



| Teaching Guide      |   |       |            |   |
|---------------------|---|-------|------------|---|
| Identifying Data    |   |       | 2023/24    |   |
| Subject (*)         | Experimental Organic Chemistry  |       | Code       | 610G01029   |
| Study programme     | Grao en Química   |       |            |   |
| Descriptors         |   |       |            |   |
| Cycle               | Period  | Year  | Type       | Credits   |
| Graduate            | 2nd four-month period   | Third | Obligatory | 6   |
| Language            | SpanishEnglish  |       |            |   |
| Teaching method     | Face-to-face  |       |            |   |
| Prerequisites       |   |       |            |   |
| Department          | Química   |       |            |   |
| Coordinador         | Ojea Cao, Vicente   |       | E-mail     | vicente.ojea@udc.es   |
| Lecturers           | Díaz Abellás, Mauro<br>Maestro Saavedra, Miguel Anxo<br>Ojea Cao, Vicente<br>Peinador Veira, Carlos<br>Riveiros Santiago, Ricardo<br>Ruiz Pita-Romero, María  |       | E-mail     | mauro.diaz@udc.es<br>miguel.maestro@udc.es<br>vicente.ojea@udc.es<br>carlos.peinador@udc.es<br>ricardo.riveiros@udc.es<br>maria.ruiz.pita-romero@udc.es |
| Web                 |   |       |            |   |
| General description | Subject dedicated to the work of Laboratory of Organic Chemistry, with special emphasis on: separation techniques, isolation and purification; reactivity, synthesis and characterization of organic compounds. |       |            |   |

| Study programme competences |   |
|-----------------------------|---|
| Code                        | Study programme competences   |
| A1                          | Ability to use chemistry terminology, nomenclature, conventions and units   |
| A9                          | Knowledge of structural characteristics of chemical and stereochemical compounds, and basic methods of structural analysis and research |
| A10                         | Knowledge of chemical kinetics, catalysis and reaction mechanisms   |
| A15                         | Ability to recognise and analyse new problems and develop solution strategies   |
| A17                         | Ability to work safely in a chemistry laboratory (handling of materials, disposal of waste)   |
| A19                         | Ability to follow standard procedures and handle scientific equipment   |
| A20                         | Ability to interpret data resulting from laboratory observation and measurement   |
| A21                         | Understanding of qualitative and quantitative aspects of chemical problems  |
| A22                         | Ability to plan, design and develop projects and experiments  |
| A23                         | Critical standards of excellence in experimental technique and analysis   |
| A26                         | Ability to follow standard laboratory procedures in relation to analysis and synthesis of organic and inorganic systems                 |
| B2                          | Effective problem solving   |
| B3                          | Application of logical, critical, creative thinking   |
| B4                          | Working independently on own initiative   |
| C1                          | Ability to express oneself accurately in the official languages of Galicia (oral and in written)  |
| C3                          | Ability to use basic information and communications technology (ICT) tools for professional purposes and learning throughout life       |

| Learning outcomes  |  |                             |    |
|--|--|-----------------------------|----|
| Learning outcomes  |  | Study programme competences |    |
| Knowledge the characteristics and properties of organic compounds, their reactivity and the main reaction mechanisms, including stereochemical aspects |  | A1                          | B3 |
|  |  | A9                          | B4 |
|  |  | A23                         |    |



|   |  |          |    |
|---|--|----------|----|
| Design, plan and execute synthesis of organic molecules. Conducting processes of isolation, purification and characterization.<br>Ability to manage the literature and finding specific information in organic chemistry. | A15<br>A17<br>A21<br>A22<br>A26                    | B2       |    |
| Knowledge of fundamental characteristics of organic compounds and the most important methods of preparation and structural determination of these compounds.  | A9<br>A17<br>A19<br>A20                            | B3       |    |
| Carry out organic chemistry experiments independently and handling reagents safely. Manage scientific instrumentation in organic chemistry laboratory and interpret the results.  | A1<br>A9<br>A10<br>A15<br>A17<br>A19<br>A20<br>A22 | B2<br>B4 | C1 |
| Ability to manage literature, as well as a search of specific information in Organic Chemistry.   | A15<br>A22   | B3       | C3 |

| Contents   |  |
|--|--|
| Topic  | Sub-topic  |
| Presentation   | Methods, programmed activities and evaluation criteria   |
| Carbonyl group.<br>Reduction reactions, synthesis of commercially interesting products   | Experiment 1a: Vainilline reduction with sodium borohydride.<br>Experiment 1b: Methyl dianthis synthesis.  |
| Alkenes, alkyl halides, alcohols and epoxides.<br>Electrophilic addition to unsaturated systems, bimolecular nucleophilic substitution and rearrangements. | Experiment 2: Stereospecific synthesis of anti-2-bromo-1,2-diphenylethanol from trans-stilbene.  |
| Aromatic compounds and electrophilic aromatic substitution.<br>Introduction to protecting groups.  | Experiment 3: Synthesis of p-nitroaniline from aniline.  |
| Carboxylic acid derivatives.<br>Nucleophilic substitution through addition-elimination.  | Experiment 4a: Synthesis of ethyl acetate.<br>Experiment 4b: Synthesis of isoamyl acetate.   |
| Sustainable chemistry. Reactions without solvents.   | Experiment 5: Synthesis of N-(2-hydroxy-3-methoxybenzyl)-N-p-tolylacetamide.   |
| Carbonyl compounds and reactions in alpha position.  | Experiment 6a: Synthesis of dibenzalacetone ((E,E)-1,5-diphenyl-1,4-pentadien-3-one) from acetone and benzaldehyde through aldol condensation.<br>Experiment 6b: Synthesis of ketone alpha,beta-unsaturated (6-etoxy-carbonyl-3,5-diphenyl-2-cyclohexanone) through Michael reactions and aldol condensation.  |
| Dienes. Diels-Alder reaction   | Experiment 7: Synthesis of exo- and endo-7-oxabicyclo[2.2.1]hept-5-en-2,3-dicarboxy-N-phenylimide from N-phenylmaleimide   |
| Polifunctional compounds.<br>Multistep synthesis   | Experiment 8a: Synthesis of benzylic acid from benzaldehyde.<br>Experiment 8b: Synthesis of 3-methylcyclohexen-2-one through Robinson annulation and decarboxylation<br>Experiment 8c: Stereoselective reduction of benzoin and synthesis of 4,5-diphenyl-2,2-dimethyl-1,3-dioxolan<br>Experiment 8d: Regioselective epoxidation of (R)-carvone.<br>Experiment 8e: Synthesis of local anesthetic benzocaine (ethyl p-aminobenzoate). |



|   |  |
|---|--|
| Organophosphorous compounds.<br>Olefinations reactions.   | Experiment 9: Synthesis of cinnamic acid through Wittig reaction.  |
| Heterocyclic compounds.<br>Synthesis. Green chemistry and pharmacologically interesting heterocycles. | Experiment 10a: Synthesis of 6-methylquinolin through Skraup reaction.<br>Experiment 10b: Synthesis of 1,6-dihydropyridines through Hantzsch reaction in solventless conditions.<br>Práctica 10c: Synthesis of Fischer indole: preparation of 1,2,3,4-tetrahydrocarbazole. |
| Carbohydrates.<br>Kinetic and thermodynamic control. Protecting groups. Sugars as chiral precursors.  | Experiment 11a: Synthesis of beta- and alpha-D-glucose pentaacetates.<br>Experiment 11b: Synthesis of 2,3-O-isopropylidene-L-erythrose from L-arabinose  |
| Amino acids and peptides  | Experiment 12: Synthesis of methyl N-acetyl-L-prolyl-L-phenylalaninate from its amino acids.   |

| Planning  |   |                      |                               |             |
|---|---|----------------------|-------------------------------|-------------|
| Methodologies / tests   | Competencies  | Ordinary class hours | Student's personal work hours | Total hours |
| Introductory activities   | A1 A10 A15 A21 A22<br>A23 A26 B2 B3 C1                                    | 2                    | 0                             | 2           |
| Supervised projects   | A1 A9 A10 A15 A20<br>A23 A26 B2 B3 B4 C1<br>C3                            | 12                   | 36                            | 48          |
| Laboratory practice   | A1 A4 A9 A15 A16<br>A17 A18 A19 A20<br>A21 A22 A23 A24<br>A26 B2 B3 B4 C1 | 44                   | 44                            | 88          |
| Mixed objective/subjective test   | A1 A4 A9 A10 A15<br>A18 A19 A20 A21<br>A22 A23 B2 B3 B4 C1                | 2                    | 8                             | 10          |
| Personalized attention  |   | 2                    | 0                             | 2           |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. |   |                      |                               |             |

| Methodologies           |   |
|-------------------------|---|
| Methodologies           | Description   |
| Introductory activities | A session is programmed in a only group in which students will be exposed to the teaching methodology, planned activities and the evaluation criteria to be applied during the course program. Available resources will be presented on the website of matter and the dates on which the experiences and interviews will be conducted for students to organize their previous work indicated. Finally accurate information will be provided for students to start preparing for the first practice.   |
| Supervised projects     | <p>Prior to entering the laboratory, from a screenplay experience and bibliographic information available on the website of the subject, the student must work independently in the preparation of each experience way.</p> <p>Tutored work also includes assistance to 6 classroom sessions up to 2 hours, in which he will supervise and evaluate the work of the independent student for the preparation of the labs. It will be held one interview per lab. Before the start of the interviews, students must have completed the previous work every practice in the laboratory notebook, which can be replaced in some cases by a report of the preparatory work done to be delivered to the teacher. During interviews, the teacher will resolve the doubts that may arise and will evaluate the work done.</p> <p>The preparation work practices should include calculations, experimental procedures and mounts necessary for the experience as well as an explanation of the mechanisms involved in the processes and solutions to questions of scripts to follow.</p> |



|                                 |  |
|---------------------------------|--|
| Laboratory practice             | <p>There will be 13 sessions of up to four hours of work, where students will do some of the planned experiments are scheduled.</p> <p>During laboratory sessions, simultaneously with the completion of the experiments so, students must develop a laboratory notebook, which collect the calculations, the experimental procedures and the necessary setups. The teacher will review the laboratory notebook for each student in each practice</p> <p>After each practice, which may require several laboratory sessions, students must complete notebook with the results and conclusions, where the answers to the questions the script will include the structural elucidation of the compounds obtained and the data on its performance and purity.</p> |
| Mixed objective/subjective test | There will be a final written exam, in order to objectively assess the degree of assimilation and the applicability of the contents of the subject by students is scheduled in May.  |

## Personalized attention

| Methodologies                              | Description  |
|--|--|
| Supervised projects<br>Laboratory practice | <p>6 Interviews (with a total duration of 2 hours) are scheduled in which the teacher will carry out a follow-up, orientation and evaluation of non-face-to-face work done by the student for the preparation of laboratory sessions. Students should go to the interviews with a report of the preparation work done.</p> <p>In addition, the student can receive personalized attention on any aspect of the subject during the teacher's tutoring schedule.</p> <p>For students with part-time dedication or specific modalities of learning or support for diversity, personalized attention will be provided within the flexibility allowed by coordination schedules and material and human resources.</p> |

## Assessment

| Methodologies                   | Competencies  | Description  | Qualification |
|---------------------------------|---|--|---------------|
| Supervised projects             | A1 A9 A10 A15 A20<br>A23 A26 B2 B3 B4 C1<br>C3                            | Self-made work done by the student for the autonomous preparation of the laboratory practices and attendance and participation during the interviews will be assessed.   | 20            |
| Laboratory practice             | A1 A4 A9 A15 A16<br>A17 A18 A19 A20<br>A21 A22 A23 A24<br>A26 B2 B3 B4 C1 | A continuous evaluation of the work in the laboratory where the interest and dedication of the students is taken into account, proper planning and organization of work, respect for the safety and skill achieved in laboratory operations will be conducted. The rating of this part includes the assessment of laboratory notebook.   | 40            |
| Mixed objective/subjective test | A1 A4 A9 A10 A15<br>A18 A19 A20 A21<br>A22 A23 B2 B3 B4 C1                | <p>In a joint test, the student must explain in writing and carried out similar to the practices in the laboratory experience program. From the data provided in the statement (description and amounts of the starting materials and products structure synthesize) shall: (1) make all necessary calculations, (2) propose appropriate experimental procedures for the preparation and purification compounds, (3) describe the required assemblies and (4) propose reaction mechanisms that explain the processes involved.</p> <p>For the correct preparation of the mixed test the student can study the supervised projects that were corrected during the interviews.</p> | 40            |

## Assessment comments



Attendance at the presentation session, the laboratory practicum, the interviews (of the supervised projects) and the mixed test are mandatory. To pass the course is necessary to obtain greater or equal to 5 out of 10 and a minimum return of 30%. Students whose average yield exceeds 4.5 points and that do not meet the minimum performance in any of the activities will be assessed as "unfit" and receive the grade of 4.5. We will only qualify as "not submitted" to students who have participated in activities that add less than 25% of the final grade. The marks obtained in interviews and in the labs will remain in the 2nd opportunity at July 2024. On the second opportunity, the students who have not passed the continuous evaluation of the practical laboratory work should take a practical laboratory test. Students who have passed the continuous assessment of practical laboratory work must complete a written mixed test to establish 40% of the grade. In the second opportunity, the students will be able to present themselves to a new evaluation of the mixed test to establish 40% of the grade. According to the academic regulations, students are evaluated on the second occasion only choose honors if the maximum number of these not completed in full at the earliest opportunity. The evaluation criteria established in the teaching guide for the 2022-23 academic year will be applied in the December early opportunity. With regard to the successive academic years, the process of teaching and learning, including assessment, refers to an academic year and thus begins again with a new academic year, including all activities and evaluation procedures that scheduled for that course. and academic exemption of assistance exemption, the professor may fully or partly exempt any member of the student body to attend the ongoing evaluation process. Students that is in this circumstance must pass a specific test that leaves no doubt about achieving the powers of matter on two occasions. In the case of students with recognition of part-time dedication, with academic of exemption of assistance or of specific modalities of learning or support to the diversity will be evaluated with the criteria exposed previously. The realization of the practices of laboratory is an indispensable requirement to surpass the matter and will be facilitated in the measure of the possible, taking in consideration the flexibility of the schedules and the material and human resources. In the case of exceptional and objective circumstances, properly justified, the professor could exempt total or partially to some student of the continuous evaluation process in the practices of laboratory. The student in this circumstance will have to surpass a specific test to demonstrate the achievement of the knowledges and skills of the subject (corresponding to 100% of the qualification) in either the first or the second opportunity. The fraudulent performance of tests or evaluation activities will be penalized taking into account what is established in the regulations.

## Sources of information

|                      |  |
|----------------------|--|
| <b>Basic</b>         | <ul style="list-style-type: none"> <li>- Rodríguez Yunta, M. J.; Gómez Contreras, F. (2008). Curso Experimental en Química Orgánica . Madrid. Síntesis.</li> <li>- Harwood, L. M.; Moody, C. J.; Percy, J. M. (1998). Experimental Organic Chemistry. Standard and microscale. Oxford. Blackwell Science.</li> <li>- Mohrig, J. R.; Hammond, C. N.; Morrill, T. C.; Neckers, D. C. Organic Chemistry: A Balanced Approach (1998). Experimental Organic Chemistry: A Balanced Approach Organic Chemistry: A Balanced Approach Macroscale and Microscale . New York. Freeman</li> <li>- Mohrig, J. R.; Hammond, C. N.; Schatz, P. F.; Morrill, T. C. (2003). Modern projects and experiments in organic chemistry miniscale and standard taper microscale . New York. Freeman</li> <li>- Martínez Grau, M<sup>a</sup> A.; Csaky, A. G. (1998). Técnicas Experimentales en Síntesis Orgánica . Madrid. Síntesis.</li> </ul> |
| <b>Complementary</b> |  |

## Recommendations

Subjects that it is recommended to have taken before



Organic Chemistry 1/610G01026

Organic Chemistry 2/610G01027

Intermediate Organic Chemistry/610G01028

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

**Subjects that continue the syllabus**

Advanced Organic Chemistry/610G01030

**Other comments**

Green Campus&nbsp;Program -&nbsp;Faculty of SciencesIn order to help achieve an immediate sustainable environment and comply with point 6 of the "Declaración Ambiental da Facultade de Ciencias (2020)", the work carried out in QO1 will be mostly requested in virtual format and computer media.

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.