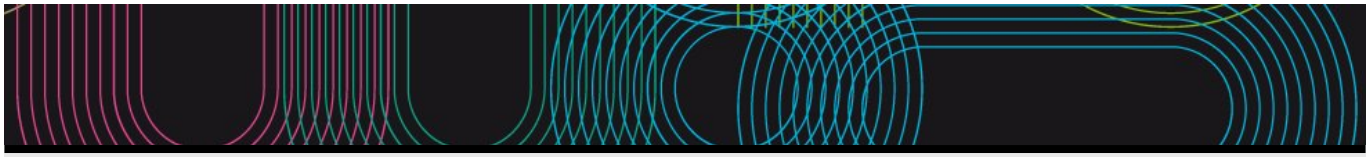

IDENTIFYING DATA				
Organic chemistry I				
Subject	Organic chemistry I			
Code	V11G200V01304			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Mandatory	2nd	1st
Teaching language	Spanish Galician			
Department	Organic Chemistry			
Coordinator	Iglesias Antelo, María Beatriz			
Lecturers	Cid Fernández, María Magdalena Iglesias Antelo, María Beatriz Muñoz López, Luis Terán Moldes, María del Carmen			
E-mail	bantelo@uvigo.es			
Web	http://secretaria.uvigo.gal/docnet-nuevo/guia_docent/index.php?centre=311&ensenyament=V11G200V01&assignatura=V11G200V01304&any_academic=2017_18			
General description	In this subject, students reach an understanding of the fundamental principles of Organic Chemistry, regarding organic compounds structure and reactivity. Following two lessons on general concepts, the reactivity of functional groups with multiple carbon-oxygen and carbon-carbon bonds, including aromatic compounds, is studied.			

Competencies	
Code	
C2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics
C10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds
C11	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: nature and behavior of functional groups in organic molecules
C12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry
C13	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main synthetic routes in organic chemistry, including interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C21	Recognize and implement good scientific practices for measurement and experimentation
C23	Present oral and written scientific material and scientific arguments to a specialized audience
C25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use
C26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work
C27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way
C28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D12	Plan and manage time properly
D13	Make decisions

D14 Analyze and synthesize information and draw conclusions

D15 Evaluate critically and constructively the environment and oneself

Learning outcomes

Expected results from this subject	Training and Learning Results	
Distinguish the most usual reactions in Organic Chemistry. Relate the energetic profile to a particular reaction. Differentiate the types of reagents. Differentiate the types of reaction intermediates.	C2 C19	D1 D3 D4 D7 D9 D12 D14
Establish the influence of the structure and the chemical features of the functional groups present in a molecule on its reactivity.	C2 C11	D1 D3 D4 D7 D9 D12 D14
Explain the reactivity of carbonyl compounds by means of a nucleophilic addition mechanism and the reactivity of carboxylic acids and their derivatives by means of an addition-elimination mechanism.	C2 C10 C11 C13	D1 D3 D4 D7 D9 D12 D14
Explain the reactivity of organic compounds with multiple carbon-carbon bonds by means of an electrophilic addition mechanism.	C2 C10 C11 C13	D1 D3 D4 D7 D9 D12 D14
Explain the reactivity of aromatic compounds through an electrophilic substitution mechanism.	C2 C10 C11 C13	D1 D3 D4 D7 D9 D12 D14
For each transformation, describe in detail the reaction mechanism, indicating reaction steps, transition states, intermediates etc.	C2 C11	D1 D3 D4 D7 D9 D12 D14
Predict the result of the reaction of a specific substrate with a given reagent in specific conditions, regarding regioselectivity and stereoselectivity of the process.	C11 C12 C13 C19	D1 D3 D4 D7 D9 D12 D14
Apply the rules for safety and health in laboratory work and carry out the treatment and correct elimination of the waste generated.	C25	D1 D3 D4 D7 D9 D12 D13 D14 D15

Carry out correctly the usual experimental procedures in simple organic preparations.	C21 C26	D1 D3 D4 D7 D9 D12 D13 D14
Carry out the work up of the reaction product, as well as its isolation and purification by means of usual techniques (extraction, distillation, recrystallization and chromatography).	C21 C26 C27	D1 D3 D4 D7 D9 D12 D13 D14
Write and describe appropriately the completed experiments in the laboratory notebook, so that they can be reproduced.	C23 C27 C28	D1 D3 D4 D7 D9 D12 D13 D14 D15
Look for and select information regarding the subjects studied.	C20	D4 D5 D8 D14 D15

Contents

Topic	
Lesson 1. Configurational stereoisomerism	Functional groups. Three-dimensional representation of organic structures. Absolute configuration of stereogenic centres, cyclic compounds and alkenes.
Lesson 2. Reactivity of organic compounds	Acid-base reactivity of organic compounds. Reaction mechanisms: stepwise reactions. Energetic profile of a reaction. Heterolytic bond cleavage. Ionic reactions. Reaction intermediates: carbanions. Redox reactivity of organic compounds. Formal states of oxidation.
Lesson 3. Addition reactions to carbon-carbon multiple bonds	Structure and general reactivity of functional groups with carbon-carbon multiple bonds: alkenes and alkynes. Hydrogenation: heats of hydrogenation and stability of alkenes and dienes; homolytic bond cleavage; concerted reactions. Electrophilic addition reactions to alkenes. Addition of HX; reaction intermediates: carbocations; regioselectivity; electrophiles and nucleophiles. Hydration reactions; orientation and stereochemistry. Addition of halogens (X2). Dihydroxylation reactions. Addition reactions to alkynes.
Lesson 4. Aromatic substitution reactions	Structure and general reactivity of aromatic compounds. General mechanism for the electrophilic aromatic substitution reaction. Reactions with non-carbon electrophiles. Reactions with carbon electrophiles. Electrophilic aromatic substitution reactions in substituted systems: orientation and reactivity. Modulation of the reactivity of aromatic rings.
Lesson 5. Reactions of nucleophilic addition to the carbonyl group	Structure and general reactivity of the carbonyl group (aldehydes and ketones). General mechanism for the nucleophilic addition reaction. Non reversible nucleophilic additions: addition of organometallic compounds (alkynyl anions, organolithium and organomagnesium reagents); addition of stabilized carbanions; addition of hydride. Reversible nucleophilic additions: addition of oxygen and sulphur compounds (water, alcohols and thiols); addition of nitrogen compounds (amines and other nitrogen compounds); addition of hydrogen cyanide.

Lesson 6. Reactions of nucleophilic substitution at the carbonyl group	Structure and general reactivity of carboxylic acids and their derivatives. Relative reactivity of acid derivatives: basicity and electrophilic character. Non reversible addition-elimination reactions: leaving group. Reversible addition-elimination reactions: basic catalysis and acid catalysis. Reactions with water and alcohols; reactions with ammonia and amines. Structure and reactivity of nitriles. Reactions of nitriles.
Practice 1	Separation of organic compounds mixtures by using two techniques: acid-base extraction (liquid-liquid extraction) and column chromatography. Four sessions.
Practice 2	Electrophilic addition to a double bond. One session.
Practice 3	Electrophilic aromatic substitution. One session.
Practice 4	Reduction of a ketone. One session.
Practice 5	Preparation of a hydrazone. One session.
Practice 6	Hydrolysis of an ester. One session.
Practice 7	Synthesis project. Three sessions.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	25	25	50
Problem solving	26	50	76
Laboratory practices	42	10	52
Essay	0	10	10
Short answer tests	8	29	37

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

Methodologies

	Description
Lecturing	Exposition by the teaching staff of the syllabus' general aspects, with special emphasis in its fundamental features. The teaching staff will facilitate, through the virtual classroom, all the material needed for the student's personal work. Prior to class, the student must use this material and consult the recommended bibliography to complete the information, in order to improve his/her academic progress in the subject.
Problem solving	Two hours each week will be devoted to discussing the most prominent aspects of the topic, to solve questions arisen in the development of the lesson and to the resolution of the proposed exercises.
Laboratory practices	Laboratory experiments will be carried out, individually, in 3.5 h sessions. The students will find, in advance, in the virtual classroom, the material needed for the preparation of the experiments. At the start of each session the professor will do an exposition of the contents to be developed. During the experiments the student will elaborate a laboratory notebook recording all the observations pertinent to the experiment. At the end of the session the student will answer some questions regarding the work done.

Personalized attention

Methodologies	**Description**
Problem solving	The teaching staff will attend the students' queries regarding the different topics within the subject. Attention to students schedules will be available through the Faculty of Chemistry webpage (http://quimica.uvigo.es/profesorado.php) and other ways provided by the university. Additionally, the teaching staff will use online channels to communicate with the students (electronic mail and tools within the virtual classroom).
Tests	**Description**
Essay	The teaching staff will tutor the students while preparing and carrying out a short laboratory project.

Assessment

	Description	Qualification	Training and Learning Results

Problem solving	Class participation and resolution by the student of all the problems and/or exercises proposed in time/conditions established by the teaching staff will be evaluated.	25	C2 C10 C11 C12 C13 C19 C20	D1 D4 D7 D8 D9 D14
Laboratory practices	Assistance to practical classes is mandatory. Monitoring of laboratory work will be evaluated as APT/NO APT. The following aspects will be considered in this section: pre-lab questionnaires, development of the experimental work, laboratory notebook, final questions. In order to pass the subject it is indispensable to be evaluated as APT.	0	C21 C25 C26 C27 C28	D12 D13 D14 D15
Essay	The student will elaborate a report prior to the execution of a short project in the laboratory during the last week of practical classes.	15	C20 C23 C25	D1 D4 D5 D9 D14
Short answer tests	First test: 15%. It will cover contents corresponding to the first three lessons. Second test: 15%. It will cover contents corresponding to the last three lessons. Written test for the experimental part: 15%. To be taken by the students that have achieved the mention APT in the monitoring of the laboratory work. In this test, student acquisition of competencies and skills related to the experimental aspects of the subject will be evaluated. Global test: 15%. In this test, student acquisition of competencies and skills related to the theoretical aspects of the subject will be evaluated.	60	C2 C10 C11 C12 C13 C19	D3 D7 D12 D14

Other comments on the Evaluation

In order to pass the subject in January, it will be required:

- Achieve mention **APT** in the evaluation of the laboratory work.
- Achieve a **minimum mark of 3 points out of 10** in each of the two short theoretical tests (first test and second test) and in the written test for the experimental part.
- Achieve a **minimum mark of 4 points out of 10** in the global test.

  If any of the previous conditions is not fulfilled, the final mark for the subject will be the mark obtained for the Short answer tests section multiplied by 0.6 (60%).

- Achieve a minimum mark of 5.0 in the weighted addition of the marks for all the sections (troubleshooting, short answer tests, works).

The final grade for the students who pass the subject could be standardized so that the highest mark can reach a value of up to 10 points.

The participation of the student in any of the acts of evaluation for the subject will involve the condition of "presentado/a" and, therefore, the assignment of a mark. The acts of evaluation that will be considered are: assistance to laboratory practices (25% or more) or the delivery of reports/exercises (25% or more) or taking any examination.

Students of 2nd and subsequent enrollment. Those students who passed the laboratory practices during the 2014-15 or 2015-16 courses or were evaluated as APT during the 2016-17 or 2017-18 courses will be awarded the APT mention for the monitoring of laboratory work in the academic course 2018-19, not being necessary the completion of the experimental work again. However, **they must elaborate the report of the project** (15%) and **take the written test for the experimental part** (15%) to achieve the mark for the experimental part of the subject in the academic course 2018-19.

EVALUATION IN JULY

45% of the Short answer tests section can be repeated in July, in the following way:

- **Tests (30%)**. It will be carried out a global test in which the competences acquired in the theoretical aspects of the subject will be evaluated. The student must achieve **a minimum mark of 4 points out of 10** so that the result of

this test will be taken into account in the global mark of the subject. This result will substitute the two lower marks obtained for the three theoretical tests carried out during the semester (first test, second test and global test), keeping the higher mark of the three, as long as it exceeds the required minimum.

- **Written test for the experimental part (15%)**. **A minimum mark of 3 points out of 10** must be achieved. The new mark will substitute the one achieved in the written test for the experimental part taken at the end of the semester.

The final mark will be the weighted addition of the marks for all the sections (troubleshooting, short answer tests, works), as long as all the required minima are reached. If this is not the case, the final mark for the subject will be the mark obtained for the Short answer tests section multiplied by 0.6 (60%). In case that this mark was lower than the one obtained in the end of semester evaluation, the official mark will be this last one.

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 edición en español, Edicións Omega, 2007

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

Complementary Bibliography

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

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

YURKANIS BRUICE, P., **Fundamentos de Química Orgánica**, 3ª edición, Pearson, 2015

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

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

Recommendations

Subjects that continue the syllabus

Organic chemistry II/V11G200V01504
Organic chemistry III/V11G200V01704

Subjects that are recommended to be taken simultaneously

Physics 3/V11G200V01301
Analytical chemistry 1/V11G200V01302
Physical chemistry I/V11G200V01303

Subjects that it is recommended to have taken before

Chemistry, physics and biology: Integrated laboratory 1/V11G200V01103
Chemistry, physics and geology: Integrated laboratory 2/V11G200V01202
Chemistry: Chemistry 1/V11G200V01105
Chemistry: Chemistry 2/V11G200V01204