Curso
2026/2027

Course Guide:

ORGANIC CHEMISTRY

FACULTY OF
CHEMICAL SCIENCES

1. IDENTIFICATION

Degree Program	Bachelor's Degree in Chemical Engineering			Code	801545
Course	Organic Chemistry			ECTS	9
Subject Area	Chemistry and Biochemistry				
Module	Chemical Technology				
Course Type	Compulsory	Course	Second	Semester	Annual
Responsible Department	Organic Chemistry				

Responsible teachers

Activity	Lecturer	Email	Office
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Group B

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2. OBJECTIVES

General Objective

To provide basic training in the knowledge of the structure, reactivity and synthesis of the main types of organic compounds, The student must understand the fundamentals of the reactivity of the functional groups present in the most important organic compounds and relate the structure to the reactivity, for which the main types of organic reactions and their relevance in the industrial world will be discussed.

Specific objectives

- Know the basic concepts of organic chemistry: nomenclature of organic compounds, structure of the most important functional groups, electronic effects, resonance theory, types of reactions and reaction intermediates.
- Distinguish the different types of isomerism that organic molecules present: constitution, configuration and conformation, and know how to represent their arrangement in space.
- Understand the relationship between the structure of the functional group and its characteristic reactivity.
- Apply the basic concepts of organic chemistry to understand the reactivity of functional groups and interpret the course of the most relevant organic reactions.

3. PRIOR KNOWLEDGE AND RECOMMENDATIONS

Priorknowledge

Following this course satisfactorily requires the student to have previously acquired the knowledge and competences corresponding to the following course of the first year: "*Basic Chemistry*", "*Fundamentals of Chemical Engineering*" and "*Thermodynamics and Chemical Kinetics*". Although enrolment is not formally conditioned on these prior knowledge, effective mastery of this knowledge is essential to follow this course with a reasonable prospect of success.

Recommendations

It is recommended that the student has a basic level of English that allows him or her to handle bibliography, search for information and communicate in that language.

4. CONTENTS

Brief description

Theoretical contents

Organic compounds: structure, classification and nomenclature. Organic reactions: types and mechanism. Saturated and unsaturated hydrocarbons. Compounds of petrochemical interest. Addition polymers: plastics and rubbers. Cyclical, alicyclic, and aromatic systems. Compounds with simple carbon-heteroatom bonds: halogenated derivatives, alcohols and ethers, amines. Properties and industrial interest. Compounds with functional groups with multiple carbon-heteroatom bonds: aldehydes and ketones, acids and acid derivatives. Industrial properties and applications. Condensation polymers of technological interest. Heterocyclic compounds and natural substances of interest. (In each family of compounds, attention will be paid to their properties, obtaining and practical and industrial interest).

Practical content

Isolation and purification of organic compounds. Organic reactions and characterization of organic compounds. Introduction to the synthesis of organic compounds of industrial interest.

Course syllabus

THEORETICAL

Topic 1: Introduction and Nomenclature

Concept of Organic Chemistry. Characteristics of organic compounds. Sources of organic compounds. Concept of radical, functional group and homologous series. Hydrocarbons: classification and nomenclature. Constitutional Isomery. Nomenclature and formulation of the main homologous series.

Topic 2: Electronic structure of organic molecules

The covalent bond in Organic Chemistry. Electronic structure of methane, ethane, ethylene and acetylene. Link polarity. Electronic effects: inductive effect and conjugative effect. Resonance. Intermolecular forces in organic chemistry.

Topic 3: Organic reactions

Organic reactions. Main types of organic reactions. Reaction mechanisms. Homolithic and heterolithic processes. Main reaction intermediates. Electrophilic and nucleophilic reactions. Energy profile of the reactions. Structure and relative stability of free radicals, carbocations and carbanions.

Topic 4: Alkanes and cycloalkanes

Conformational isomers. Conformational analysis. Cycloalkanes: stability and annular tension. Cis-trans isomerism. Chemical reactivity of alkanes. Substitution reactions by radical mechanism: halogenation. Applications.

Topic 5: Stereochemistry

Stereochemistry. Concept of chirality. Enantiomería. Representation on the plane and three-dimensional. Absolute configuration. Molecules with two chiral centers: diastereoisomers, meso forms. Epimeral. Biological and technological importance of stereoisomerism.

Unsaturated hydrocarbons

Topic 6: Alkenes, dienes and alkynes.

Alkenes and cycloalkenes. Structure. Stereoisomerism. Chemical reactivity of the double bond. Hydrogenation: relative stability of alkenes. Electrophilic addition reactions. Oxidation of double bonds: hydroxylation and ozonelysis. Cyclopropanation reactions. Polymerization. Allyl substitution reactions. Dienos. Structure and reactivity of conjugated dienes Addition 1,2- and 1,4. Diels-Alder's reaction. Polymerization. Alkynes. Structure of the triple bond. Reactivity. Acidity of terminal alkynes: acetylides. Electrophilic addition reactions. Addition of water: concept of tautomery. Hydrogenation.

Topic 7: Arenes

Structure of benzene. Aromaticity concept. Benzene reactivity. Electrophilic substitution reactions in benzene: mechanism. Electrophilic substitution reactions in substituted benzenes. Side chain reactions. Condensed aromatic hydrocarbons: generalities. Industrial applications.

Compounds with single carbon-heteroatom bonds

Topic 8: Halogenated derivatives

Alkyl halides. Nucleophilic substitution reactions: mechanisms and stereochemistry. Elimination reactions: mechanisms and stereochemistry. Elimination-substitution competition. Organometallic compounds. Concept. Types and nomenclature. Structure and general reactivity.

Topic 9: Alcohols and phenols

Acidity of alcohols and phenols: influence of substituents. Ester formation. Dehydration of alcohols: transpositions. Formation of ethers. Transformation of alcohols into alkyl halides. Oxidation of alcohols and phenols. Hydrogenation and electrophilic substitution reactions in phenols. Industrial aspects of alcohols and phenols.

Topic 10: Ethers, epoxies and sulphur compounds

Reactions of the ethers. Epoxy opening. Ethers and epoxides of industrial importance. Organic sulfur compounds: thiols and thioethers. Sulfonic acids and other sulfur compounds.

Topic 11: Amines. Other nitrogenous compounds

Amines. Structure of the amines. Acid-base properties of amines. N-alkylation and N-acylation reactions. Electrophilic substitution reactions in aromatic amines. Arenodiazozonium salts. Structure and substitution reactions of the diazonium group. Reactions without nitrogen loss: copulation. The dye industry. Amines of industrial interest.

Compounds with multiple carbon-heteroatom bonds

Topic 12: Aldehydes and Ketones

Structure of the carbonyl group. General reactivity of carbonyl compounds. Nucleophilic addition reactions: addition and addition-elimination. Reduction and oxidation of carbonyl compounds. Aldehydes and ketones of industrial importance. Enolyzable carbonyl compounds. Acidity. Ketoenolic tautotomy. Aldol condensation reactions.

Topic 13: Carboxylic acids and derivatives

Carboxylic acids. Structure of the carboxyl group. Acidity. Nucleophilic substitution on the acyl group: transformation into acid derivatives. Acid derivatives. Main types. Relative reactivity. Hydrolysis reactions. Interconversion reactions. Reduction reactions. Other specific reactions. Condensation polymerization: polyesters, polyamides and polyurethanes.

PRACTICAL

1. Chromatographic techniques: column and thin layer chromatography.
2. Simple and fractional distillation, by vacuum and steam dragging.
3. Isolation and purification of organic compounds. Recrystallization and melting points.
4. Products of pharmacological and industrial interest.
5. Transformations of functional groups.
6. Spectroscopic techniques.

5. COMPETENCIES

General

CG1-TQ1	Use concepts for the autonomous learning of new methods and theories.
CG5-TQ1	Analyse, design, simulate and optimise processes and products.

Specific

CE24-QB5	Describe the main types of organic compounds and their functional groups.
CE24-QB6	Describe the structure and stereochemistry of organic molecules.
CE24-QB7	Describe the fundamental reactivity of the main families of organic compounds.
CE24-QB8	Know the main procedures for obtaining and industrially manufacturing organic substances.
CE24-QB9	Demonstrate the ability to use and handle chemical reagents and organic compounds effectively and safely.
CE24-QB10	Use scientific information sources in Organic Chemistry.
CE24-QB11	Relate Organic Chemistry to science, technology, and its industrial applications and impact on society.
CE25	Interpret data from laboratory observations and measurements in terms of their significance and the theories that support them.

Cross-cutting

CT1-TQ1	Develop capacity for analysis and synthesis.
CT2-TQ1	Solve problems in the area of Chemical Technology.
CT4-TQ1	Communicate in Spanish using standard audiovisual media.
CT5-TQ1	Consult, use and analyse bibliographic sources in the area of Chemical Technology.
CT8-TQ1	Demonstrate capacity for critical and self-critical reasoning.
CT11-TQ1	Learn autonomously.
CT12-TQ1	Develop sensitivity to the social and environmental repercussions of engineering solutions.

6. WORKLOAD DISTRIBUTION BY ACTIVITY

Activity	In-class (hours)	Self-study (hours)	Credits
Lectures	46	74	4,8
Seminars	14	21	1,4
Tutorials/guided work	4	6	0,4
Laboratories	28	14	1,7
Preparation of assignments and exams	7	11	0,7
Total	**99**	**126**	**9**

7. METHODOLOGY

Teaching practice will follow a mixed methodology based on cooperative learning, collaborative learning and self-learning. This methodology will be developed through theory classes, seminars, laboratory practices and scheduled tutorials, all of them face-to-face.

In-class theoretical classes (3 hours/fortnight throughout the course): they will be expository and in them the epigraphs indicated in the subject program will be developed orally. The whiteboard and PowerPoint presentations will be used. The necessary material for the prior preparation and monitoring of the classes will be available to students on the Virtual Campus.

In-class seminar classes (1 hour/fortnight throughout the course): the most representative questions and exercises from a collection that will be provided to students well in advance (Virtual Campus) will be solved and discussed. The resolution of the remaining proposed exercises will be part of the student's personal work. For these classes, students will be divided into two subgroups with the same schedule.

In-class tutorials/Directed activities: four face-to-face tutorial sessions will be scheduled (two for each semester) with small groups of students. In these tutorial sessions, the teacher will review and correct, if necessary, the solutions proposed by the students for the unresolved exercises in the seminar classes and will resolve any doubts and difficulties that have arisen in the study of the subject.

In-class laboratory practices: laboratory practices will be developed with content directly related to the theoretical ones, distributing the students in small groups, each of them under the direct supervision of a teacher. After an introductory seminar (1 hour), 8 experimental laboratory sessions (3 h/session) and 2 seminar sessions (1.5 h per session) dedicated to the spectroscopic characterization of organic compounds will be held. Part of the laboratory practice will be conducted in English. Students will have an internship script (Virtual Campus) that will contain all the necessary information for the previous planning and subsequent performance of the selected experiments, as well as for the preparation of the laboratory report, which will be delivered to the teacher at the end of these practical sessions. In addition, a safety test will be carried out in the laboratory, which must be passed prior to carrying out the practices.

8. BIBLIOGRAPHY

Basic

- Bruice, Paula Y.: "*Organic Chemistry*", 7th Edition. Prentice Hall 2012 ISBN-13: 9780321663139978032166313997803216763856
- Bruice, Paula Y.: "*Organic Chemistry*". 5th Edition. Pearson/Prentice Hall 2007.
- Wade, L.G.: "*Organic Chemistry*". 9th Edition. Pearson/Prentice Hall 2017. ISBN: Vol. 1, 978-607-32-3847-2 and Vol. 2, 978-607-32-3849-6.
- Vollhardt, K. P.C.; Schore, N. E.: "*Química Orgánica*", 5th ed., Ediciones Omega, 2008. ISBN: 978-84-282-1431-5
- Csákÿ, Aurelio G.; Martínez Grau, M. A.: "*Experimental Techniques in Organic Synthesis*", Editorial Síntesis, 2012, ISBN: 84-7738-605-6.

Complementary

- Quíñoá, E.; Riguera, R: "*Issues and exercises of organic compounds. A Guide to Self-Evaluation*", 2nd ed., Ed. McGraw-Hill, 2005. ISBN: 844814015X.
- Carey, F.: "*Organic Chemistry*", 6ª ed., Ed. McGraw-Hill, 2006. ISBN: 0-07-282837-4.

9. ASSESSMENT

In order to access the final evaluation, the student must have participated in at least 70% of the face-to-face activities. It is mandatory to attend all directed tutorials, as well as all laboratory sessions.

All grades will be based on the absolute score out of 10 points, and in accordance with the scale established in RD 1125/2003. The final grade will result from the weighted average of the assessable activities. However, in order to pass the subject, it will be necessary to achieve the minimum grade established in each of them. If this requirement is not met, the final grade will be the weighted average obtained, with a maximum of 4.5 out of 10. These criteria will be maintained in all assessment periods.

The **grades** of the activities planned for the evaluation of the subject (midterm exams, laboratories, tutorials, delivery of problems...) **Students will be notified sufficiently in advance before the final exam**, so that they can properly plan the study of this or other subjects. In particular, the **marks of the partial exams** will be communicated within a *maximum period of 20 days*, except in the case of the second midterm, in which the period may be shorter to adapt to the final exam. In any case, **the minimum period of seven days** between the **publication of the grades and the date of the final exam** of the subject will be respected.

ORDINARY PERIOD

- **WRITTEN EXAMS: 60%**

  The theoretical knowledge acquired will be evaluated through two partial exams, one at the end of each semester, and a final exam (ordinary and extraordinary call). Students who pass the two midterm exams will not be required to take the final exam, unless they wish to improve their grade. Those students who take the final exam will have to obtain a minimum grade of 5.0 in said exam.

- **SELF-WORK WORK AND ACTIVE PARTICIPATION IN CLASSES: 20%**

  The quality of the personal work carried out will be evaluated by assessing the answers to the questions and exercises, participation in class and carrying out periodic controls throughout the course.

- **LABORATORY PRACTICES: 20%**

  Attendance at all scheduled sessions is required, which will be continuously evaluated along with a written exam and completion of the lab notebook. The grade of the laboratory sessions will include a weighted joint grade of the work carried out in the laboratory (including the seminars) and the preparation of the laboratory notebook (70%) and the grade obtained in the written exam that will be carried out at the end of these sessions (30%). The grade for each of these parts (lab work/notebook and exam) must have a minimum value of 4.5 points, and it is essential to obtain a minimum weighted grade of 5.0 in the evaluation of the Laboratory Practices in order to pass the subject.

  Students who have passed the laboratory practices in the two previous years will not be obliged to do it again. In accordance with this, students who passed the internship in the 2023-2024 academic year or earlier will have to repeat them in their entirety and in person.

EXTRAORDINARY PERIOD

The same criteria and percentages are maintained among the evaluation activities as in the ordinary call

- **WRITTEN EXAMS: 60%**

  A single final exam will be held, similar to the one held in the ordinary call

- **SELF-WORK WORK AND DIRECTED ACTIVITIES: 20%**

  The grade obtained in the ordinary call in this part will be maintained in the extraordinary call.

- **LABORATORY AND SEMINARS: 20%**

  The mark obtained in the ordinary call will be maintained if it has been passed.

  A written exam will be held for those students who have failed the corresponding exam of the ordinary call, and a written exam plus a practical exam in the event that the part corresponding to the laboratory work and notebook has not been passed in the ordinary call. It will be essential to obtain a grade of 5.0 in the written exam to take the practical exam

ACTIVITY PLANNING -SCHEDULE

TOPIC	ACTIVITY	HOURS	GROUPS	START	END
1. Topics 1-3	Theory Classes	6	1	1st Week	4th Week
	Classes Problems	2	1		
2. Topics 4-5	Theory Classes	5	1	5th Week	8th Week
	Classes Problems	2	1		
	Scheduled Tutoring	1	4	7th Week	
3. Topics 6-7	Theory Classes	9	1	Week 8	Week 14
	Classes Problems	3	1		
	Scheduled Tutoring	1	4	Week 14	
4. Topics 12-13	Theory Classes	13	1	Week 14	Week 22
	Classes Problems	4	1		
	Scheduled Tutoring	1	4	Week 21	
	Midterm Exam	1	1	**Exam Week 1st semester**	
5. Topics 8-11	Theory Classes	13	1	Week 22	Week 30
	Classes Problems	3	1		
	Scheduled Tutoring	1	4	Week 30	
	Midterm Exam	1	1	**Exam Week 2nd semester**	
LABORATORY					
1. Introduction	Seminar	1	1	Week 24	
2. Chromatographic techniques	Laboratory Practices	3	4	Week 25	Week 25
3. Distillation	Laboratory Practices	3	4	25th Week	25th Week
4. Isolation and purification of organic compounds	Laboratory Practices	6	4	26th Week	26th Week
5. Products of pharmacological and industrial interest	Laboratory Practices	6	4	27th Week	27th Week
6. Functional Group Transformations	Laboratory Practices	6	4	28th Week	28th Week
7. Spectroscopic characterization	Seminar	3	4	29th Week	

* The planning of tutorials depends on the overall planning of all the subjects of the course.

SUMMARY OF THE ACTIVITIES

ACTIVITY	ASSOCIATED COMPETENCIES	TEACHEING ACTIVITY	STUDENT ACTIVITY	ASSESSMENT	P	NP	TOTAL	C
Theory Classes	CG1. TQ1, CE24-B5, CE24-QB6, CE24-QB7, CE24-QB8, CE24-QB10, CE24-QB11, CT1-TQ1, CT4-TQ1, CT5-TQ1, CT8-TQ1, CT11-TQ1, CT12-TQ1	Preparation of the material. Presentation of theoretical concepts.	Prior preparation. Note-taking	Grading of written answers to questions related to the theoretical concepts explained	46	74	120	**10%**
Seminars	CG1. TQ1, CE24-QB5, CE24-QB6, CE24-QB7, CE24-QB8, CE24-QB10, CT1-TQ1, CT2-TQ1, CT4-TQ1, CT5-TQ1, CT8-TQ1, CT11-TQ1, CT12-TQ1	Preliminary proposal of exercises. Application of theory to the resolution of exercises and problems.	Prior preparation. Correction of errors made. Performing exercises. Formulation of questions and doubts.	Grading of the answers (approach and result) made in writing for the resolution of practical exercises and problems.	14	21	35	
Tutorials	All Competencies	Help the student to direct their study with bibliographic explanations and recommendations.	Consult the teacher about the conceptual and methodological difficulties encountered when studying the subject.	Assessment of the work done.	4	6	10	**10%**
Laboratories	All Competencies	Explanation and monitoring of the experimental work and results	Prior preparation. Conducting experiments. Elaboration of results.	Assessment of the experimental work carried out, laboratory diary and laboratory examination.	28	14	42	**20%**
Exams	All Competencies	Proposal, monitoring and correction of the exam. Student's grade.	Preparation and realization.	Assessment of the exam.	7	11	18	**60%**

P: Contact activities **NP:** Non-contact activities (independent study) **C:** Grade