Teaching Guide				
Identifying Data				2022/23
Subject (*)	Techniques of Characterisation of Nanomaterials 2		Code	610G04030
Study programme	Grao en Nanociencia e Nanotecnoloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Third	Obligatory	6
Language	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría Naval e IndustrialFísica e Ciencias da TerraQuímica			
Coordinador	Fernandez Perez, Maria Isabel		E-mail	isabel.fernandez.perez@udc.es
Lecturers	Andrade Garda, Jose Manuel Canle López, Moisés Fernandez Perez, Maria Isabel Garcia Dopico, Maria Victoria Montero Rodríguez, María Belén Santaballa Lopez, Juan Arturo		E-mail	jose.manuel.andrade@udc.es moises.canle@udc.es isabel.fernandez.perez@udc.es victoria.gdopico@udc.es belen.montero@udc.es arturo.santaballa@udc.es
Web	https://campusvirtual.udc.gal/my/			
General description	Description: Understand the basic aspects of the techniques for the morphological, structural and microstructural characterization of materials, as well as develop criteria that allow selection among the characterization techniques that is most appropriate when solving specific problems. Context: The subject is offered when other subjects have already been taken that provide basic knowledge about the radiation-matter interaction that will serve as a start for the development of this subject			

Study programme competences / results	
Code	Study programme competences / results
A1	CE1 - Comprender los conceptos, principios, teorías y hechos fundamentales relacionados con la Nanociencia y Nanotecnología.
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.
A4	CE4 - Desarrollar trabajos de síntesis y preparación, caracterización y estudio de las propiedades de materiales en la nanoescala.
A5	CE5 - Conocer los rasgos estructurales de los nanomateriales, incluyendo las principales técnicas para su identificación y caracterización
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.
A9	CE9 - Evaluar correctamente los riesgos sanitarios y de impacto ambiental asociados a la Nanociencia y la Nanotecnología.
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
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.
B10	CG5 - Trabajar de forma colaborativa.
B11	CG6 - Comportarse con ética y responsabilidad social como ciudadano/a y como profesional.

C2	CT2 - Dominar la expresión y la comprensión de forma oral y escrita de un idioma extranjero
C6	CT6 - Adquirir habilidades para la vida y hábitos, rutinas y estilos de vida saludables
C7	CT7 - Desarrollar la capacidad de trabajar en equipos interdisciplinares o transdisciplinares, para ofrecer propuestas que contribuyan a un desarrollo sostenible ambiental, económico, político y social.
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 / results		
Deepen the understanding of the basic aspects of advanced techniques of morphological, structural and microstructural characterization of materials.	A1 A2	B1	C2
Ability to correctly interpret the results obtained through different characterization techniques	A5 A7	B3 B7 B8 B10	C2 C7 C8
Develop selection criteria among the characterization techniques for the resolution of specific problems.	A4 A6 A8 A9	B7 B8 B9 B11	C6 C7 C8 C9

Contents	
Topic	Sub-topic
MODULE 1: Characterization using spectroscopies:	? Ultraviolet-visible (UV-Vis) ? Diffuse reflectance (DRS) ? Infrared with Fourier transform (FT-IR) ? Raman ? Surface enhanced Raman spectroscopy. (SERS) ? X-ray spectroscopy
MODULE 2: Characterization using microscopies:	? Atomic force microsopy ? Tunnel effect ? Confocal

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 C2	5	11	16
Laboratory practice	A2 A4 A5 A6 A7 A8 A9 B1 B3 B7 B8 B9 B10 B11 C6 C7 C8 C9	55	63	118
Oral presentation	A1 A2 A7 B1 B3 B7 B8 B9 B10 B11 C2 C6 C7 C8 C9	2	8	10
Mixed objective/subjective test	A1 A2 A4 A5 A7 A8 A9 B1 B3 B7 B8 B9 B11 C2 C6 C9	3	0	3

Personalized attention		3	0	3
(*)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	Sesións previas onde se presentarán os distintos módulos da materia e introduciranse os conceptos necesarios para as diferentes técnicas experimentais.
Laboratory practice	Laboratory practices and interpretation and analysis of experimental results. The student must upload in the Moodle / Onenote of the subject the different activities carried out during the sessions (laboratory notebook, brief review, graphics, etc.) in order to evaluate the use of the work sessions. A report will be delivered per module that will be written following the instructions of the teaching staff. The report will be made individually and dates will be established for delivery through the virtual field. Several dates will be established, within a group session, to expose individually the activities carried out during the practice sessions. The teacher will assign the activity. Several dates will be established, within a group session, to expose individually the activities carried out during the practice sessions. The teacher will assign the activity.
Oral presentation	Several dates will be established, within a group session, to expose individually the activities carried out during the practice sessions. The teacher will assign the activity
Mixed objective/subjective test	Combination of different types of questions: type test, problems, short answer or essay which allows to evaluate the knowledge, reasoning capacity and critical spirit.

Personalized attention	
Methodologies	**Description**
Oral presentation	To look for a deeper understanding of the subject content and to find the best personalized strategy in problem solving. Tutoring schedule will be decided at lecturers and students convenience. They take place at the lecturers' offices

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Oral presentation	A1 A2 A7 B1 B3 B7 B8 B9 B10 B11 C2 C6 C7 C8 C9	Avaliarase: -a calidade da información contida a presentación, así como a habilidade mostrada. -a capacidade para defender o traballo presentado.	15
Mixed objective/subjective test	A1 A2 A4 A5 A7 A8 A9 B1 B3 B7 B8 B9 B11 C2 C6 C9	Exame final con dous partes, unha teórica (50%) que inclúe preguntas de tipo test, de resposta breve e/o de ensaio, e outra de resolución/análise de problemas (50%).	20
Laboratory practice	A2 A4 A5 A6 A7 A8 A9 B1 B3 B7 B8 B9 B10 B11 C6 C7 C8 C9	Avaliarase: -aspectos operacionales, planificación, organización e realización do caderno de laboratorio. -preparación de gráficas, revisión bibliográfica, etc. -elaboración de informes, o que inclúe a análise critico de resultados.	65

Assessment comments

Assistance at all the sessions is obligatory to be able to pass the subject.
The pass of the subject is obtained by obtaining a final grade of at least 5 points out of 10. The final grade is obtained according to the established percentages and the previously set restrictions.First opportunity. At least a grade of 4 over ten in each of the two parts of the final exam is required to take into consideration the rest of the assessable activities. The final grade is obtained according to the established percentages and the previously set restrictionsSecond opportunity. Repetition of the mixed test. The final grade is obtained according to the established percentages and the previously set restrictionsIn both oportunities, in spite of getting a mark of five or above, over ten, by using the weighted average, the final mark will be 4.5 if a least a grade of 4 over ten is not obtained in each of the two parts of the final exam In both opportunities, a final grade of five over ten is required to pass the subject. The final grade is calculated by considering all assessable activities and applying the weights indicated above. Matricula de Honor (MH). An extra exam will be carried out in case of the number of student students, eligible for Matrícula de Honor, is greater than the number of allowed MHs. Students assessed in the second opportunity could also be eligible for Matrícula de Honor if the maximum allowed number of MHs has not been fully covered in the first opportunity.Part-time students and those exempted from attending classes. It is necessary for students to inform the teacher at the beginning of the course. "NORMA QUE REGULA Ou RÉXIME DE DEDICACIÓN AO ESTUDO DÚAS ESTUDANTES DE GRAO NA UDC (Arts. 2.3; 3.b; 4.3 e 7.5) (04/05/2017) poderá realizar a proba mixta, sempre e cando os profesores sexan debidamente informados ao principio do curso. Sen menoscabo do anterior, os profesores poderán encargarlle a este alumnado diferentes traballos/problemas ó longo do curso para ser expostos en horario de titorias.Plagiarism and fraud: for cases of fraudulent performance of evaluable activities, the rules of the Universidade da Coruña will apply. ?Normas de evaluación, revisión y reclamación de las calificaciones de los estudios de grado y máster universitario (CG 19/12/2013, modificado por el CG 30/04/2014, por el CG 24/07/2014, por el CG 29/01/2015, CG 28/09/2016 y CG 29/06/2017)

Sources of information	
Basic	- G. Socrates (2005). Infrared and raman characteristic group frequencies tables and charts.. John Wiley & Sons - P. R. Griffiths (2007). Fourier transform infrared spectrometry. John Wiley & Sons - Ellis, Andrew M. (2005). Electronic and photoelectron spectroscopy fundamentals and case studies.. Cambridge University Press - Dahm, Donald J. (2012). Interpreting diffuse reflectance and transmitance : a theoretical introduction to diffuse reflectance and transmission in absorption spectroscopy of scattering materials. Chichester : NIR Publicaions - Smith, Ewen (2019). Modern Raman spectroscopy : a practical approach. Hoboken, NJ - Schlücker, Sebastian (2011). Surface enhanced Raman spectroscopy : analytical, biophysical and life science applications. Weinheim : Wiley-VCH Estas son posibles fontes de información que poderes atopar no catálogo da biblioteca da UDC. Poderán suxerirse na plataforma de teleformación MOODLE,outras que ó longo do curso se consideren interesantes.
Complementary	

Recommendations
Subjects that it is recommended to have taken before

Techniques of Characterisation of Nanomaterials 1/610G04025
Synthesis and Preparation of Nanomaterials/610G04020
Instrumental Analysis/610G04014
Fundamentals of Quantum Theory/610G04015
Spectroscopy/610G04017
Crystallography and Symmetry/610G04006
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Nanotechnology in Pharmacy/610G04043
Nanotechnology in Food Industry/610G04044
Nanotechnology in Civil Engineering/610G04045
Nanotechnology in Medicine/610G04037
Nanotechnology in Environmental Science/610G04038
Nanofabrication/610G04040
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.