Teaching Guide				
Identifying Data				2020/21
Subject (*)	Advanced Instrumental Analysis		Code	610500023
Study programme	Mestrado Universitario en Ciencias, Tecnoloxías e Xestión Ambiental (plan 2012)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Optional	3
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Química			
Coordinador	Soto Ferreiro, Rosa Maria	E-mail	rosa.soto.ferreiro@udc.es	
Lecturers	Soto Ferreiro, Rosa Maria Turnes Carou, Maria Isabel	E-mail	rosa.soto.ferreiro@udc.es isabel.turnes@udc.es	
Web				
General description	In this course advanced and novel aspects of instrumental techniques currently used on solving analytical problems related to the environment analysis, industry, etc are taught. Especially explores issues related to the experimental development of them.			
Contingency plan	1. Modifications to the contents: no changes are made. 2. Methodologies *Teaching methodologies that are maintained: all (events academic / information, guest lectures, laboratory practices and mixed test. *Teaching methodologies that are modified: all the methodologies are adapted to the non-face-to-face modality through Moodle and Teams and the programming established in the coordination calendar of the Center is maintained. 3. Mechanisms for personalized attention to students: personalized monitoring will be carried out through email, the Moodle platform or the TEAMS tool, at the request of the students and, as far as possible, during the hours established for tutoring. For students with part-time dedication or specific learning modalities or diversity support, personalized attention will be provided within the flexibility allowed by coordination schedules and material and human resources. 4. Modifications in the evaluation: no changes are made. *Evaluation observations: all the observations included in the teaching guide are maintained. 5. Modifications to the bibliography or webgraphy: no modifications are made, all the necessary materials will be available in Moodle or through access to the electronic resources available in the Library of the Center.			

Study programme competences	
Code	Study programme competences
A1	Coñecemento das realidades interdisciplinares da Química e do Medio Ambiente, dos temas punteiros nestas disciplinas e das perspectivas de futuro.
A3	Capacitar ao alumno para o desenvolvemento dun traballo de investigación nun campo da Química ou do Medio Ambiente, incluíndo os procesos de caracterización de materiais, o estudo das súas propiedades fisicoquímicas e biolóxicas e dos procesos que poden sufrir no medio natural.
A9	Coñecer algunhas aplicacións básicas da química computacional e dos programas de cálculo máis utilizados nos ámbitos da química e o medio ambiente.
A22	Dominar as técnicas instrumentais de análises máis típicas no ámbito químico profesional.

B1	Posuír e comprender coñecementos que acheguen unha base ou oportunidade de ser orixinais no desenvolvemento e/ou aplicación de ideas, a miúdo nun contexto de investigación.
B2	Que os estudantes saiban aplicar os coñecementos adquiridos e a súa capacidade de resolución de problemas en contornas novas ou pouco coñecidos dentro de contextos máis amplos (ou multidisciplinares) relacionados coa súa área de estudo.
B5	Que os estudantes posúan as habilidades de aprendizaxe que lles permitan continuar estudando dun modo que haberá de ser en gran medida autodirixido ou autónomo.
B6	Ser capaz de analizar datos e situacións, xestionar a información dispoñible e sintetizala, todo iso a un nivel especializado.
B7	Ser capaz de planificar adecuadamente desenvolvementos experimentais, a un nivel especializado.
C2	Ser capaz de manter un pensamento crítico dentro dun compromiso ético e no marco da cultura da calidade.
C3	Ser capaz de adaptarse a situacións novas, mostrando creatividade, iniciativa, espírito emprendedor e capacidade de liderado.
C4	Expresarse correctamente, tanto de forma oral coma escrita, nas linguas oficiais da comunidade autónoma.
C6	Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.
C9	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C10	Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.
C11	Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.

Learning outcomes			
Learning outcomes	Study programme competences		
Learn the applicability and potential of the different instrumental techniques in solving problems related to the environment, industry, etc.	AC1 AC22	BC1 BC5	CC2 CC11
Be able to select the most appropriate technique depending on the type of species to be determined, its contents, sample type, cost, etc.	AC3 AC22	BC2	CC3 CC9
Acquire skill in the use of different instruments and adjusting the instrumental variables.	AC22	BC7	
Be able to get the most reliable information from experimental results.	AC9	BC6	CC4 CC6 CC10

Contents	
Topic	Sub-topic
1.- Introduction	Presentation. Documentation for the students.
2.- Mass spectrometry	Fundamentals. Sources of ionization. Analyzers. Detectors. Tandem mass spectrometry (MS/MS). Aplications: environmental, industry.
3.- Atomic absorption spectrometry	Atomization systems. Advances in instrumentation. Operational considerations. Aplications: environmental, industry.
4.- ICP optical emision spectrometry. ICP mass spectrometry	Operational considerations. Aplications: environmental, industry.
5.- Gas chromatography	Advances in instrumentation and modes of operation. Operational considerations. Coupled and multidimensional techniques. Aplications: environmental, industry.
6.- Liquid chromatography	Advances in instrumentation and modes of operation. Operational considerations. Coupled and multidimensional techniques. Aplications: environmental, industry.
7.- Capillary electrophoresis	Fundamentals. Instrumentation and modes of operation. Operational considerations. Aplications. Electrochromatography.
Experimental work	1.- Determination of ionic species by Capillary Electrophoresis. 2.- Visit to the Chromatography unit of Servicios Xerais de Apoio a Investigación. 3.- Visit to the Plasma-mass unit of Servicios Xerais de Apoio a Investigación. 4.- Treatment of the experimental results obtained from different atomic spectrometric techniques.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 A22 B1 B5 C2 C9 C10 C11	10.5	35	45.5
Laboratory practice	A3 A9 B2 B6 B7 C3 C6 C9 C11	8	16	24
Events academic / information	A1 C9 C10 C11	1.5	1.5	3
Mixed objective/subjective test	A22 B2 B5 C4	1	0	1
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
Guest lecture / keynote speech	The teacher presents the fundamental concepts and develops the essential aspects of the subject. It also raises different issues to be discussed and resolved by the students, thereby encouraging their participation.
Laboratory practice	The script of the laboratory practice includes: - A scheme of the experimental procedure. - Issues related to the work done in the laboratory: justification for selection of instrumental parameters, obtaining information from the experimental results, etc.. In the laboratory, the student performs the selection of the experimental conditions, contributes to the adjustment and optimization of the experimental variables, the introduction of the samples, performs calculations of experimental parameters, concentrations, etc. At the end he must submit a report of the practices carried out.
Events academic / information	The alumn shuld be participate in a Scientific meeting, symposium or conference of the scope of the subject.
Mixed objective/subjective test	The student will have to answer to questions related to aspects dealt with in the guest lectures or to apply the acquired knowledge to the resolution of practical cases. It will also include questions related to scientific articles that the student should read.

Personalized attention	
Methodologies	Description
Laboratory practice	In the laboratory sessions, the teacher monitors each student performing operations, so that an incident will not happen, taking into account that complex instrumentation is being used in most cases. The student in recognition of part-time dedication and academic waiver assistance will be attended under tutorial hours (by appointment).

Assessment			
Methodologies	Competencies	Description	**Qualification**
Events academic / information	A1 C9 C10 C11	Attendance and active participation of the student will be taken into account.	10
Guest lecture / keynote speech	A1 A22 B1 B5 C2 C9 C10 C11	Attendance at keynote sessions and active participation in them will be assessed.	20
Laboratory practice	A3 A9 B2 B6 B7 C3 C6 C9 C11	Skill in conducting the experimental activities and the quality of the delivered report will be assessed.	20

Mixed objective/subjective test	A22 B2 B5 C4	It will be done at the end of the teaching activities, in order to assess the degree of learning and acquisition of skills by the student. It will consist of both theoretical questions and questions applied to solving real problems, and related to scientific articles.	50

Assessment comments
To pass the course, three basic requirements are required: - Regular attendance at all the activities and achieve a final score of 5 points and at least a minimum of 4 points in each of the activities. If this minimum value is not achieved in any of them, and the average is greater than or equal to 5 (out of 10), the student will not pass the course and will appear a qualification of 4.5. In the absence of any scientific and / or informative event scheduled in the teaching period, the corresponding evaluation percentage will be assigned to the mixed test. The student will obtain the qualification of ?No presentado? when he attends less than 25% of the scheduled academic activities, and he does not make the mixed test. For students with part-time dedication and academic exemption from attendance or specific modalities of learning or support for diversity, if they cannot make the tests of continuous evaluation, the professor will adopt appropriate actions to avoid prejudicing their qualification.

Sources of information	
Basic	- ESTEBAN, L. (1993). La Espectrometría de Masas en Imágenes. ACK Editores - HOFFMANN, E.; STROOBANT, V (2005). Mass Spectrometry. Principles and Applications. Ed. Wiley - WELZ, B.; SPERLING, M. (1999). Atomic Absorption Spectrometry. Ed. Wiley-VCH - Sanz-Medel, Alfredo (2008). Analytical atomic absorption spectrometry : an introduction. Oxford : Coxmoor - HILL, S.J. (Ed) (2007). Inductively Coupled Plasma Spectrometry and its Aplications. Ed. Blackwell Publishing - CELA, R.; LORENZO, R.A.; CASAIS, M.C. (2002). Técnicas de Separación en Química Analítica. Ed. Síntesis - NIESSEN, W.M.A. (2006). Liquid chromatography-mass spectrometry. Chromatographic science series, vol. 97. . Ed. Boca Ratón: Taylor & Francis - SKOOG, D.; HOLLER, F.J.; NIEMAN T.A. (2000). Principios de Análisis Instrumental . Ed. McGraw-Hill Utilizaranse distintos recursos web que axuden ó alumno a comprender e fixar os coñecementos que se imparten nas clases teóricas e prácticas. Ex: simulacións, esquemas, etc.Os alumnos terán acceso a artículos de revistas científicas, tesinas de licenciatura da Facultade de Ciencias e outros documentos que mostren a aplicación práctica das técnicas que estudiaron ó longo da asignatura.
Complementary	- RUBINSON, K.A.; RUBINSON, J.F. (2002). Análisis Instrumental. Ed. Prentice Hall - ROUESSAC, F., ROUESSAC, A. (2007). Chemical Analysis. Ed. Wiley - KELLNER, R.; MERMET, M.; OTTO, M.; VALCARCEL, M.; WIDMER, H. M. (1998). Analytical Chemistry . Ed. Wiley-VCH - MONTASER, A.; GOLIGHTLY, D.W. (Eds) (1992). Inductively Coupled Plasmas in Analytical Atomic Spectrometry. Ed. VCH - CULLEN, M. (Ed.) (2004). Atomic Spectroscopy in Elemental Análisis . Ed. Blackwell Plublishing Ltd. - DEDINA J., TSALEV D. L. (1995). Hydride Generation Atomic Absorption Spectroscopy . John Wiley & Sons

Recommendations
Subjects that it is recommended to have taken before
Analytical Estrategies and the Environment/610500002
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments

(*)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.