



IDENTIFYING DATA

Organic chemistry II

Subject	Organic chemistry II			
Code	V11G201V01210			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish Galician English			
Department				
Coordinator	Tojo Suárez, Emilia			
Lecturers	Alonso Gómez, José Lorenzo Cid Fernández, María Magdalena Iglesias Antelo, María Beatriz Tojo Suárez, Emilia			
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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, of the carboxylic acid derivatives and of the reactivity in alpha to carbonyl group will be tackled. It will continue with the main reactions of oxidation-reduction in organic chemistry and finally the reactivity of the bifunctional carbonyl compounds will be study.</p> <p>This is a matter of the English Friendly program: International students will be able to request: a) material and bibliographic references in English, b) tutoring in English, c) exams and evaluations in English.</p>			

Competencies

Code	
A2	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

Learning outcomes

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.	A2 A5	C17 C18	D1 D3
To apply nucleophilic substitution reactions on sp ³ carbons to obtain organic compounds with single bonds.	A2 A5	C17 C18	D1 D3
To distinguish, according to the reaction conditions and substrates used, the mechanisms of elimination reactions E1 and E2.	A2 A5	C17 C18	D1 D3

To apply redox reactions to the organic compounds.	A2 A5	C17 C18	D1 D3
To explain the reactivity of carbonyl compounds through nucleophilic addition.	A5	C17 C18	D1 D3
To explain the reactivity of carboxylic acids derivatives by means of a mechanism of addition-elimination.	A5	C17 C18	D1 D3
To apply the reactivity of enols and enolates.	A2 A5	C17 C18	D1 D3
To apply the reactivity of alpha-dicarbonyl compounds in organic synthesis.	A2 A5	C17 C18	D1 D3
To design the synthesis of derivatives of alpha,beta-unsaturated carbonyl compounds by means of 1,2 and 1,4 addition reactions.	A2 A5	C17 C18	D1 D3
To carry out properly the usual experimental procedures in simple organic preparations.	A2 A5	B5 C17 C18 C26 C28	D1 D3

Contents

Topic	
LESSON 1. Reactions of nucleophilic substitution on sp ³ carbons.	Bimolecular and unimolecular nucleophilic substitution reactions (SN ₂ and SN ₁): kinetic, mechanisms and stereochemistry. Competition between SN ₂ and SN ₁ . Transformation of functional groups through SN ₂ and SN ₁ reactions: synthesis of Williamson, preparation of thiols and thioethers, preparation of amines, reactions of alcohols and ethers, opening of epoxides, conversion of carboxylic acids into methyl esters by reaction with diazomethane.
LESSON 2. Reactions of elimination.	Bimolecular elimination (E ₂). Unimolecular elimination (E ₁). E ₁ cb elimination. Intramolecular elimination (E _i). Mechanisms. Competition between substitution and elimination. Application of elimination reactions in organic synthesis: Hofmann elimination, Cope elimination, dehydration of alcohols, pinacol rearrangement.
LESSON 3. Reactions of nucleophilic addition to the carbonyl group.	Structure and general reactivity of carbonyl group (aldehydes and ketones). General mechanism of nucleophilic addition. Non reversible nucleophilic additions: addition of organometallic compounds (alkyne anions, organolithium and Grignard reagents); addition of stabilised carbanions; addition of hydride. Reversible nucleophilic additions: addition of oxygenated and sulphur compounds (water, alcohols and thiols); addition of nitrogenous compounds (amines and other nitrogenous compounds); addition of cyanide of hydrogen.
LESSON 4. Reactions of nucleophilic substitution on the carbonyl group.	Structure and general reactivity of carboxylic acids and derivatives. Relative reactivity of acid derivatives: basicity and electrophilic character. Non reversible addition-elimination reactions: the leaving group. Reversible reactions of addition-elimination: basic and acid catalysis. Reactions with water and alcohols; reactions with ammonia and amines. Structure and reactivity of nitriles. Reactions of nitriles.
LESSON 5. Reactivity in alpha position of the carbonyl group.	Enols and enolates: general reactivity. Reactions of enolate anions of ketones and esters: alkylation of ketones, alkylation of esters. Halogenation of ketones. Reactions of enolate anions with carbonyl compounds: aldol reaction, Claisen condensation, Dieckmann condensation, reaction of Reformatsky.
LESSON 6. Reactions of oxidation-reduction.	Reactions of oxidation of alcohols. Reactions of oxidation of carbonyl compounds. Oxidative cleavage of alkenes and alkynes. Reduction of aldehydes and ketones. Reduction of carboxylic acids, esters and nitriles.
LESSON 7. Conjugated additions to bifunctional compounds.	Reactions of alpha-dicarbonyl compounds: transposition of benzilic acid, enolization. Reactions of beta-dicarbonyl compounds: enolization, alkylation, decarboxylation, malonic synthesis, acetyl acetic synthesis, Knoevenagel reaction, alkylation of dianions. Reactions of alpha,beta-unsaturated carbonyl compounds: reactions with electrophiles, reaction with nucleophiles, addition of organometallic compounds, addition of carbanions (Michael addition), Robinson annulation.
LABORATORY	In these sessions experiments related with the theoretical content of the subject will be carried out.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	24	48

Problem solving	12	18	30
Laboratory practical	28	8	36
Problem and/or exercise solving	2	22	24
Essay	0	12	12

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

Methodologies	
	Description
Lecturing	Teachers will present, in a structured manner, the general aspects of the subject, paying special attention to those of greater relevance and of greater difficulty for the students. Teachers will provide, through the virtual classroom, the material necessary for the students' personal work. The students must work in advance the submitted material and consult the recommended literature to complete the information.
Problem solving	In this activity, that will take place 1 hour per week, 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 the specific aspects that were not explained in lectures. A selection of the exercises will be delivered regularly to the teacher for evaluation.
Laboratory practical	A series of experiments of laboratory will be carried out in face-to-face sessions 3,5 h long. Through the virtual classroom, the students will have all the necessary material for the previous preparation of the experiments. During the laboratory sessions, the students will elaborate a laboratory notebook in which they will annotate all observations related to the experiment. After the realisation of the practice, the students will have to complete the work indicated in each case.

Personalized assistance	
Methodologies	Description
Lecturing	The teacher will attend the queries of the students related to the study of the subjects related to the matter through tutorials. The teacher will also employ channels of telematic communication with the students (email, tools of the virtual classroom).
Laboratory practical	Teachers will attend 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.
Problem solving	Teachers will attend 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).
Tests	Description
Problem and/or exercise solving	Teachers will attend the queries of the students related to the proofs of evaluation, 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).
Essay	Teachers will attend 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).

Assessment		Qualification	Training and Learning Results			
	Description		A2	B5	C17	D1
Problem solving	The participation and resolution of the exercises proposed by the teacher will be evaluated. Regularly, a selection of the exercises will be resolved in the classroom and delivered to the teacher for evaluation.	20	A5	B5	C18	D3
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 work, the development of the experimental work, the lab notebook and the rear work. The evaluation of the development of experimental work will be done by using the systematic observation tool. In order for the students to pass the subject, a qualification of APTO in laboratory practices must be reached.	0	A5	B5	C17 C18 C26 C28	D1 D3

Problem and/or exercise solving	There will be three exams: 1.- An exam on the contents of the 4 first lessons, that will weight 15% of the final mark. It will be demanded a minimum score of 3.0 points over 10.0 in this exam. 2.- A test on all the contents of the matter, that will weight 30% of the final mark. A minimum score of 4.0 points aver 10.0 in this exam will be demanded. 3.- 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 over 10.0 will be demanded in this exam. If the minimum required in any of the exams is not reached, the final mark of the subject will be the weighted score of the three exams.	60	A2 A5	B5 C18	C17 D3	D1 D3
Essay	The students will make two works related with the content of the matter. These works will apply the parameters specified by the teacher.	20	A2 A5	B5 C18	C17 D3 C26 C28	D1 D3

Other comments on the Evaluation

CONDITION OF PRESENTED: The participation of the students in any of the tests will involve the condition of presented.

EVALUATION OF THE SECOND OPPORTUNITY: the score obtained by the students in problems solving, practices of laboratory and works will be kept. There will be an exam on all the contents of the subject that will weight 60% of the final mark. It will be necessary to reach in this exam a minimum of 4 points over 10 to pass the subject and to take into account the rest of the elements of evaluation.

OPTION OF NO CONTINUOUS EVALUATION: the students that chose the NO continuous evaluation will have to obtain the score APTO in the Practices of Laboratory. In addition, a minimum of 5 points over 10 will have to be reached in an exam on all the contents of the subject.

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, Pearsons-Educación, 2017

Complementary Bibliography

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

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

QUIÑOÁ, 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

Recommendations

Subjects that are recommended to be taken simultaneously

Structural Determination/V11G201V01206

Subjects that it is recommended to have taken before

Organic chemistry I/V11G201V01205

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health, and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===

The priority is to maintain the methodologies as planned.

- Non-face-to-face teaching methodologies:

In case of need, the Lecturing, the Problems solving and the laboratory classes will be done by virtual means. The teaching activity will be conducted through the Remote Campus, and Fatic platform, without prejudice to other measures that may be taken to ensure students' access to the teaching content.

- Non-face-to-face personalized assistance (tutoring):

Tutoring sessions will be conducted by telematic means (email, remote campus, videoconference,...), preferably by appointment.

- Modifications (if any) of the contents to be taught:

No changes are expected to be made to the content to be taught.

- Additional bibliography to facilitate self-learning:

Specific material will be provided if necessary.
