

**COURSE DATA****DATA SUBJECT****Code:** 36454**Name:** Organic Chemistry II**Cycle:** Undergraduate Studies**ECTS Credits:** 6**Academic year:** 2025-26**STUDY (S)**

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Facultat de Química	2	Second quarter
1929 - Double Degree Program in Physics and Chemistry	Facultat de Física	3	Second quarter
1934 - Double Degree Program in Chemistry-Chemical Engineering	Facultat de Química	3	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1110 - Degree in Chemistry	Organic Chemistry	COMPULSORY
1929 - Double Degree Program in Physics and Chemistry	Tercer Curso (Obligatorio)	COMPULSORY
1934 - Double Degree Program in Chemistry-Chemical Engineering	Tercer curso	COMPULSORY

COORDINATION

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SUMMARY

Organic chemistry is the branch of chemistry that studies the structure and reactivity of carbon compounds, generally known as organic molecules. Among these molecules are found the most essential compounds for life, such as lipids, carbohydrates, amino acids, proteins and nucleic acids. Also organic molecules are many substances with which we come into direct contact, such as fuels, glues, paints or textile fibers. A large group of organic compounds are those that have pharmacological activity and that are the basis of medicines. Pesticides, fertilizers and herbicides have changed agriculture and preservatives have helped to modify our eating habits. Now, not all organic compounds are beneficial, there are many of them that are harmful to health or to the environment and therefore, it is necessary to continue preparing compounds with better properties to replace those that present problems.

The knowledge of the structure and reactivity of organic compounds has the purpose of opening ways for the preparation of compounds that maintain all their beneficial characteristics minimizing undesirable side



effects.

The subject Organic Chemistry II is proposed as a continuation of knowledge acquired in Organic Chemistry I and will be complemented with Organic Chemistry III. Over all, they constitute the theoretical foundations of the Module of Organic Chemistry obligatory of the Degree in Chemistry and must be treated as a whole to show the perspective of the area that is intended to show the students.

The objectives that are intended to achieve in the subject can be summarized in the following points:

- Set the student's knowledge about the structure and bond in organic compounds.
- Study the different types of representation of organic molecules.
- Apply the general rules of nomenclature for organic compounds.
- Study the stereochemistry of organic compounds and the appropriate nomenclature rules.
- Identify the different functional groups present in organic molecules.
- Study the reactivity of the different functional groups that only contain carbon-heteroatom bonds.
- Study the methods of obtaining these functional groups.
- Study the mechanisms of the most important reactions in which these are involved functional groups.
- Design synthesis of organic compounds from certain starting products and that involve more than one reaction.

Regarding the Sustainable Development Goals (SDGs), it is expected that students will be able to acquire a special sensitivity for sustainable management of water (SDG 6), raw materials and energy sources (SDG 7), as well as for an environmentally friendly and sustainable development (SDGs 11, 12, 13, 14 and 15), in addition to being able to design, select and/or develop efficient chemical products, processes and/or analytical methodologies (SDG 7) that minimize their impact on the environment (SDGs 14 and 15), using alternative raw materials and reducing wastes (SDG 11).

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

The study of Organic Chemistry is based on the knowledge acquired in the subjects of General Chemistry I and General Chemistry II.

In the same way, the study of the Organic Chemistry II is based on the knowledge acquired in the Organic Chemistry I.

COMPETENCES / LEARNING OUTCOMES

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Act autonomously in learning, making well-founded decisions in various contexts, forming judgements based on experimentation and analysis, and applying knowledge to new situations.

Address new problems and propose strategies to solve them.

Collaborate effectively in work teams, assume responsibilities and leadership roles, and contribute to collective improvement and development.

Communicate effectively both orally and in writing, adapting to the context and audience.

Contribute to the design, development and implementation of solutions that respond to social demands, using the Sustainable Development Goals as a reference.

Demonstrate both inductive and deductive reasoning skills.

Demonstrate critical and self-critical thinking, considering professional ethics, moral values and social implications of the different activities carried out throughout the degree.

Demonstrate the ability to analyse, synthesise and reason critically.

Distinguish between the qualitative and quantitative aspects of chemical problems.

Distinguish the principles, procedures and techniques used in the determination, separation, identification and characterisation of chemical compounds.

Evaluate the risks involved in the use of chemical substances and laboratory procedures.

Express ideas correctly, both orally and in writing, in any of the official languages of the Valencian Community.

Identify chemical elements and their compounds, including their extraction, structure, reactivity, properties and applications.

Identify chemical processes in everyday life.

Identify the main types of chemical reactions and their associated key characteristics.

Implement sustainable and environmentally friendly methodologies.

Interpret the relationship between the variation in the characteristic properties of chemical elements and the Periodic Table.

Propose creative and innovative solutions to complex situations or problems in the field, addressing diverse professional and social needs.

Relate chemistry to other disciplines.

Relate theory to experimentation.

Solve problems effectively.

State the principles of thermodynamics and kinetics and their application in chemistry.



Understand and analyse, from the perspective of the degree programme, social inequalities based on sex and gender; integrate gender-sensitive approaches into problem-solving and solution design.

Use chemical terminology, nomenclature, conventions and units correctly.

DESCRIPTION OF CONTENTS

1. Conjugated compounds and ultraviolet spectroscopy

Stability of conjugated dienes: theory of molecular orbitals. Electrophilic additions to conjugated dienes: allylic carbocations. Kinetic and thermodynamic control of the reactions. The Diels Alder's cycloaddition reaction. Diene polymers: synthetic and natural rubbers. Interpretation of ultraviolet spectra: the effect of conjugation. Conjugation, color and the chemistry of vision

2. Benzene and aromaticity. Aromatic electrophilic substitution

Names and sources of aromatic compounds. Structure and stability of benzene. Aromaticity and the Hückel rule of $4n + 2$ electrons. Aromatic ions. Polycyclic aromatic compounds. Spectroscopy of aromatic compounds. Electrophilic aromatic substitution reactions: bromination. Other aromatic substitutions Alkylation and acylation of aromatic rings: Friedel-Crafts reaction. The effect of substituents on substituted aromatic rings. An explanation of the effect of substituents. Trisubstituted benzenes: additivity of the effects. Aromatic nucleophilic substitution. Benzyne. Oxidation of aromatic compounds. Reduction of aromatic compounds. Synthesis of polysubstituted benzenes.

3. Hydroxyl functional group: alcohols and phenols

Nomenclature and properties of alcohols and phenols. Alcohols as acids and bases. Formation of alkoxydes. Preparation of alcohols from carbonyl compounds: reduction. Preparation of alcohols from Grignard reagents. Alcohol reactions with strong acids: substitution and elimination processes through alkyl oxonium ions. Transpositions. Transformation of alcohols into alkyl halides by reaction with thionyl chloride and phosphorus tribromide. Oxidation of alcohols. Protection of alcohols. Phenols and their uses. Reactions of phenols. Spectroscopy of alcohols and phenols.

4. Ethers and epoxides. Thioles and sulfurs.

Nomenclature. Structure and physical properties of ethers . Synthesis of ethers from alcohols and mineral acids. Williamson synthesis of ethers. Reactions with strong acids. Claisen transposition of ethers. Cyclic ethers: epoxides. Opening of epoxides. Crown ethers. Thioles and sulfides: physical and chemical properties. Ethers spectroscopy.



5. Aldehydes and ketones: nucleophilic addition reactions

Nomenclature of aldehydes and ketones. Structure of the carbonyl group. Physical properties of aldehydes and ketones. Preparation of aldehydes and ketones from alcohols. Reactivity of the carbonyl group: nucleophilic addition mechanisms. Addition of water to form hydrates. Addition of hydrogen cyanide to give cyanohydrins. Addition of alcohols to form acetals and hemiacetals. Acetals as protective groups. Nucleophilic addition of ammonia and its derivatives. Reactions with organometallic compounds: preparation of alcohols. Reduction of carbonyl compounds: catalytic hydrogenation and reductions with metal hydrides. Deoxygenation of the carbonyl group. Oxidation of aldehydes and ketones. Spectroscopy of aldehydes and ketones.

6. Carboxylic acids and derivatives

Nomenclature of carboxylic acids. Structural and physical properties of carboxylic acids. Acidic and basic nature of carboxylic acids. Preparation of carboxylic acids. Substitution in carboxylic carbon: addition-elimination mechanism. Reactions of carboxylic acids. Nomenclature and properties of carboxylic acid derivatives. Acyl nucleophilic substitution reactions. Alkanoyl halides, anhydrides, esters, amides and nitriles. Relative reactivities and structural characteristics of carboxylic acid derivatives. Preparation of the acid derivatives from the corresponding acids. Chemistry of alkanoyl halides, anhydrides and esters: hydrolysis reactions, reactions with other nucleophiles and reduction reactions. Amides: similarities and differences with the other carboxylic acid derivatives. Reactions of nitriles: hydrolysis, reduction and reaction with organo-metals. Spectroscopy of carboxylic acids and derivatives.

7. Substitution reactions in alpha position of the carbonyl group

Acidity of the hydrogens in alpha of aldehydes and ketones: enolate ions. Keto-enol tautomeria. Halogenation in alpha of aldehydes and ketones. Bromination in alpha of carboxylic acids. Enolate formation: alkylation. Aldol condensation. Dehydration of aldoles: synthesis of enonas. Uses of the aldol reaction in synthesis. Crossed aldol condensation. Intramolecular aldol condensation. Condensing of Claisen. Condensing of mixed Claisen. Intramolecular Claisen condensation: Dieckmann reaction. Enoliation of beta-dicarbonyl compounds: stability and reactivity of their enolate anions. Decarboxylation of beta-ketoacids. Malonic synthesis and acetoacetic synthesis.

8. Amines. Other nitrogen-containing compounds

Nomenclature of amines. Structure and physical properties of amines. Acidity and basicity of amines. Formation of amines by alkylation reactions. Quaternary ammonium salts: Hofmann elimination. Synthesis of Gabriel. Synthesis of amines from other nitrogen compounds. Synthesis of amines by reductive amination. Synthesis of amines from carboxylic acid derivatives. Characteristics of aromatic amines. Reactions of arylamines. Other nitrogen-containing functional groups. Amine spectroscopy.

WORKLOAD

PRESENCIAL ACTIVITIES



Activity	Hours
Tutorials	9,00
Theory	51,00
Total hours	60,00

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	90,00
Preparation of lessons	0,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	90,00

TEACHING METHODOLOGY

The subject is designed so that the student is the protagonist of his/her own learning. The subject structure is:

- Theory classes and questions.- Theory lessons will introduce the students to the most fundamental aspects of the subject. The question sessions will be dedicated to the application of the specific knowledge that students have acquired in theory classes. Students must have previously worked on the questions to be solved. The answers will be discussed in class by both the teacher and the students. The classes should be complemented by personal study time.
- Tutoring.- In them the overall learning process of the students will be evaluated. In the tutorial sessions the professor could entrust written reports to the students. Furthermore, the tutorials will serve to solve any doubts that may have arisen during the classes and guide students on the most convenient work methods.
- Seminars-Talks: The Seminars-Talks will deal with complementary aspects of their formation in Organic Chemistry and will be dedicated to the presentation by a specialist of a relevant topic in current Chemistry. For this task, students will attend the event and answer a questionnaire prepared by the teacher.

EVALUATION

The minimum global qualification to pass the subject will be 5 points out of 10.

FIRST CALL

Continuous evaluation through the course. In this case, the following sections will be considered:



1. Direct evaluation by the teacher (5%): this evaluation will take into account different aspects, among which include:

Assistance and reasoned and clear participation in the discussions and questions in the class

Progress in the use of the language specific to organic chemistry

Troubleshooting and raising doubts

Critical spirit

2. Tutorials and Seminars (globally 15%): In this section the following aspects will be considered:

Assistance

Content and written presentation of the exercises proposed by the teacher (if applicable).

Rational and clear participation in the discussions.

3. Exams (80%): will be held on the date indicated by the Faculty and will be common to all groups of the subject. It will consist of theoretical and practical questions related to the subject explained during the teaching period. The global passing of the subject will necessarily entail having obtained a minimum score of 5 out of 10 points on the exam.

SECOND CALL

In the second call evaluation, the grade obtained by the student in the first call for sections 1 and 2 will be maintained but, section 3 will be re-evaluated.

Final warning

Copying or plagiarism of any assignment that is part of the evaluation will make it impossible to pass the course, and the student will be subject to the appropriate disciplinary procedures.



Please note that, according to Article 13 d) of the University Student Statute (RD 1791/2010, December 30), "it is the duty of a student to refrain from using or cooperating in fraudulent procedures in evaluation tests, in the work performed or in official University documents".

REFERENCES

BASIC

- McMURRY, J. Organic Chemistry, 9 Ed., Cengage Learning, 2016. Disponible en formato electrónico en la biblioteca.
- WADE, L. G. Química Orgánica, 9 Ed., Pearson Prentice Hall, 2017. Disponible en formato electrónico en la biblioteca.
- BRUICE, P. Y. Química Orgánica, 5 Ed., Pearson Prentice Hall, 2008. Disponible en formato papel y electrónico en la biblioteca.
- VOLLHARDT, K. P. C. Química Orgánica Estructura y Función, 5 Ed., Ediciones Omega, 2007. Disponible en formato papel en la biblioteca.
- EGE, S. Química Orgánica. 3 Ed., Editorial Reverté, 2000. Disponible en formato papel en la biblioteca.
- QUIÑO A CABANA, E.; RIGUERA VEGA, R. Nomenclatura y representación de los compuestos orgánicos, McGraw-Hill/Interamericana, 2013. Disponible en formato papel y electrónico en la biblioteca.
- ChemBioOffice Ultra, Perkin Elmer (CambridgeSoft) Amplia selección de aplicaciones y funcionalidades que permite a químicos y biólogos dibujar, formular, modelar y editar estructuras moleculares químicas y biológicas así como simular espectros de RMN de protón y carbono.

ADDITIONAL

- CLAYDEN, J.; GREEVES, N.; WARREN, S. Organic Chemistry, 2 Ed., Oxford University Press: Oxford, 2012. Disponible en formato papel y electrónico en la biblioteca.
- CLAYDEN, J.; WARREN, S. Solutions manual to accompany Organic Chemistry, 2 Ed., Oxford University Press: Oxford, 2013. Disponible en formato papel en la biblioteca.
- CAREY, F. A.; SUNDBERG, R. J. Advanced Organic Chemistry, 4 Ed., Plenum Press, 2000.
- QUIÑO A CABANA, E.; RIGUERA VEGA, R. Cuestiones y ejercicios de química orgánica: una guía de estudio y autoevaluación, 2 Ed., McGraw-Hill, 2004. Disponible en formato papel en la biblioteca.
- PETERSON, W.R. Formulación y Nomenclatura Química Orgánica. Eunibar.