Organic Chemistry

Academic Year: (2023 / 2024) **Review date: 05/05/2022 09:41:05**

Department assigned to the subject: Materials Science and Engineering and Chemical Engineering Department

Coordinating teacher: SERRANO PRIETO, MARIA BERNARDA

Type: Basic Core ECTS Credits : 6.0

Year : 1 Semester : 2

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

It is recommended to have completed a Scientific / Technical high school level (bachillerato)
General Chemistry, Course 1st (first semester)

LEARNING OUTCOMES

LEARNING OUTCOMES:

- Recognize the most common functional groups of organic compounds and use the basic naming rules according to the IUPAC.
- Identify the stereochemical aspects of organic molecules and the three-dimensional representation of organic structures with one or more stereogenic centers.
- Relate the structure of organic compounds with their reactivity and with acid-base properties
- Carry out transformations between functional groups in one or more stages.
- Analyze and solve problems, according to previously studied and reasoned models, of application of the theoretical concepts of the different topics.
- Apply the safety rules in the laboratory
- Correctly use the basic material of the laboratory, properly handle chemicals and their residues.
- To be able to handle basic laboratory techniques and interpret the experimental data obtained.
- Write reports, laboratory notebooks or scripts to reproduce the experiments carried out.
- Assess critically and from parameters of equity and sustainability, the applications of the knowledge acquired.
- Evaluate the impact in these areas of the use of products from Sustainable Chemistry.
- Being able to correctly apply chemical and physical protocols depending on the application for evaluating the environmental risks of products derived from Nanotechnology

DESCRIPTION OF CONTENTS: PROGRAMME

1. Structure and properties of organic compounds. Structure of organic compounds. Properties of organic compounds. Bond in organic compounds. Tetrahedral carbon geometry. Isomerism. Functional groups. Nomenclature. Molecular structure. Acids and Bases, Polar and Nonpolar Molecules. Deeper look: Organic Foods. Alkaloids

2. Alkanes and cicloalkanes. Physical properties. Bond-Dissociation Energies. Substituted alkanes. Structure of Alkyl Radicals: Hyperconjugation. Reactions of Alkanes. Stability and conformations of Cycloalkanes: Ring Strain. Conformations of Cyclohexane: Axial and Equatorial Bonds. Combustion. Deeper look: Petroleum. Cyclohexane, Adamantane, and Diamandoids.

3. Stereochemistry at Tetrahedral Centers. Enantiomers and the Tetrahedral Carbon, Chirality. Optical Activity. Sequence Rules for
Specifying Configuration. Diastereomers. Meso Compounds. Racemic Mixtures and the Resolution of Enantiomers. Deep looks: Chiral Drugs

4. Alkyl halides. Halogenation. Nucleophilic bimolecular and unimolecular substitution: SN2 and SN1 reactions. Preparation of alkenes: unimolecular and bimolecular elimination reactions: E1 and E2.

5. Alkenes, dienes and alkynes. Structure and reactivity of alkenes: physical properties of alkenes; Cis¿Trans Isomerism in alkenes and stereochemistry; stability of alkenes; reactions of alkenes: electrophilic addition reactions, reduction and oxidation; radical additions to alkenes: Radical Additions: anti-Markovnikov product formation, chain-growth polymers. Radical mechanism substitution reactions. Preparation of alkenes. Dienes: Stability of Conjugated Dienes. Diels-Alder reactions. Deeper look: Terpenes: Naturally Occurring. Biological Additions of Radicals to Alkenes. Synthesis of Antitumor Drugs. Polymers and natural and synthetic rubbers. The Diels-Alder Reaction is ¿Green¿. Properties of alkynes; Preparation of alkynes; Reactions of alkynes: electrophilic addition reactions and anti-Markovnikov Additions reactions. Deep look: Ethyne as an Industrial Starting Material. Alkynes in Nature and in Medicine.

6. Spectroscopy. Radiation-matter interaction. UV-Visible Spectroscopy. UV-Visible and conjugation: color. Fluorescence. Infrared spectroscopy. Nuclear magnetic resonance. Chemical shift. 1H-NMR and 13C-NMR. Spin¿spin splitting: coupling constant.

7. Aromatic Compounds. Sources and Names of Aromatic Compounds. Structure and Stability of Benzene. Aromaticity. Aromatic Heterocycles: Pyridine and Pyrrole. Synthesis of Benzene Derivatives: Electrophilic Aromatic Substitution: Bromination, Alkylation, Acylation and Other Aromatic Substitutions. Deeper look: Compounds Made of Pure Carbon: Graphite, Graphene, Diamond, and Fullerenes. Explosive Nitroarenes: TNT and Picric Acid

8. Alcohols, phenols, and ethers. Naming alcohols and phenols. Properties of alcohols and phenols. Preparation of alcohols: from carbonyl compounds: Reduction, Grignard Reaction. Reactions of alcohols: Dehydration of alcohols. Oxidation of alcohols and phenols and their uses. Reactions of phenols. Deeper look: Ethanol: Chemical, Drug, Poison. Alcohol oxidation in the body. Names and Properties of Ethers. Synthesis of Ethers. Reactions of Ethers. Reactions of Epoxides: Ring-Opening. Thiols and Sulfides. Deeper Look: Epoxy Resins and Adhesives

9. Adehydes and ketones. Structure of the Carbonyl Group. Naming the Aldehydes and Ketones. Preparation of Aldehydes and Ketones. Reactivity of the Carbonyl Group: Mechanisms of Addition: addition of water to form hydrates, addition of alcohols to form hemiacetals and acetals, nucleophilic addition of ammonia and its derivatives. Deoxygenation of the carbonyl group. Addition of hydrogen cyanide to give cyanohydrins. Addition of phosphorus Ylides: the Wittig Reaction. Enols, enolates and the aldol condensation. alpha-beta- Unsaturated Aldehydes and Ketones. Oxidative Chemical Tests for Aldehydes. Worked Examples: Integrating the Concepts. Reactions in Nature and in the Laboratory.

10. Carboxylic acids and derivatives Naming the Carboxylic Acids. Structural and Physical Properties of Carboxylic Acids. Acidic and Basic Character of Carboxylic Acids. Carboxylic Acid Synthesis in Industry. Methods for Introducing the Carboxy Functional Group. Substitution at the Carboxy Carbon: The Addition¿Elimination Mechanism. Carboxylic Acid Derivatives: Acyl Halides and Anhydrides. Esters. Esters in Nature: Waxes, Fats, Oils, and Lipids. Amides. Reduction of Carboxylic Acids by Lithium Aluminum Hydride. Biological Activity of Carboxylic Acids. Deeper look: Long-Chain Carboxylates and Sulfonates Make Soaps and Detergents. Green Plastics, Fibers, and Energy from Biomass-Derived Hydroxyesters.

11. Amines Naming Amines. Structure and properties of amines. Basicity of amines and arylamines. Biological Amines . Synthesis of Amines. Reactions of Amines and Arylamines. Heterocyclic Amines. Deeper Look: Green Chemistry II: Ionic Liquids.

12. Biomolecules. Carbohydrates. Lipids. Amino acids, proteins and enzymes. Nucleic acids and protein synthesis. Metabolic processes and energy production. Deeper look: Saturated Fats, Cholesterol, and Heart Disease. Statin Drugs

LEARNING ACTIVITIES AND METHODOLOGY

PRESENTIAL
-Master Classes: these are systematic and orderly exposition sessions of the subject's agenda and selected problems are solved in detail to exemplify the implementation of the theoretical contents. Their objective will be that students acquire the specific competences of each subject and/or course.
-Classroom practical classes: in these sessions we work on the applications of the contents of the subjects, including numerical examples, case analysis, data search, directed work, gamma sessions,

etc. The aim is to show students how to act.
-Practical laboratory classes and computer practices: the student will carry out supervised experimental or computer work in specialized laboratories in which he/she will put into practice the theoretical knowledge acquired in the different subjects and will learn to work safely in the laboratory.
-Individual and/or small group tutorials: this is a personalized attention to students, in a face-to-face way and where a teacher attends, facilitates and guides one or several students in the training process. They allow the teacher to follow the learning process
-Evaluation Tests
-Study and group work: it consists of preparing seminars, problems, exercises, readings, obtaining and analyzing data, etc., to expose or deliver in class through the work of students in groups, so that they acquire the ability to work as a team and learn through interaction between them
NON PRESENTIAL
-Individual Study and Self-Employment: to develop the capacity for self-learning Includes the same activities as group work but done individually. It also includes personal study (preparing examinations, further reading, problem solving and exercises) which is essential for autonomous learning.
-Preparation of reports, writing practice reports (laboratory, fieldwork, computer), writing papers on current issues related to the development and applications of science and technology etc.

METHODOLOGIES
-Expository method: oral presentations by the teacher supported, if necessary, with computer material (PowerPoint, videos, etc.). They provide the transmission of knowledge and activation of cognitive processes in the student.
-Problem-based learning: development of active learning through problem solving, which confronts students with new situations in which they have to seek information and apply new knowledge to solve problems.
-Cooperative learning: encourages the development of autonomous learning, through collaboration between peers.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	55
% of continuous assessment (assigments, laboratory, practicals…):	45

The learning results will be evaluated throughout the course through different evaluation methods, whose contribution to the final grade will be as follows:

Final written exam 55%
Periodic testing 35%
Carrying out of experimental practices 10%

Attendance and participation in the classroom will be recommended but not evaluable, with the weight of the final grade being 0%

CONTINUOUS ASSESSMENT:
Laboratory practices divided into 4 sessions and reporting, weighting 10% of the final grade for the course. Attendance at the laboratory and delivery of reports is mandatory. The theoretical and practical knowledge, skills and competences (not laboratory) will be assessed through knowledge tests, distributed throughout the course, and delivery of individual or small group work, with a weighting of 35% of the final grade. In this way, continuous assessment will contribute 45% to the final grade.

FINAL EXAM: Weights 55% of the final mark and will be obtained through a knowledge test at the end of the course. In order to pass the course, the minimum mark for this exam must be above than 3,5 (out of 10).