



## Teaching Guide

Identifying Data					2020/21
<b>Subject (*)</b>	Instrumental Analytical Chemistry 2	<b>Code</b>	610G01014		
<b>Study programme</b>	Grao en Química				
Descriptors					
Cycle	Period	Year	Type	Credits	
Graduate	2nd four-month period	Third	Obligatory	6	
<b>Language</b>	SpanishGalician				
<b>Teaching method</b>	Face-to-face				
<b>Prerequisites</b>					
<b>Department</b>	Química				
<b>Coordinador</b>	Prieto Blanco, Maria del Carmen	<b>E-mail</b>	m.c.prieto.blanco@udc.es		
<b>Lecturers</b>	Andrade Garda, Jose Manuel Gonzalez Castro, Maria Jose Prieto Blanco, Maria del Carmen	<b>E-mail</b>	jose.manuel.andrade@udc.es m.j.gonzalez.castro@udc.es m.c.prieto.blanco@udc.es		
<b>Web</b>					
<b>General description</b>	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.				

<b>Contingency plan</b>	<p>1. Modifications to the contents No changes will be made to the content.</p> <p>2. Methodologies *Teaching methodologies that are maintained -Guest lecture/keynote speech -Seminar -Mixed test</p> <p>*Teaching methodologies that are modified -Laboratory practice. They will be replaced by virtual practices using real examples. Special attention will be paid to numerical calculations and qualitative and quantitative evaluation -Group works</p> <p>3. Mechanisms for personalized attention to students E-mail. Students will be able to make individual consultations or tutorials via email whenever they need it. Moodle. In each keynote speech, seminar and virtual practices, students are encouraged to ask questions through the forum.</p> <p>4. Modifications in the evaluation Laboratory practice (35%). They will be evaluated through the reports that students must submit in Moodle (a tool called homework) in which they will answer questions related to the indicated activities and proposed calculations. Group works (20%). Supervised continuous self-assessment of group work on theoretical knowledge. Mixed test (45%). A test will be carried out to evaluate the knowledge acquired and its management. This test will consist on theoretical questions and numerical exercises, which will evaluate the contents of the master sessions and seminars.</p> <p>*Evaluation observations: All those collected in the observations section of the teaching guide. Regarding the new methodologies, the qualification of those achieved in the first opportunity will be kept in the second opportunity in July. In the case of not being passed, students will have the opportunity to improve the grade associated with related questions in the second opportunity (objective test).</p> <p>5. Modifications to the bibliography or webgraphy In the UDC library students have access to a part of the recommended bibliography through electronic resources. In addition, in Moodle supporting documents will be placed for the study and realization of work.</p>
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<b>Study programme competences</b>	
<b>Code</b>	<b>Study programme competences</b>
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		
- 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: Enzymatic and immunochemical techniques	Fundamentals of the enzymatic techniques Fundamentals of the immunochemical 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	Ordinary class hours	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	24.5	31.5
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	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.  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.
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.
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
Laboratory practice Seminar	Students may solve their doubts both during the theoretical classes and the seminars. However, dedicated attention can be obtained in special attention hours (tutorships) which will be agreed between the student and the teacher.  Students being recognized officially as partial-time and entitled not to attend the lectures will be attended in a tutorships regime (set hour with teacher in advance).

Assessment			
Methodologies	Competencies	Description	Qualification
Laboratory practice	A7 A16 A17 A19 A20 A22 A23 A26 B3 B4 B5 C3 C6	Daily evaluation: attitude, order, attention, correct experimental work, correct answers.  At the end, a general evaluation will be undergone using the student's laboratory notebook.	30
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.	60
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**Assessment comments**

To pass the subject two basic requisites will be mandatory: (i) attendance to all the activities planned for the subject and (ii) get a minimum score on all (and each) activities (5 point out of 10). The test will consist of two parts containing theoretical questions and numerical exercises. Each of these two parts are evaluated separately. In order to compensate some of the parts, a minimum qualification of 4 points out of 10 must be obtained in each of them.

The subject will not be passed in case the student shows errors in the presentation of the equilibria, stoichiometric calculations and / or formulation of chemical equations

After finishing the first chapters, an optional objective test will be carried out (one including theoretical questions and the other with numerical exercises) so that the students passing it (score of 5, out of ten, in each part) may reduce the amount of chapters to be studied for the first examination (first opportunity, May-June).

Accordingly, all the scores must yield a minimum sum of 5 (out of 10). However, note that the subject will not be approved (even when the overall sum exceeds 5) if a particular score does not reach 4. In this case, the final score of the subject will be "fail" (score = 4).

The "Not presented" score will be obtained in case the student makes less than 25% of the academic activities.

Note that "continuous evaluation" means that the second opportunity of July is a second opportunity for the exam (Mixed/subjective test). Following, the scores of the laboratory classes, seminars, etc. obtained previously will be maintained. The score of the new exam will substitute that from the first opportunity, with the same criteria.

For next courses, no score will be maintained and all activities will have to be repeated.

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 (75%) and the laboratory practices (25%). This applies to both opportunities

**Sources of information**

<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>
<b>Complementary</b>	<ul style="list-style-type: none"><li>- KELLNER, R (Editor) (2004). Analytical chemistry. Weinheim, Wiley</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 y QAI1

(\*)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.