



## IDENTIFYING DATA

### Organic chemistry II

Subject	Organic chemistry II			
Code	V11G201V01210			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish Galician English			
Department				
Coordinator	Cid Fernández, María Magdalena Iglesias Antelo, María Beatriz			
Lecturers	Cid Fernández, María Magdalena Iglesias Antelo, María Beatriz Sánchez Sanz, Irene Teijeira Bautista, Marta			
E-mail	bantelo@uvigo.gal mcid@uvigo.es			
Web				
General description	<p>The main objective of this subject is to go in depth in the knowledge of the properties and reactivity of the functional groups. After a detailed study of the reactions of nucleophile substitution and elimination, the reactions of addition to carbonyl group, the carboxylic acid derivatives and the reactivity in alpha to carbonyl group will be tackled.</p> <p>English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.</p>			

## Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
B5	Ability to adapt to new situations and to make decisions
C17	Know the nature and behavior of functional groups in organic molecules
C18	Know the properties of aliphatic, aromatic, heterocyclic and organometallic compounds
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work
C28	Interpret data derived from laboratory observations and measurements in terms of their meaning and relate them to the appropriate theory
D1	Ability to solve problems
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

## Expected results from this subject

Expected results from this subject	Training and Learning Results		
To distinguish, according to the reaction conditions and substrates used, the mechanisms of nucleophilic substitutions SN1 and SN2.	A1	C17	D1
	A5	C18	D3
To apply nucleophilic substitution reactions on sp <sup>3</sup> carbons to obtain organic compounds with single bonds.	A1	C17	D1
	A5	C18	D3
To distinguish, according to the reaction conditions and substrates used, the E1 and E2 mechanisms of elimination reactions.	A1	C17	D1
	A5	C18	D3

To explain the reactivity of carbonyl compounds through nucleophilic addition.	A5	C17 C18	D1 D3
To explain the reactivity of carboxylic acid derivatives by means of an addition-elimination mechanism.	A5	C17 C18	D1 D3
To apply the reactivity of enols and enolates.	A1 A5	C17 C18	D1 D3
To apply the reactivity of beta-dicarbonyl compounds and alpha,beta-unsaturated carbonyl compounds in organic synthesis.	A1 A5	C17 C18	D1 D3
To carry out properly the usual experimental procedures in simple organic preparations.	A1 A5	B5 C17 C18 C26 C28	D1 D3

## Contents

Topic	
LESSON 1. Reactions of nucleophilic substitution on sp <sup>3</sup> carbons	Bimolecular and unimolecular nucleophilic substitution reactions (SN <sub>2</sub> and SN <sub>1</sub> ): kinetic, mechanisms and stereochemistry. Competition between SN <sub>2</sub> and SN <sub>1</sub> . Transformation of functional groups through SN <sub>2</sub> and SN <sub>1</sub> reactions.
LESSON 2. Reactions of elimination	Bimolecular elimination reaction (E <sub>2</sub> ). Unimolecular elimination reaction (E <sub>1</sub> ). Competition between substitution and elimination. Application of elimination reactions in organic synthesis.
LESSON 3. Reactions of nucleophilic addition to the carbonyl group	Structure and general reactivity of the carbonyl group (aldehydes and ketones). General mechanism of the nucleophilic addition. Addition of oxygenated and sulfur compounds, nitrogenated compounds, hydride, organometallic compounds, cyanide, and acetylides. The reaction of Wittig.
LESSON 4. Reactions of nucleophilic substitution on the carbonyl group	Structure and general reactivity of carboxylic acids and derivatives. Preparation and reactivity of acid halides, acid anhydrides, esters, and amides. Structure and reactivity of nitriles.
LESSON 5. Reactivity in alpha position of the carbonyl group	Enols and enolates: general reactivity. Keto-enol Tautomerism. Alpha-alkylation of enolates. Alpha-halogenation of enols and enolates. Reactions of enolate anions with carbonyl compounds (aldolic condensation).
LESSON 6. Reactivity of bifunctional carbonyl compounds	Reactions of alpha-dicarbonyl compounds. Reactions of beta-dicarbonyl compounds. Reactions of alpha-beta unsaturated carbonyl compounds. Michael reaction. Robinson annulation.
LABORATORY	In these sessions, experiments related to the theoretical content of the lessons will be carried out.

## Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	23	30	53
Problem solving	12	18	30
Laboratory practical	28	8	36
Presentation	0	6	6
Problem and/or exercise solving	1	4	5
Problem and/or exercise solving	1	8	9
Problem and/or exercise solving	1	4	5
Essay	0	6	6

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

	Description
Lecturing	The teaching staff will expose, in a structured way, those general aspects of the subject, paying special attention to those of greatest relevance to the program and the most difficult for students to assimilate. The teaching staff will provide, through the virtual classroom, the necessary material for the realization of the personal work of the students. In the class session, activities will be carried out that can lead to qualifiable deliverables.
Problem solving	In this activity, a series of exercises and problems previously elaborated and proposed by the teacher will be resolved. The teacher will solve the doubts and will comment on the specific aspects. The students will carry out tasks individually that will be graded.

Laboratory practical	A series of experiments in the laboratory will be carried out in face-to-face sessions 3,5 h long. The students will have all the necessary material for the previous preparation of the experiments through the virtual classroom. During the laboratory sessions, the students will elaborate a laboratory notebook in which they will annotate all observations related to the experiments. After the development of the practices, the students will have to complete the work indicated in each case.
Presentation	The students, grouped into teams, must make a presentation on a topic assigned by the teacher. This activity will be graded.

### Personalized assistance

Methodologies	Description
Lecturing	The teacher will attend to the queries of the students related to the study of the contents related to the subject through tutorials. The teacher will also use channels of telematic communication with the students (email, tools of the virtual classroom). For consultation and/or request for tutorials: <a href="https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/">https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/</a>
Laboratory practical	Teachers will attend to the queries of the students related to the experiments during the laboratory sessions and in tutorials. The schedule office hours will be available in the virtual classroom and through other ways established by the University. For consultation and/or request for tutorials: <a href="https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/">https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/</a> <a href="https://quimica.uvigo.es/gl/docencia/profesorado/maria-beatriz-iglesias-antelo/">https://quimica.uvigo.es/gl/docencia/profesorado/maria-beatriz-iglesias-antelo/</a> <a href="https://quimica.uvigo.es/gl/docencia/profesorado/marta-teijeira-bautista/">https://quimica.uvigo.es/gl/docencia/profesorado/marta-teijeira-bautista/</a>
Problem solving	Teachers will attend to the queries of the students related to the problems and exercises linked to the contents of the subject, through the schedules of tutorials. The teacher will also employ channels of telematic communication with the students (email, tools of the virtual classroom). For consultation and/or request for tutorials: <a href="https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/">https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/</a>
Presentation	The teaching staff will attend in a personalized way the queries of the students related to the preparation of the presentation. The tutoring sessions may be carried out in person or by telematic means under the modality of prior consultation. For consultation and/or request for tutorials: <a href="https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/">https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/</a>

Tests	Description
Essay	Teachers will attend to the queries of the students related to the proposed works, during the schedules of tutorials, which will be available in the virtual classroom and through other ways established by the University. The teacher will also employ channels of telematic communication with the students (email, tools of the virtual classroom). For consultation and/or request for tutorials: <a href="https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/">https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/</a>
Problem and/or exercise solving	Teachers will attend to the queries of the students related to the proposed works, during the schedules of tutorials, which will be available in the virtual classroom and through other ways established by the University. The teacher will also employ channels of telematic communication with the students (email, tools of the virtual classroom). For consultation and/or request for tutorials: <a href="https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/">https://quimica.uvigo.es/gl/docencia/profesorado/maria-magdalena-cid-fernandez/</a> <a href="https://quimica.uvigo.es/gl/docencia/profesorado/maria-beatriz-iglesias-antelo/">https://quimica.uvigo.es/gl/docencia/profesorado/maria-beatriz-iglesias-antelo/</a> <a href="https://quimica.uvigo.es/gl/docencia/profesorado/marta-teijeira-bautista/">https://quimica.uvigo.es/gl/docencia/profesorado/marta-teijeira-bautista/</a>

### Assessment

	Description	Qualification	Training and Learning Results			
Lecturing	Participation and the resolution of individual tasks proposed by the teaching staff in the master sessions will be valued.	10	A1	B5	C17	D1
Problem solving	The participation and resolution of the exercises proposed by the teacher will be evaluated.	15	A1	B5	C17	D1
Laboratory practical	The assistance to the practical classes of laboratory is compulsory. The work of laboratory will be evaluated as APTO or NO APTO. The following aspects will be evaluated: the previous or later work, the development of the experimental work and the lab notebook. In order for the students to pass the subject, a qualification of APTO in laboratory practices must be reached.	0		B5	C17	D1
Presentation	The students will realize a presentation in formal group. It will be an activity of application of the knowledges/skills developed in the subject.	10	A1		C17	D3
Problem and/or exercise solving	A test of the contents of the first lessons, that will weight 15% of the final mark.	15	A1	B5	C17	D1
Problem and/or exercise solving	A test of all the contents of the subject, that will weight 25 % of the final mark. A minimum score of 4.0 points out of 10.0 in this test will be demanded to pass the subject.	25	A1	B5	C17	D1
			A5		C18	D3
			A5		C18	D3

Problem and/or exercise solving	A written test related to the experimental part of the subject, that will weight 15% of the final mark. A minimum score of 4.0 points out of 10.0 will be demanded in this test.	15	B5 C17 D1 C18 C26 C28
Essay	The students will elaborate an essay related to the content of the subject. It will comply with the parameters specified by the teacher.	10	B5 C17 D1 C26 C28

### Other comments on the Evaluation

In this subject, BASIC learning outcomes that will be necessary to achieve to pass will be defined.

In case of doubt about the acquisition of the learning results by the students, additional oral assessment tests may be taken.

#### To pass the subject in June you will need:

- Achieve the mention of PASS in the evaluation of laboratory practices
- Achieve a minimum score of 4 points out of 10 in the global test
- Get a minimum score of 4 points out of 10 in the written test of the experimental part

If any of the above conditions is not met, the mark that will appear in the report will be the weighted mark of the tests.

Achieve a minimum score of 5.0 in the weighted sum of all sections.

The final grade of the student who passes the subject may be normalized so that the highest grade can reach a value of up to 10 points.

**2nd AND SUBSEQUENT REGISTRATION STUDENTS:** Students who have been evaluated with PASS in the laboratory work in a previous year will be awarded a PASS in the follow-up of the laboratory work in the current academic year. It is not needed to redo the experiments. However, they must carry out the essay (10%) and the written test of the experimental part (15%) to obtain the corresponding qualification for the experimental part of the subject in the current academic year.

**EVALUATION IN JULY:** The grade obtained by the students during the course in the lectures/problem solving, laboratory practices and assignments/exhibitions will be maintained. It will be possible to take a test of all the theoretical content of the subject that will mean 40% of the final grade and/or a written test of the experimental part that will mean 15% of the final grade.

It will be necessary to achieve a minimum of 4 points out of 10 in this test to pass the subject and take into account the rest of the evaluation elements.

The final mark will be the weighted sum of all the sections, provided that the required minimums are exceeded. Otherwise, the score that will appear in the report will be the weighted score of the tests.

**GLOBAL EVALUATION OPTION:** To pass the subject, the student must carry out the laboratory practices, achieve a PASS grade in the work developed in the laboratory and a grade equal to or greater than 5 points out of 10 in the written test of the experimental part (20% of the final mark). In addition, it is necessary to achieve at least 5 points out of 10 in a test in which all the contents of the subject will be evaluated (80% of the final grade).

### Sources of information

#### Basic Bibliography

KLEIN, D., **Química Orgánica**, 1ª edición en español, Médica Panamericana, 2013

VOLLHARDT, K.P.C.; SCHORE, N.E., **Química Orgánica**, 5ª en español, Ediciones Omega, 2007

WADE, L.G., **Química Orgánica**, 9ª en español, Pearson-Educación, 2017

M A Martínez Grau, **TECNICAS EXPERIMENTALES EN SINTESIS ORGANICA**, 2ª Edición, Síntesis, 1988

#### Complementary Bibliography

PALLEROS, D.R., **Experimental Organic Chemistry**, John Wiley and Sons, 2000

QUINOÁ, E.; RIGUERA, R., **Cuestiones y ejercicios de Química Orgánica**, 2ª edición, McGraw-Hill Interamericana, 2004

QUINOÁ, E.; RIGUERA, R., **Nomenclatura y representación de los compuestos orgánicos**, 2ª edición, McGraw-Hill Interamericana, 2005

DOBADO, J.A.; GARCÍA-CALVO, F.; GARCÍA, J.I., **Química Orgánica: ejercicios comentados**, Garceta, 2012

CAREY, F., **Química Orgánica**, 9ª en español, McGraw-Hill Interamericana, 2014

CLAYDEN, J.; GREEVES, N.; WARREN, S., **Organic Chemistry**, 2ª edición, Oxford University Press, 2012

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**Recommendations**

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**Subjects that continue the syllabus**

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Organic Chemistry III: Concerted, Radical and Photochemical Reactions/V11G201V01305

Organic Chemistry IV: Design of Organic Synthesis/V11G201V01310

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**Subjects that are recommended to be taken simultaneously**

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Structural Determination/V11G201V01206

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**Subjects that it is recommended to have taken before**

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Organic chemistry I/V11G201V01205

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