NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING
PETROCHEMICAL ENGINEERING PROGRAM

PQ322 – ORGANIC CHEMISTRY II

I. GENERAL INFORMATION

CODE	**:**	PQ322 Organic Chemistry II
SEMESTER	**:**	6
CREDITS	**:**	5
HOURS PER WEEK	**:**	7 (Theory – Practice - Laboratory)
PREREQUISITES	**:**	PQ311 Organic Chemistry I
CONDITION	**:**	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 / Diasteromers / 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 alkenos via free radicals / Alkenos oxidation reactions / Alilic 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.