Teaching Guide				
Identifying Data				2023/24
Subject (*)	Instrumental Analysis		Code	610G04014
Study programme	Grao en Nanociencia e Nanotecnoloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Second	Obligatory	6
Language	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Química			
Coordinador	Moreda Piñeiro, Jorge	E-mail	jorge.moreda@udc.es	
Lecturers	Andrade Garda, Jose Manuel Moreda Piñeiro, Jorge Prieto Blanco, Maria del Carmen	E-mail	jose.manuel.andrade@udc.es jorge.moreda@udc.es m.c.prieto.blanco@udc.es	
Web				
General description	In this course it is intended that the student understands the fundamentals and possibilities of the most common instrumental analytical techniques. Special attention will be paid to the physical and chemical fundamentals of the main techniques, equipment configuration, experimental conditions and applications at the nanoscale level.			

Study programme competences	
Code	Study programme competences
A2	CE2 - Aplicar los conceptos, principios, teorías y hechos fundamentales relacionados con la Nanociencia y Nanotecnología a la resolución de problemas de naturaleza cuantitativa o cualitativa.
A3	CE3 - Reconocer y analizar problemas físicos, químicos, matemáticos, biológicos en el ámbito de la Nanociencia y Nanotecnología, así como plantear respuestas o trabajos adecuados para su resolución, incluyendo el uso de fuentes bibliográficas.
A6	CE6 - Manipular instrumentación y material propios de laboratorios para ensayos físicos, químicos y biológicos en el estudio y análisis de fenómenos en la nanoescala.
A7	CE7 - Interpretar los datos obtenidos mediante medidas experimentales y simulaciones, incluyendo el uso de herramientas informáticas, identificar su significado y relacionarlos con las teorías químicas, físicas o biológicas apropiadas.
A8	CE8 - Aplicar las normas generales de seguridad y funcionamiento de un laboratorio y las normativas específicas para la manipulación de la instrumentación y de los productos y nanomateriales.
B1	CB1 - Que los estudiantes hayan demostrado poseer y comprender conocimientos en un área de estudio que parte de la base de la educación secundaria general, y se suele encontrar a un nivel que, si bien se apoya en libros de texto avanzados, incluye también algunos aspectos que implican conocimientos procedentes de la vanguardia de su campo de estudio
B2	CB2 - Que los estudiantes sepan aplicar sus conocimientos a su trabajo o vocación de una forma profesional y posean las competencias que suelen demostrarse por medio de la elaboración y defensa de argumentos y la resolución de problemas dentro de su área de estudio
B3	CB3 - Que los estudiantes tengan la capacidad de reunir e interpretar datos relevantes (normalmente dentro de su área de estudio) para emitir juicios que incluyan una reflexión sobre temas relevantes de índole social, científica o ética
B7	CG2 - Resolver problemas de forma efectiva.
B8	CG3 - Aplicar un pensamiento crítico, lógico y creativo.
B9	CG4 - Trabajar de forma autónoma con iniciativa.
B11	CG6 - Comportarse con ética y responsabilidad social como ciudadano/a y como profesional.
C3	CT3 - Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida
C4	CT4 - Desarrollarse para el ejercicio de una ciudadanía respetuosa con la cultura democrática, los derechos humanos y la perspectiva de género
C8	CT8 - Valorar la importancia que tiene la investigación, la innovación y el desarrollo tecnológico en el avance socioeconómico y cultural de la sociedad

C9	CT9 - Tener la capacidad de gestionar tiempos y recursos: desarrollar planes, priorizar actividades, identificar las críticas, establecer plazos y cumplirlos

Learning outcomes			
Learning outcomes	Study programme competences		
Plan and execute the stages of the analytical process for nanoscale analysis.	A2 A3	B1 B2 B8 B9	
Know the fundamentals and characteristics of the most common instrumental techniques (chromatography, spectrometry and electroanalytical)	A2 A3		
Ability to select the most appropriate instrumental technique in solving nanometric analysis	A6 A7		C4
Ability to obtain the most reliable information from experimental data. Making calculations. Learn to interpret data and express analytical results.	A3 A7	B3 B7 B11	
Skill in the use of different instruments and adjusting the instrumental variables. Develop a critical attitude in experimental work.	A8	B1	C3 C4 C8 C9

Contents	
Topic	Sub-topic
Unit 1. Introduction to instrumental analytical techniques.	The analytical process and analysis at the nanoscale. Characteristics and classification of instrumental techniques. Basic components of the instruments. Signs and noise. Analytical problem solving. Quality parameters of instrumental techniques. Calibration.
Unit 2. Mass spectrometry.	Basis. Instrumentation. Applications.
Unit 3. Atomic spectrometry.	Basis. Instrumentation. Applications.
Unit 4.- X-ray spectrometry and related techniques.	Basis. Instrumentation. Applications.
Unit 5.- Electroanalytical methods	Basis. Instrumentation. Applications.
Unit 6.- Introduction to chromatography	Basis. Van Deemter's equation.
Unit 7.- Gas chromatography	Basis. Instrumentation. Applications.
Unit 8.- Liquid chromatography	Basis. Instrumentation. Applications.
Unit 9.- The mass spectrometer as a detector in chromatography.	Chromatographic techniques coupled with mass spectrometry. Applications.
Laboratory practices.	Practice 1-2.- Atomic absorption and emission spectrometry Practices 3-4. Gas and liquid chromatography

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Seminar	A3 B2 B7 B9 C3 C8	8	8	16
Laboratory practice	A6 A8 B3 C4 C9	15	0	15
Workshop	A2	0	2	2
Objective test	A2 A3	3	0	3
Guest lecture / keynote speech	A2 A7 B1 B8 B11	28	84	112
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
Seminar	Classes for solving cases and problems. In the seminars, 8 sessions will be held in small groups in which the teacher and the students will solve different problems and numerical questions. The work of the students in these seminars will be evaluated by solving problems at the same day of the objective test.
Laboratory practice	The learning of the contents of the subject will involve 5 sessions of laboratory practices in which the student will put into practice the theoretical concepts acquired, will manipulate analytical instruments and solve problems. The teacher will advise these activities.
Workshop	The contents explained will be reinforced with the individual completion of self-evaluation questionnaires.
Objective test	A final exam will be held to assess the degree of learning throughout the semester. The date of the same is indicated in the exam calendar of the degree.
Guest lecture / keynote speech	Presentation in the classroom, in participatory classes, of the concepts and procedures associated with the subject. Learning will involve the incorporation of fundamental concepts about each of the instrumental techniques. For this, 28 Master Sessions will be given on the most important contents of the program. For a full use of these, it is recommended that the student has previously read on their own the fundamental aspects of these topics in the recommended texts.

Personalized attention	
Methodologies	Description
Seminar Laboratory practice	The labs and seminars for the numerical solution of problems are conducted under the supervision of the teacher at school hours. Tutorial sessions (if necessary) will be made in which doubts will be resolved and the work performed by the student will be supervised, etc.

Assessment			
Methodologies	Competencies	Description	**Qualification**
Seminar	A3 B2 B7 B9 C3 C8	The seminars will be avaluated by the individual resolution of numerical problems on the day of the multiple choice question test.	20
Objective test	A2 A3	The students' work will be evaluated through an Objective Test that may consist of multiple-choice questions, short questions and diagrammatic drawings which enclosed all theoretical and practical contents.	50
Workshop	A2	The questionnaires will completed by the students at the end of each topic.	10
Laboratory practice	A6 A8 B3 C4 C9	The Labs will be mandatory throughout the semester. The students will anwered several cuestions during at the end of lab sesions.	20

Assessment comments

To pass the course at the first opportunity, there are three basic requirements:
- Compulsory attendance at laboratory practices and regular attendance at other assessable activities (seminars for solving numerical problems),
-carry out all assessable activities (workshops) and
-Achieve a minimum final grade of 5 points in each of them.
If this minimum score is not reached in any of them, if the average is greater than or equal to 5 (out of 10), the subject will appear as failed (4.5).
Students who do not perform the laboratory practices and do not take the objective test will be classified as Not Presented. Grades for labs and workshops will be kept the second time in July. While the qualification of the objective test of July will replace the one obtained in the objective test of February. Students evaluated on the second opportunity will only be eligible for honors enrollment if the maximum number of honors for the corresponding course has not been fully covered on the first opportunity.
Fraudulent performance of tests or evaluation activities will be penalized taking into account what is established in the regulations.
For students with academic exemptions and attendance exemptions, the realization of laboratory practices will be mandatory and will be facilitated within the flexibility allowed by the coordination schedules and the material and human resources. They will be considered exempt from the lectures, although they will be facilitated to attend as many seminars as possible outside of the established academic hours. The teacher will solve the doubts and review the work done in the hours of tutorials (by appointment) that he establishes with the students. It will be mandatory to carry out the laboratory practices in the established academic schedule. The student with recognition of part-time dedication will be evaluated by the marks obtained in the mixed tests (65%), in the practices (20%) and workshops (15%). This will apply to both opportunities.
Students who request the early call in December, will apply the considerations indicated in the previous year's teaching guide.
The teaching-learning process, including evaluation, refers to a complete academic course and, therefore, will start again with a new academic course, including all the activities and evaluation procedures that are scheduled for said academic course.

Sources of information	
Basic	- SKOOG, D.A.; HOLLER, F.J.; NIEMAN, T.A (2001). Principios de análisis instrumental . Madrid, McGraw Hill - HARRIS, D.C (2007). Análisis químico cuantitativo. Barcelona, Reverté - CELA, R.; LORENZO, R.A.; CASAIS, M.C (2002). Técnicas de separación en química analítica. Madrid, Síntesis - GAVIRA VALLEJO, J.M.,HERNANZ GISMERO, A (2007). Técnicas Físicoquímicas en Medio Ambiente. Universidad Nacional de Educación a Distancia - RÍOS CASTRO, A.; MORENO BONDI, M.C.; SIMONET SUAU, B.M. (2012). Técnicas Espectroscópicas en Química Analítica. Volumen I y II. Ed. Síntesis - ANDRADE GARDA JM, CARLOSENA ZUBIETA A., GÓMEZ CARRACEDO MP, , MAESTRO-SAAVEDRA MA, PRIETO BLANCO MC, (2017). Problems of Instrumental Analytical Chemistry. A Hands-On Guide. Editorial World Scientific (London) - Sulabha K. Kulkarni (2015). Nanotechnology: Principles and Practices . Ed. Springer
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments

Recommended:- Study and review the contents taught weekly using bibliographic material to understand and deepen the information obtained in class. - Clarify any doubts with the teacher. - Prepare the seminars thoroughly. - Participate actively in class. -Required activities should be delivered in virtual format and on computer support, if they are carried out on paper, plastics will not be used, double-sided printing will be made using recycled paper and drafts will be avoided.