidation of Aldehydes and Ketones

**3.4** Nucleophilic Addition Reactions of Aldehydes and Ketones

**3.4.1** Nucleophilic Addition of H2O: Hydration

**3.4.2** Nucleophilic Addition of HCN: Cyanohydrin Formation

**3.4.3** Nucleophilic Addition of Hydride and Grignard Reagents: Alcohol Formation

**3.4.4** Nucleophilic Addition of Hydrazine: The Wolff–Kishner Reaction

**3.4.5** Nucleophilic Addition of Alcohols: Acetal Formation

**3.4.6** Nucleophilic Addition of Phosphorus Ylides: The Wittig Reaction

**3.5** Conjugate Nucleophilic Addition to *α*, β-Unsaturated Aldehydes and Ketones

Practical Organic Chemistry - Module Structure

**Syllabus**

Experiment No. 1: Reduction of Benzophenone

Experiment No. 2: Preparation of Butanal

Experiment No. 3: Preparation of Benzyl alcohol

Experiment No. 4: Oxidation of Benzophenone by Sodium hypochlorit

Experiment No. 5: Aldol condensation: Synthesis of dibenzalacetone

Experiment No. 6: Photochemical Reaction: Preparation of Benzopinacol

Experiment No. 7: Nitration of p-xylene

Experiment No. 8: Sulfonation of p-xylene

**References for practical:**

**1)** Bansal R. K. (2009), “Laboratory Manual of Organic Chemistry “. 5th edition. New Delhi: Glorious Printer.

**2)** Bhutani S. P. and Chikara A., (2008), “Practical Organic Chemistry : Qualitative Analysis”. 1st edition. Delhi: Gopaljee Enterprises.

**3)** Fieser L. F. and Willimson K. L., (1983), “Organic Experiments”. 5th edition. USA.

**4)** John C. Gilbert and Stephen F. Martin (2011), “Experimental Organic Chemistry”. 5th edition. USA.

**5)** Pedersen S. F. and Myers A. M., (2011),”Understanding The Principle Of Organic Chemistry A Laboratory Course”. 1st edition. USA.

**6)** Pavia D. L, Lampman G. M., Kriz G. S. and Engel R. G, (2002),” Microsclae and Macrsclae Techniques in the Organic Laboratory”.1st edition. USA.

**7)** Mohrig J. R., Hammond C. N. and Schatz P. F., (2010),”Techniques in Organic Chemistry”. 3rd edition. New York: W.H. Freeman and Company.

**8)** Mayo D. W., Pike R. M. and Forbes D. C., (2011), “ Microsclae Organic Laboratory With Multistep and Multiscale Synthesis.5th edition.USA

**9)** Williamson K. L. and Masters K. M., (2011),” Macroscale and Miicrosclae Orgainc Experiments”. 6th edition. USA.

**10)** Pavia D. L., Lampman G. M., Kriz G. S. and Engel R. G., (2011), “ A Small-Scale Approach To Organic Laboratory Techniques”. 3rd edition. CANADA.

**Assessment**

Midterm:

Two Midterm exams for theoretical: 2×10%

Homework and Quizzes: 5%

One practical exam: 15%

Total mark: 40%

Final Exam:

One final written exam for theoretical: 40%

One final Written/practical for practical exam: 20%

Total Mark: 60%

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