Teaching Guide				
Identifying Data				2023/24
Subject (*)	Techniques of Characterisation of Nanomaterials 1		Code	610G04025
Study programme	Grao en Nanociencia e Nanotecnoloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Third	Obligatory	6
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría Naval e IndustrialFísica e Ciencias da TerraQuímica			
Coordinador	López Beceiro, Jorge José		E-mail	jorge.lopez.beceiro@udc.es
Lecturers	Del Castillo Busto, Estela López Beceiro, Jorge José Martín Pérez, Jaime Novo Quiza, Natalia Soto Ferreiro, Rosa Maria Terán Baamonde, Javier		E-mail	estela.delcastillo@udc.es jorge.lopez.beceiro@udc.es jaime.martin.perez@udc.es natalia.novo@udc.es rosa.soto.ferreiro@udc.es javier.teran.baamonde@udc.es
Web				
General description	Introduction to different materials characterisation techniques and their application to different nanomaterials. Students will acquire knowledge of the fundamentals of different characterisation techniques and how to interpret the results obtained.			

Study programme competences / results	
Code	Study programme competences / results
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.
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.
B10	CG5 - Trabajar de forma colaborativa.
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
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

Knowledge of the fundamentals of different characterization techniques.	A5	B8	C3 C8
Ability to correctly interpret the results obtained through different characterization techniques.	A4 A6 A7	B3 B7 B10	C9
Know and understand the main characteristics and security protocols of a clean room.	A6 A8	B8	C8 C9

Contents	
Topic	**Sub-topic**
Introduction to characterization techniques.	- Optical characterisation techniques. - Microscopic characterisation techniques. - Spectroscopic characterisation techniques. - Thermodynamic and other important characterisation techniques. - Separation and purification methods
Thermal analysis.	Thermogravimetry (TGA). Differential Scanning Calorimetry. (DSC, PDSC, MTDSC) Dielectric Analyzer (DEA)
Rheology	Viscoelasticity Rheometer types and experimental geometries Experimental set-up Interpretation of results
XR Diffraction.	Introduction to X-ray diffraction analysis (XRD) Uses and applications in the characterisation of nanomaterials Presentation and analysis of results
Electronic microcospies	Scanning Electron Microscopy (SEM): uses and applications in the characterisation of nanomaterials. Image analysis. Transmission Electron Microscopy (TEM): uses and applications in the characterisation of nanomaterials. Image analysis.
Main characteristics of a clean room. Usage requirements and safety protocols.	Risk assessment associated with the experiment. Experimental procedure, selection of techniques and interpretation of results. Preparation of laboratory notebook/report.

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
Mixed objective/subjective test	A5 A7 A8 B7 B8	2	6	8
Laboratory practice	A4 A6 A7 A8 B3 B7 B8 B10 C3 C8 C9	27	27	54
Seminar	A4 A5 A7 A8 B7 B8 C8	27	27	54
Supervised projects	A4 A5 A7 A8 B3 B7 B8 B10 C3 C8 C9	4	28	32
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**

Mixed objective/subjective test	A test that integrates essay-type questions and objective-type questions. The former includes open-ended essay questions; the latter may combine multiple-choice, ordering, short-answer, discrimination, completion and/or association questions.
Laboratory practice	Methodology that enables students to learn effectively through practical activities such as demonstrations, exercises, experiments and investigations.
Seminar	A group work technique aimed at the intensive study of a subject. It is characterised by discussion, participation, the preparation of documents and the conclusions to be reached by all members of the seminar.
Supervised projects	Methodology designed to promote autonomous learning by students, under the supervision of the lecturer and in a variety of scenarios (academic and professional). It is primarily concerned with learning "how to do things". It is an option based on students taking responsibility for their own learning. This teaching system is based on two basic elements: independent learning by the students and the monitoring of this learning by the teacher-tutor.

Personalized attention	
Methodologies	**Description**
Seminar Supervised projects Laboratory practice	Personalised attention to address the needs and queries of students related to the subject, providing guidance, support and motivation in the learning process. This personalised attention may be provided in person or in a non-classroom setting via email, the virtual campus or similar means.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Mixed objective/subjective test	A5 A7 A8 B7 B8	A test that integrates essay-type questions and objective-type questions. The former includes open-ended essay questions; the latter may combine multiple-choice, ordering, short-answer, discrimination, completion and/or association questions.	35
Supervised projects	A4 A5 A7 A8 B3 B7 B8 B10 C3 C8 C9	Methodology designed to promote autonomous learning by students, under the supervision of the lecturer and in a variety of scenarios (academic and professional). It is primarily concerned with learning "how to do things". It is an option based on students taking responsibility for their own learning. This teaching system is based on two basic elements: independent learning by the students and the monitoring of this learning by the teacher-tutor. Students will prepare a tutored project which they will have to deliver and defend orally.	15
Laboratory practice	A4 A6 A7 A8 B3 B7 B8 B10 C3 C8 C9	Methodology that enables students to learn effectively through practical activities such as demonstrations, exercises, experiments and investigations. Students must deliver a practice notebook in which they include all the activities carried out.	50

Assessment comments

The attendance to practical sessions is mandatory (minimum 80% attendance).
To pass the course, both on the first and second attempt, a minimum grade of 4 (out of 10) is required in both the mixed test and the laboratory practices.
Students with recognition of part-time dedication and academic exemption from attendance, as established in the "REGULATION ON THE REGIME OF STUDY DEDICATION FOR TWO DEGREE STUDENTS AT UDC (Art. 2.3; 3.b; 4.3 and 7.5) (04/05/2017)," may take the mixed test, provided that the professors are duly informed at the beginning of the course. Notwithstanding the above, the professors may assign different assignments/problems to these students throughout the course to be presented during tutoring hours.
The fraudulent completion of exams or assessment activities, once verified, will result in a failing grade in the respective exam session: the student will be given a grade of "fail" (numeric grade of 0) in the corresponding exam session of the academic year, whether the offense occurs in the first or second attempt. To this end, their grade will be modified in the first attempt transcript, if necessary.
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Sources of information	
Basic	1. Dieter Vollath (2013). Nanomaterials: an introduction to synthesis, properties and applications. Wiley.VCH.2. Surender Kumar Sharma (2018). Handbook of Materials?Characterization. Springer.3. Menczel JD, Prime RB, editors. Thermal analysis of polymers: fundamentals and applications. Hoboken, N.J: John Wiley; 2009.4. Artiaga Díaz R. Thermal analysis, fundamentals and applications to material characterization: proceedings of the international seminar?: thermal analysis and rheology, Ferrol, Spain, 30 Juny-4 July 2003 [Internet]. La Coruña], Spain: Universidade da Coruña; 2005 [cited 2017 Jan 31]. Available from: http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=331434
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Synthesis and Preparation of Nanomaterials/610G04020 Instrumental Analysis/610G04014 Spectroscopy/610G04017
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Techniques of Characterisation of Nanomaterials 2/610G04030 Polymers/610G04028
Other comments
As stated in the transversal competencies of the degree (C4), the development of a critical, open, and respectful citizenship will be fostered, emphasizing the equality of rights for students without discrimination based on gender or sexual orientation. Inclusive language will be used in the materials and during the sessions. Efforts will be made to identify and modify sexist prejudices and attitudes, and the environment will be influenced to modify them and promote values of respect and equality.To help achieve an immediate sustainable environment and comply with point 6 of the "Environmental Declaration of the Faculty of Sciences (2020)", documentary work in this subject will be requested in virtual and digital formats. If done on paper, plastics will not be used, double-sided printing will be employed, recycled paper will be used, and the production of drafts will be avoided.