Organic Chemistry

Code: 102446
ECTS Credits: 8

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Degree	Type	Year
2500897 Chemical Engineering	FB	2

Contact

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

It is very convenient for the student to review the general concepts acquired in the first year subject Fonaments de Química. In particular, the part that refers to chemical and acid-base equilibrium.

Minimum knowledge of organic nomenclature is necessary.

Remember that it is a face-to-face subject where part of the assessment will be carried out in class hours (theory and / or problems). For this reason, it is highly recommended not to be enrolled in other subjects that overlap the hours scheduled to this subject.

Objectives and Contextualisation

To make the student to be able to identify the main functional groups and their corresponding degrees of oxidation.

To make the student to acquire a basic structural knowledge of organic molecules and organic stereochemistry.

To make the student to be able to identify the possible synthetic precursors of the main functional groups as well as have a basic knowledge of their reactivity.

Competences

- Apply relevant knowledge of the basic sciences, such as mathematics, chemistry, physics and biology, and the principles of economics, biochemistry, statistics and material science, to comprehend, describe and resolve typical chemical engineering problems.
- Develop personal work habits.
- Develop thinking habits.

Learning Outcomes

1. Associate the properties and reactivity of the main families of bioorganic compounds with the functional groups that they contain.
2. Be able to classify organic compounds and recognise reactivity from the functional groups that are present.
3. Develop independent learning strategies.
4. Develop scientific thinking.
5. Identify simple organic compounds from the spectroscopic and analytical properties of their functional groups and relate the structural characteristics with their physical and chemical properties.
6. Propose effective synthetic pathways for the preparation of simple organic compounds and evaluate synthesis processes of simple organic compounds using criteria of energetic and atomic economics (green chemistry).
7. Understand the concept of stereoisomerism and be able to identify the type and number of stereoisomers in a certain organic compounds.
8. Understand the essential principles of the stability and reactivity of organic compounds.

Content

1. Introduction. Basic concepts in Organic Chemistry

Chemical bond Lewis structures and resonance. Atomic orbitals, hybrid orbitals and molecular orbitals. Polarity and Intermolecular forces. Structures and formulas of organic molecules. Oxidation state. Classification of the compounds according to the oxidation state and its functional group. Thermodynamics and equilibrium. Kinetics and reaction mechanisms: elemental and step reactions, coordinate and reaction profile, transition state, reaction intermediate, catalysis. Organic Nomenclature. Acids and Bases in Organic Chemistry.

2. Stereochemistry

Isomerism. Chirality Stereogenic center *R*/*S* nomenclature. Enantiomers and diastereomers. Racemic mix meso form. Fischer projections. Optical activity, optical purity. Isomerism of alkenes *cis-trans* (*Z*/*E*). Chiral molecules and their biological importance.

3. Alkanes

Classes of alkanes: homologous series. Physical properties Sources of obtaining alkanes, fractional distillation. Halogenation reactions of alkanes: homolytic and heterolytic bond breaking, chain reactions, reactivity / selectivity.

4. Alkenes and alkynes

Physical properties. Sources for obtaining of alkenes: cracking of naphtha. Obtaining of alkenes by elimination. Hydrogenation reactions of alkenes. Addition reactions to alkenes. Isomerization of alkenes. Polymerization of alkenes. Reactions of oxidation of alkenes. General reactivity of alkynes.

5. Aromatic compounds

Benzene: electronic structure. Resonance Criteria of aromaticity. Aromatic Electronic Substitution Reactions (SEAr): Effects of substituents in SEAr, reactivity and orientation.

6. Compounds with oxidation state = 1:

Halides of alkyl, alcohols, ethers, amines, thiols, thioethers. Concepts: Nucleophilic and electrophilic. Nucleophilicsubstitution reactions (mechanisms S_N1-S_N2). Elimination reactions (*E*1-*E*2 mechanisms). Basicity and nucleophilicity of amines.

7. Compounds with oxidation state = 2:

Aldehydes and ketones. Structure and reactivity of the carbonyl group. Synthesis of aldehydes and ketones reactions. Oxidation and reduction reactions. Nucleophilic addition reactions. Ketals and hemiketals. Schiff Bases of Carbohydrates. Aldolic condensation.

8. Compounds with oxidation state= 3 and 4:

Carboxylic acids and derivatives. Urethanes and carbamates Acid structure and character. Synthesis reactions. Interconversion reactions of carboxylic acids and their derivatives: halides of acid, anhydrides, esters, amides. Amino acids, peptides and proteins. Carboxylic acids and derivatives of industrial interest: synthetic fibers, lipids and natural fats. Urethanes and carbamates.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory Sessions	35	1.4	1, 2, 4, 5, 8
Lecture Classes	30	1.2	1, 2, 4, 7, 8
Seminars	5	0.2	1, 2, 4, 5, 7, 8
Solving Exercices Sessions	15	0.6	1, 2, 4, 5, 6, 7, 8
Type: Autonomous			
Solving Exercices	30	1.2	1, 2, 3, 4, 5, 6, 7, 8
Study and application of the concepts explained in classes	74	2.96	1, 2, 3, 4, 5, 7, 8

According to the objectives of the subject, the student in the course of the semester must be involved in a series of activities to achieve the established objectives.

In general, teaching activities can be grouped into three different types:
Theoretical classes: In this case, students receive a series of knowledge articulated exclusively by the professor. This scientific-technical knowledge is intended to serve as a basis for further maturation by students. To teach these classes, it is planned to do so through a chat-type communication platform, such as Microsoft TEAMs. In any case, as far as possible, student participation will be encouraged through the revitalization of classes by resolving cases and questions on a regular basis. As a complement to the classes, students will be given facilities to consult via e-mail in relation to aspects that require a more personal clarification. In some cases, students will be prompted to answer short questions through the Moodle platform with which, the objectives to be achieved could be evaluated.
Problem solving classes: At the beginning of each topic, students will have a collection of problems with which students will put into practice, the knowledge acquired in the Theory classes and the tasks that derive from. The problem-solving classes will focus on answering all the problems that the allotted time allows. Special emphasis will be placed on the active participation of students in solving the problems that arise as well as proposed exercises. These exercises, in some cases, will be proposed so that through the solutions proposed by the students, the objectives to be achieved can be assessed.

Seminars: Throughout the course there will be sessions dedicated to clarifying doubts and / or correcting assessment tests. We will try to teach these sessions in person.
Practice sessions: Face-to-face practice sessions will be organized in the laboratory related to the contents of the theoretical classes and the problem-solving classes. Attendance is mandatory at all sessions.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
2 Mid-term exams	60%	6	0.24	1, 2, 4, 5, 6, 7, 8
1 Retake Exam	60%	3	0.12	1, 2, 4, 5, 6, 7, 8
Laboratory Sessions	25%	2	0.08	1, 2, 3, 4, 5, 8
Quick Answer Questions delivery	15%	0	0	1, 2, 3, 4, 5, 6, 7, 8

1. General

The assessment regulations are shown below. In addition, the first day of class an explanation will be held about the procedures of the subject where emphasis will be placed on the evaluation of the subject.

In this subject, the scientific-technical knowledge of the subject obtained by the students, as well as their capacity for analysis, synthesis and critical reasoning, are evaluated individually. The overall grade of the subject will be calculated based on 3 marks each with a different contribution:

Part 1: Written Exams (60% contribution to the total of the course).

Part 2: Exercises (15% contribution to the total of the course).

Part 3: Laboratory Practices (25% contribution to the total of the course).

2. Parts in which the overall assessment of the subject is divided

Below is a detail of each of the parts:

2.1. Part 1: Exams (60%):

2.1.1. Partial exams (60%):

Two written partial exams: The evaluated subject will include all that is taught from the beginning of the course or from after the 1st exam, until the date of the test in the first and second parts, respectively. The mark obtained in the 1st part contributes 30% and that of the 2nd 30% both on the overall mark of the subject.

2.2.2. Final test (retake) (60%):

The subject evaluated will include all that taught during the course. This test has two purposes:

a) Anyone who has not passed the course with the partial examinations must submit to approve the course. The grade you get will be equal to the average of the two partials and will contribute 60% to the final mark of the subject.

b) Any student who has passed the course through partial exams can submit to raise the mark of Part 1. It is allowed for the students in this case to decide at the end of the examination time whether it is delivered or not. In case of delivery, the mark that will eventually count as Part 1 will be the final exam. If not delivered, the note will be obtained by partial exams average.

2.2. Part 2: Exercises (15%):

Throughout the course, a number of brief questions will be proposed and collected, with quick response. These exercises may be proposed both in Theory classes and in Problems resolution. The number of issues to evaluate is not predetermined. The marks of these tests will contribute with 15% to the final mark.

Not presenting one of these exercises will be scored as 0.0 when doing the average to calculate the note in Part 2.

2.3. Part 3: Laboratory Practices (25%):

The practical sessions will have a weight of 25% on the final grade of the subject. This percentage will be distributed in: 10% attitude and results in the laboratory (no retake will be possible for this mark), 15% of a written exam that will be done at the end of the laboratory sessions. Attendance at the laboratory sessions is mandatory and in no case may be less than 80% to be able to pass the subject. Any absence must be justified to the professor responsible for the laboratory. Failure to comply with safety regulations in the laboratory will result in the immediate expulsion of the involved student and therefore the loss of the right to be evaluated of the practices with which it will not be able to pass the subject.

NOTE: Regular review of evaluation activities will begin at least twenty-four hours after the notes have been published.

3. Global Subject Qualification

It is defined:

3.1. A Student PASS THE SUBJECT WHEN:

3.1.1. Students who pass the subject will only be considered those who meet the following 2 sections a and b:

a) Have obtained at least 4 out of 10 points in each of the partial exams and also have an average equal to or greater than 5 points out of 10 (Part 1). Alternatively, in case of being submitted to the final exam, the mark is equal to or greater than 5 outof 10.

b) Have a mark of laboratory practices (Part 3) equal to or greater than 5 out of 10.The mark of the written examination of practices must be at least 4.

There is no minimum markwith respect to Part 2 (exercises carried out in class) the note that results in average of the sum of the notes of the exercises presented with respect to the total of the exercises proposed during the course, will be applied contributing 15% of the note of the subject.

3.1.2. Distinction. For each subject of the same syllabus, Distinctions resulting from calculating the five percent or fraction of the students enrolled in all the groups of teaching of the subject will be granted globally. Only students that have obtained a final grade of 9.00 or more can be awarded.

3.2. A Student who DOES NOT PASS THE SUBJECT

a) Any student who does not fulfill with any of the conditions mentioned in section 3.1.1. The mark that will be the one that results from applying the weighting between the different Parts mentioned in section 2.

b) A student who has plagiarized or committed any irregularity in any of the assessment activities.

3.3. Student with qualification of NOT AVALUABLE.

Non-valuable students will be considered those who:

a) If they are enrolled for the first time: They have not performed any of the written assessment tests (Part 1) nor the Laboratory Practices.

b) If they are enrolled for the 2nd time or more: They have not performed any of the written assessment tests (Part 1).

4. Irregularities:

Without prejudice to other disciplinary measures that are deemed appropriate, and in accordance with the current academic regulations, the irregularities committed by the student that can lead to a variation of the qualification of an act of self- evaluation. Therefore, copying or letting copy a practice or any other evaluation activity will imply suspending it with a zero, and if it is a condition to pass it, the entiresubject will be failed. No retake is planned for qualified assessment activities, and therefore the subject will be straight failed without opportunity to retake it in the same academic year.

5. Communication

The main communication tool for the subject, mark lists and news will be the virtual platform Moodle (Campus Virtual).

Bibliography

P.Y. Bruice. *Organic Chemistry* (6th Ed.) Prentice-Hall International - Pearson Education, 2010.

F.A. Carey. *Organic Chemistry* (8th Ed.) McGraw-Hill, 2011.

T.W.G. Solomons. *Organic Chemistry* (9th Ed.), Wiley Publishing, New York, 2008.

K.P.C. Vollhardt; N.E. Schore *Química Orgánica. Estructura y Función* (5ª Ed.), Omega, 2008.

W.R. Peterson. *Formulación y nomenclatura en Química Orgánica*, EUNIBAR, 1987.

Teaching Aids:

Guia Docent:

https://www.uab.cat/web/estudiar/llistat-de-graus/pla-d-estudis/guies-docents/x-1345467811508.html?param1=1

Chemical therminology Dictionary:

http://goldbook.iupac.org/

Nomenclature & Estructures:

http://www.freechemsketch.com/

Drawing structures and nomenclature practice Programme (Campus UAB Licensed):

ChemDraw: http://sitelicense.cambridgesoft.com/sitelicense.cfm?sid=1111; introduint l'adreça d'e-mail institucional: xxx@e-campus.uab.es

Virtual space for the subject (Campus Virtual), Moodle:

https://cv.uab.cat/portada/ca/index.html

Reaction Mechanisms : Organic Chemistry Portal:

https://www.organic-chemistry.org/namedreactions/

Software

Molecular structure drawings free edition programs:

https://chemaxon.com/products/marvin

https://www.acdlabs.com/resources/freeware/chemsketch/index.php

Language list

Information on the teaching languages can be checked on the CONTENTS section of the guide.