



**NATIONAL UNIVERSITY OF ENGINEERING**  
**COLLEGE OF SCIENCES**  
**CHEMISTRY PROGRAM**

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**CQ112 – CHEMISTRY II**

**I. GENERAL INFORMATION**

<b>CODE</b>	: CQ112 Chemistry II
<b>SEMESTER</b>	: 2
<b>CREDITS</b>	: 5
<b>HOURS PER WEEK</b>	: 7 (Theory – Practice - Laboratory)
<b>PREREQUISITES</b>	: CQ111 Chemistry I
<b>CONDITION</b>	: Compulsory

**II. COURSE DESCRIPTION**

The course prepares students for the analysis of the structure properties, and reactions of organic compounds and organic materials. Students analyze the structure, properties and behavior of the different types of organic compounds regarding their synthesis processes, extraction, transformation, usability, toxicity against environment agents. It includes the study of alcohols, ethers, and hydrocarbons. Students also understand the principles of spectroscopy for the measurement of different elements and compounds. Laboratories experiences are carried out to verify the validity and applicability of laws and principles. Problems with engineering applications are analyzed and solved.

**III. COURSE OUTCOMES**

1. Understand the structure and properties of main organic compounds.
2. Understand the laws of organic chemistry in the context of petroleum chemistry within the relationship: synthesis-applications-toxicity-environment.
3. Formulate relationships between the structural aspects of organic compounds and their physical-chemical properties.
4. Understand the structure and properties of alcohols and ethers, as well as their sources, preparation methods and reactions.
5. Understand the principles of spectroscopy, its types and its use for the determination and measurement of different types of elements and compounds.
6. Carry out practical experiences and controlled reactions with organic compounds.

**IV. LEARNING UNITS**

**1. ALKANES AND CYCLO-ALKANES**

Organic chemistry / Alkanes / Cyclo-alkanes / Hydrocarbons / Natural gas / Petroleum / Alkanes reactions: halogenation / Combustion.

**2. STEREO-CHEMISTRY**

Stereo-isomery / Enantiomer, simmetry / Diastereomers / Meso compounds / Optical activity / Reactions involving stereo-isomers.

**3. ALKYL HALIDE**

Alkyl halides / Nomenclature, uses, toxicity, distribution / Environmental pollution / Sn2 reactions / Sn1 reactions / E1 reactions / E2 reactions / Organo-metallics.

#### 4. ALKENES

Structure and nomenclature of alkenes / Physical properties / Preparation and synthesis / Reactions: electrophilic addition / Hydrogenation, hydrogenation heat / Addition to alkenes via free radicals / Alkenes oxidation reactions / Allylic substitution by free radicals.

#### 5. DIENES

Dienes: Classification, structure, stability / S-cis and S-trans formations / Polyenes nomenclature: isoprenic rule / 1,2 and 1,4 addition reactions / Diels-Alder reactions.

#### 6. ALKYNES

Structure and nomenclature / Physical properties / Acetylene, industrial sources, uses / Acetylene flame / Preparation and synthesis / Electrophilic addition reactions / Oxidation.

#### 7. ALCOHOLS AND ETHERS

Structure and nomenclature / Natural sources / Physical properties / Alcohol sources and synthesis / Ethane / Preparation of alcohols and ethers / Reactions of alcohols and ethers.

#### 8. HYDROCARBONS

Structure and general properties / Types / Saturated hydrocarbons / Unsaturated hydrocarbons / Aromatic hydrocarbons / Reactions: substitution, addition, combustion / Hydrocarbon mixtures / Fractional distillation / Usage / Energy storage / Safety / Biohydrocarbons.

#### 9. SPECTROSCOPY

**Magnetic resonance. Nuclear magnetic resonance NMR.** Resonance phenomena ( NMR apparatus / Chemical displacement / Number of signals. Equivalent hydrogen / Spin-spin couplings / Multiplicity of coupling signals / Interpretation of NMR spectrum.

**Mass spectrometry MS.** Introduction / Isotope abundance / MS apparatus / Ion molecular determination of molecular weight / Fragmentation / Fragmentation models: alkanes, alkenes, R-X, R-OH, R-O-R and aromatics.

### VI. METHODOLOGY

The course consists of theory, practice and laboratory sessions. The instructor presents the concepts and chemical principles using applets and videos. Problems related to engineering are solved with active student participation. Laboratory experiences are carried out for analyzing and verifying the structure, properties of organic compounds. For every experience, students work in group and present a report summarizing main results, analysis and conclusions. Student active participation is promoted.

### VII. GRADING SYSTEM

The Final Grade (FG) is calculated with the following formula:

$$FG = (EP + EF + PP) / 3$$

EP: Mid-term exam

EF: Final exam

PP: Average of quizzes and laboratories

### VIII. BIBLIOGRAPHY

1. Wade, L.  
Organic Chemistry, 2011, Prentice Hall Hispanoamerican.
2. McMurry, J.  
Organic Chemistry, 2009, International Thomson Editions.
3. Yufera, E.  
Basic and Applied Organic Chemistry, Vol. I and II, Barcelona, Reverte Edit.