



Teaching Guide				
Identifying Data			2023/24	
Subject (*)	Instrumental Analytical Chemistry 2	Code	610G01014	
Study programme	Grao en Química			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Third	Obligatory	6
Language	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Química			
Coordinador	Prieto Blanco, Maria del Carmen	E-mail	m.c.prieto.blanco@udc.es	
Lecturers	Gonzalez Castro, Maria Jose Lejo Santiago, Jorge Prieto Blanco, Maria del Carmen	E-mail	m.j.gonzalez.castro@udc.es jorge.lsantiago@udc.es m.c.prieto.blanco@udc.es	
Web				
General description	The basics, advantages and typical limitations, as well as normal working protocols on several analytical techniques are to be presented. In particular: electroanalytical, chromatographic (gases and liquids), capillary electrophoresis, and enzymatic and immunologic analyses.			

Study programme competences / results	
Code	Study programme competences / results
A7	Knowledge and application of analytical methods
A15	Ability to recognise and analyse new problems and develop solution strategies
A16	Ability to source, assess and apply technical bibliographical information and data relating to chemistry
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
A24	Ability to explain chemical processes and phenomena clearly and simply
A26	Ability to follow standard laboratory procedures in relation to analysis and synthesis of organic and inorganic systems
B1	Learning to learn
B2	Effective problem solving
B3	Application of logical, critical, creative thinking
B4	Working independently on own initiative
B5	Teamwork and collaboration
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
C6	Ability to assess critically the knowledge, technology and information available for problem solving
C7	Acceptance as a professional and as a citizen of importance of lifelong learning

Learning outcomes	
Learning outcomes	Study programme competences / results



- Explain adequately the basics and processes related to some fundamental analytical techniques.	A7	B1	C1
- Understand their fundamentals, instruments, advantages and limitations.	A15	B2	C3
- Get, evaluate and use any source of technical information related to these techniques.	A20	B3	C6
- Design and develop strategies to solve analytical problems.	A21	B4	C7
- Select the most adequate analytical technique for each particular situation.	A24	B5	
- Interpret the analytical data.			
- Get critical thinking about the experimental work			
To get skills in the laboratory most common tasks. In particular:	A15		C3
- to evaluate and use bibliographical information related to the analytical techniques.	A16		C6
- to design and to develop strategies to solve problems.	A17		
- to interpret the analytical data and the experimental results.	A19		
- to develop a critical attitude during the experimental work.	A20		
	A22		
	A23		
	A26		

Contents	
Topic	Sub-topic
Chapter 1: Electroanalytical techniques	Fundamentals of the potentiometric measurements. Fundamentals of polarography and voltamperometry. Electrochemical sensors. Examples Numerical exercises
Chapter 2: Chromatographic techniques	Fundamentals of gas chromatography. Fundamentals of liquid chromatography. Examples Numerical exercises
Chapter 3: Electrophoretical techniques	Fundamentals of the electrophoresis Examples
Chapter 4: Enzimatic and inmunochemical techniques	Fundamentals of the enzimatic techniques Fundamentals of the inmunochemical techniques
Laboratory classes	In total, 20 hours of laboratory classes will be given. They will show the most relevant issues of the instrumentation studied in this subject, taking into account the infrastructure limitations of the Faculty.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Laboratory practice	A7 A16 A17 A19 A20 A22 A23 A26 B3 B4 B5 C3 C6	20	10	30
Mixed objective/subjective test	A7 A20 A21 A24 B2 C1	3	0	3
Seminar	A15 A16 A20 A21 B1 B2 C7	7	21.56	28.56
Supervised projects	A7 A16 B1 B2 B4 C1	0	2.94	2.94
Guest lecture / keynote speech	A7 A15 A21 A22 A23 A24 B3 C6 C7	21	63	84
Personalized attention		1.5	0	1.5

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

Methodologies	
Methodologies	Description
Laboratory practice	<p>It is intended that the student works with the analytical techniques studied in the theoretical lessons, taking into account the infrastructure limitations of the Faculty. A laboratory notebook (logbook) has to be kept by the student in order to address his/her practical lessons.</p> <p>The use of leaflets will not be allowed anyway and its use will strongly penalize the final score. A formal notebook has to be used instead.</p>
Mixed objective/subjective test	The test to evaluate the knowledge gained by the student will include both theoretical and numerical questions. The former will consist mainly in short questions and one or two questions to be developed longer. They will evaluate the theoretical classes and the seminars. An exam will be made at the end of the first chapters so that (if passed) the student can simplify the first official exam.
Seminar	Seminars will be mostly devoted to solve numerical exercises. They must be tried previously by the students so that the seminars would be devoted mainly to solve their doubts.
Supervised projects	<p>Supervised learning process in small groups (3-4 students) with the aim of helping students to work independently and encouraging students to become responsible for their own learning.</p> <p>The proposed activities will be related with problem solving sessions. The students will work together to solve the tasks assigned by the teacher, with the aim of optimising their learning experience and that of other members of group. The activities will be discussed in a tutelage session.</p>
Guest lecture / keynote speech	The conceptual basis of the different analytical techniques considered in the subject will be reviewed and explained. The underlying chemical, physical or biological bases will be presented. The basic instrumental equipments will be studied and discussed.

Personalized attention	
Methodologies	Description
Supervised projects Laboratory practice Seminar	<p>The laboratory practices and the seminars for the numerical resolution of problems will be carried out under the supervision of the professor during class hours. If necessary, tutorials will be held in which doubts will be answered and the work done will be reviewed.</p> <p>Regarding the supervised projects, for each group of students a tutelage session will be programmed for discussion of the activities and resolution of doubts. Therefore, the teacher will be able to analyse if the process of learning of the student is suitable.</p> <p>For students with recognition of part-time dedication and academic dispensation from attendance exemption to seminars, the numerical resolution of problems will be carried out by the student outside the established academic hours; the teacher will resolve any doubts and will review the work carried out in a tutorial regimen (by appointment) established with the student. It will be mandatory to carry out the laboratory practices within the established schedule.</p>

Assessment			
Methodologies	Competencies / Results	Description	Qualification
Supervised projects	A7 A16 B1 B2 B4 C1	The adequate resolution of the proposed projects, the degree of participation of the student in the tutelage session, and the quality of explanation of each activity.	5
Laboratory practice	A7 A16 A17 A19 A20 A22 A23 A26 B3 B4 B5 C3 C6	<p>Daily evaluation: attitude, order, attention, correct experimental work, correct answers.</p> <p>At the end, a general evaluation will be undergone using the student's laboratory notebook.</p>	20
Guest lecture / keynote speech	A7 A15 A21 A22 A23 A24 B3 C6 C7	Attitude and degree of participation of the student in the classes.	2



Seminar	A15 A16 A20 A21 B1 B2 C7	Attitude and degree of participation of the student in the classes. Degree of preparation of the numerical exercises before the seminars. Performing of group works that can be assigned.	8
Mixed objective/subjective test	A7 A20 A21 A24 B2 C1	Correctness and adequacy in the responses to the theoretical questions. Correct solution to the numerical exercises. Calculations and final exact result.	65

Assessment comments



The global qualification of the subject will be calculated from the contribution of the evaluable activities: mixed test (up to a maximum of 6 points), laboratory practices (up to a maximum of 2.5 points), supervised work (up to a maximum of 0.5 points), and keynote speech and seminars (up to a maximum of 1 point). Students who do not participate in the seminars and supervised works will obtain a grade of 0 in that section.

Completing laboratory practices is a basic requirement to pass the subject.

The mixed test will consist of two parts corresponding to two blocks of content: Block I (electroanalytical techniques) and Block II (chromatographic techniques, capillary electrophoresis and enzymatic and immunochemical analysis). In each of the parts it will be necessary to solve theoretical questions and numerical exercises, each of which constitutes an evaluable activity. The qualification of the mixed test will be the average of the qualifications obtained in the two activities. In order to compensate any of the parts, a minimum score of 4.0 points out of 10 must be achieved in some of them. If the minimum grade is not reached in any of them, in the event that the average is greater than or equal to 5 (out of 10), the subject will be ?fail? (4.5).

The "Not presented" score will be obtained in case the student does not take the mixed test.

The scores of the laboratory classes, supervised projects and seminars obtained previously will be maintained in the second opportunity of July. If the laboratory practices were failed due to the low quality of the report, the qualification may be improved by special questions in the second opportunity.

The qualifications of the mixed test of the second opportunity (July) will replace those obtained in the mixed test of the first opportunity (June), with the same criteria.

The maximum score (10, Matricula de Honor) will be obtained by pupils doing the second exam (July) only if that score was not given in the first exam (May-June), according to the Administrative requirements.

Students being recognized officially as partial-time and entitled not to attend the lectures will be evaluated considering only the scores obtained in the objective tests (70%) and the laboratory practices (30%). This applies to both opportunities.

In the early call of December, the regulations of the corresponding teaching guide for the 2022-2023 academic year are applied.

In the evaluation of the subject, the provisions of article 14, relating to the Fraud Commission and disciplinary responsibilities, of the evaluation regulations for Degrees and Masters will be applied.



<b>Basic</b>	<ul style="list-style-type: none"><li>- RUBINSON, K.A.; RUBINSON, J.J. (2001). Análisis instrumental. Madrid, Prentice Hall</li><li>- HARRIS, D.C. (2007). Análisis químico cuantitativo. Barcelona, Reverté</li><li>- SKOOK, D.A.; WEST, D.M.; HOLLER, F.J. (1996). Fundamentos de química analítica (volumen 2). Barcelona, Reverté</li><li>- CHRISTIAN, G.D. (2004). Química analítica (6a edición). México, McGraw Hill</li><li>- CELA, R.; LORENZO, R.A.; CASAIS, M.C. (2002). Técnicas de separación en química analítica. Madrid, Síntesis</li><li>- ANDRADE ET AL. (2017). Problems of Instrumental Analytical Chemistry. London, World Scientific Publication</li></ul> <p>O libro "Análisis Químico Cuantitativo" "Análisis Químico Cuantitativo" of author Daniel C. Harris (Ed. Reverté SA) is available on the library's website.</p>
<b>Complementary</b>	<ul style="list-style-type: none"><li>- KELLNER, R (Editor) (2004). Analytical chemistry. Winheim, Willey</li><li>- SKOOG, D.A.; HOLLER, F.J.; NIEMAN, T.A. (2001). Principios de análisis instrumental (5a edición). Madrid, McGraw Hill</li></ul>

## Recommendations

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

General Chemistry 1/610G01007  
General Chemistry 2/610G01008  
General Chemistry 3/610G01009  
Chemistry Laboratory 1/610G01010  
Analytical Chemistry 1/610G01011  
Analytical Chemistry 2/610G01012  
Instrumental Analytical Chemistry 1/610G01013  
Chemistry Laboratory 2/610G01032

### Subjects that are recommended to be taken simultaneously

### Subjects that continue the syllabus

Advanced Analytical Chemistry and Chemometrics/610G01015  
Environment and Quality/610G01037

### Other comments

To avoid the problems mentioned in Assessment, the student should be aware of the need of have been studied (and passed) other subjects; at the very least: QA1, QA2, Laboratorio de Química 2 y QAI1. Sustainability In order to help achieve an immediate sustainable environment and comply with the point 6 of "Environmental Declaration of the Faculty of Sciences (2020) the documentary works carried out in this subject will be requested in virtual format and computer support. If they made on paper, plastics should not be used, they will be double-sided, recycled paper will be used and the making of drafts will be avoided. Gender Perspective The teachers of this subject work with recognition of diversity and multiculturalism and respect for fundamental rights and equality between men and women.

(\*)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.