Teaching Guide				
Identifying Data				2021/22
Subject (*)	Advanced Materials Characterization Techniques		Code	610509121
Study programme	Mestrado Universitario en Investigación Química e Química Industrial (Plan 2020)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Optional	3
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Departamento profesorado másterQuímica			
Coordinador	Sanchez Andujar, Manuel	E-mail	m.andujar@udc.es	
Lecturers	Sanchez Andujar, Manuel	E-mail	m.andujar@udc.es	
Web				
General description	This course includes a description of the fundamentals and main applications of several characterization techniques widely used in Materials Science and not previously treated in the compulsory subject "Materials Characterization Techniques and Biointerphases" (module M1). These contents are important to complete the training in this module M5 -Nanoquímica and New Materials- and to have a more complete vision of the techniques of characterization of materials and nanomaterials.			
Contingency plan	In principle, the contents will be kept in their entirety. However, if necessary and for reasons of force majeure, a more general presentation of the contents can be chosen, but in any case all the most relevant aspects of the subject will be covered.			

Study programme competences / results	
Code	Study programme competences / results
A1	Define concepts, principles, theories and specialized facts of different areas of chemistry.
A2	Suggest alternatives for solving complex chemical problems related to the different areas of chemistry.
A9	Promote innovation and entrepreneurship in the chemical industry and in research.
B2	Students should apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
B3	Students should be able to integrate knowledge and handle complexity, and formulate judgments based on information that was incomplete or limited, include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments.
B5	Students must possess learning skills to allow them to continue studying in a way that will have to be largely self-directed or autonomous.
B8	Evaluate responsibility in the management of information and knowledge in the field of Industrial Chemistry and Chemical Research
B10	Use of scientific terminology in English to explain the experimental results in the context of the chemical profession
B11	Apply correctly the new technologies to gather and organize the information to solve problems in the professional activity.
C1	CT1 - Elaborar, escribir e defender publicamente informes de carácter científico e técnico
C3	CT3 - Traballar con autonomía e eficiencia na práctica diaria da investigación ou da actividade profesional.
C4	CT4 - Apreciar o valor da calidade e mellora continua, actuando con rigor, responsabilidade e ética profesional.

Learning outcomes			
Learning outcomes	Study programme competences / results		
- The student will obtain an overview of the advanced techniques of morphological, structural and microstructural characterization. - The student will learn the advantages and limitations of each one of the characterization technique. - When you need to characterize a material, the student will be able to discern what are the characterization techniques that better fit your needs / possibilities.	AC1 AC2 AC9	BC2 BC3 BC5 BC8 BC10 BC11	CC1 CC3 CC4

Contents	
Topic	**Sub-topic**
Theme 1. microscopic techniques	Introduction to microscopic techniques. Optical microscopies (fluorescence and confocal), electronic microscopies (TEM, SEM, STEM, electron diffraction), scanning probe microscopies (STM, AFM).
Theme 2. diffractometric techniques	Introduction to diffractometric techniques. X-ray and synchrotron diffraction, neutron diffraction
Theme 3. spectroscopic techniques.	electronic spectroscopic techniques. (EDXS, EELS) electron paramagnetic resonance (EPR)
Theme 4: Characterization of porous materials	Physical adsorption of gases, specific surface area, pore size distribution.
Tema 5: Atomic mass spectrometry techniques	Single particle (SP-ICP-MS), and hybrid techniques (HPLC-ICP-MS, FFF-ICP-MS

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
Guest lecture / keynote speech	A1 A2 A9	12	0	12
Seminar	A1 B2 B3 B5 B8	7	0	7
Problem solving	A1 A2 A9 B2 B10 B11 C1 C4	0	24	24
Document analysis	C3 C4	0	12	12
Objective test	A1 A2 A9 B2 B3 B5 B8 B10 B11 C1	1	18	19
Personalized attention		1	0	1
(*)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	Theoretical classes. Magisterial lessons (with the use of blackboard and computer), complemented with the tools of virtual teaching
Seminar	Practical seminars conducted by teachers of the Master, or invited professionals from companies, the Administration or other universities. Interactive sessions related to the subjects with discussions and exchange of points of view with the students
Problem solving	Resolution of practical exercises (problems, quizzes, processing and interpretation of information, evaluation of scientific publications, etc.).
Document analysis	Personal study based on different sources of information.
Objective test	Preparation of the different tests for verification of obtaining both theoretical and practical knowledges, and the acquisition of skills and attitudes.

Personalized attention	
Methodologies	**Description**
Seminar Problem solving Document analysis	Individual or small group tutoring.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**

Guest lecture / keynote speech	A1 A2 A9	Valorarase o traballo do alumnado, as súas respostas, o seu nivel de coñecemento,e a súa participación activa no debate cos seus compañeiros.	5
Seminar	A1 B2 B3 B5 B8	SESIÓN MAXISTRAL, SEMINARIOS, SOLUCIÓN DE PROBLEMAS: computaranse conxuntamente (45% da calificación global)	20
Problem solving	A1 A2 A9 B2 B10 B11 C1 C4	SESIÓN MAXISTRAL, SEMINARIOS, SOLUCIÓN DE PROBLEMAS: computaranse conxuntamente (45% da calificación global)	20
Objective test	A1 A2 A9 B2 B3 B5 B8 B10 B11 C1	Computará o 55% da calificación global.	55

Assessment comments

1. Assessment procedure. The assessment of this subject will be done
through a system whose sections and their respective weighting is detailed:
Assessment system (Weighting):
- Final examination (55 %)
- Continuous evaluation (45 %)
The continuous assessment (N1) will have a weight of 45% in the qualification of the subject and will be fundamentally telematic (Virtual Campus or Microsoft TEAMS). It will consist of presentations in the Virtual Campus of problems and practical cases (35%), in the evaluation of the student through questions and questionnaires during the course (5%) and in the oral presentation (works, reports, problems and practical cases) (5%).
The final examination (N2) will have a weight of 55 % and will cover all the contents of the subject.
The final student?s score will be calculated by applying the following formula:
Final mark = 0.45 x N1 + 0.55 x N2
Being N1 the numerical mark corresponding to the continuous assessment (0-10 scale) and N2 the numerical mark of the final examination (0-10 scale). In any case, to pass the course, it is mandatory to achieve a minimum mark of 5.0 (0-10 scale).
2. Recommendations with regard to the evaluation.
The student should review the theoretical concepts introduced in the
various topics using the supporting material provided by teachers and the
literature recommended for each theme. The degree of success in the resolution
of the exercises provides a measure of the student's preparation to deal with
the final examination of the subject. Students who find difficulties in working
the proposed activities should consult with the teacher, with the goal that it
can analyze the problem and help solve these challenges.
3. Recommendations with regard to the recovery.
Teacher will discuss with students who do not successfully overcome the
evaluation process, and want it, the difficulties encountered in learning the
contents of the subject. The teacher will also provide additional material
(questions, exercises, exams, etc.) to reinforce the learning of the subject.
4. Others.
Attendance at face-to-face activities (face to face lectures, seminars and tutorials) is mandatory. The faults must be documentary supported, accepting reasons referred to in the University regulations.

Sources of information

Basic	- P. Atkins, J. de Paula: Physical Chemistry, 10ª Edición; Oxford University- I. N. Levine: Principios de Fisicoquímica, 6ª Edición; McGraw-Hill, 2014As ediciones previas ás especificadas tamén son válidas para esta materia.- A.R. West: "Solid State Chemistry and its Applications". Wiley, 2 ed., 2014.- L.E. Smart, E.A. Moore: "Solid State Chemistry: An Introduction". CRC Press, 4 ed., 2012.- R.Thomas : ?Practical Guide to ICP-MS?, CRC Press, Taylor & Francis Group 2008- C.Stephan: ?Single-Particle ICP-MS Compendium? Perkin Elmer, 2016 - M.E.Schimpf, K.Cadwell, J.Calvin Giddings: ? Field-Flow fractionation handbook?, John Willey & Sons, New York, 2000 - J.Janca :? Field-flow fractionation: analysis of macromolecules and particles?, Marcel Dekker, New York, 1988

Complementary	- A.I. Kirkland, S.J. Haigh: "Nanocharacterisation", 2ª Edición. RSC Publishing, 2015.- S.R. Morrison: The Chemical Physics of Surfaces; 2nd ed.; Plenum Press, 1990.- D. Myers: Surfaces, Interfaces and Colloids: Principles and Applications; VCH, 1999. - S.E. Lyshevski (Editor): "Dekker Encyclopedia of nanoscience and nanotechnology" (7 volumes), 3ª Edición. CRC Press, 2014. - John P. Sibilia: ?A guide to materials characterization and chemical analysis?. VCH Publishers, 1998. - C. Hammond: "The basics of Crystallography and Diffraction", 4ª Edición. International Union of Crystallography, Oxford University Press, 2015. - C. Giacovazzo, editor ?Fundamentals of Crystallography? 3ª Edición. International Union of Crystallography, Oxford University Press, 2011. - P.J. Goodhew: Electron Microscopy and Analysis. 3ª edición. Taylor & Francis, 2001.- J.-P. Eberhart: "Structural and chemical analysis of materials : X-ray, electron and neutron diffraction, X-ray, electron and ion spectrometry, electron microscopy ". Wiley, 1991. - Y. Leng: ?Materials Characterization. Introduction to Microscopic and Spectroscopic Methods?, 2ª Edición. Wiley-VCH, 2013 Ademais, recomendaranse para cada tema textos complementarios (artigos científicos, páxinas web, textos específicos) no momento de impartición da materia.

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

(*)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.