



Teaching Guide

Teaching Guide				
Identifying Data			2023/24	
Subject (*)	Nanotechnology in Environmental Science		Code	610G04038
Study programme	Grao en Nanociencia e Nanotecnoloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Fourth	Optional	4.5
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	BioloXíaFísica e Ciencias da TerraQuímica			
Coordinador	Muniategui Lorenzo, Soledad	E-mail	soledad.muniategui@udc.es	
Lecturers	Álvarez López, Vanessa Díaz Varela, Jose Lopez Mahia, Purificacion Muniategui Lorenzo, Soledad Vidal Vázquez, Eva	E-mail	vanessa.alvarez.lopez@udc.es jose.diaz.varela@udc.es purificacion.lopez.mahia@udc.es soledad.muniategui@udc.es eva.vidal.vazquez@udc.es	
Web				
General description	This subject focuses on the potential and main applications of nanotechnology to provide innovative solutions to a variety of current environmental problems and challenges. Technologies and methods for air, water and soil pollution control and abatement, detection and monitoring of environmental pollutants and treatment of contaminated media are included. Potential applications of nanotechnology in agriculture and ecological and energy efficiency will be indicated. As well as the importance of assessing the impact of nanoparticles on the environment and their life cycle.			

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.
A9	CE9 - Evaluar correctamente los riesgos sanitarios y de impacto ambiental asociados a la Nanociencia y la Nanotecnología.
A10	CE10 - Comprender la legislación en el ámbito del conocimiento y la aplicación de la Nanociencia y Nanotecnología. Aplicar principios éticos en este marco.
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
B4	CB4 - Que los estudiantes puedan transmitir información, ideas, problemas y soluciones a un público tanto especializado como no especializado
B6	CG1 - Aprender a aprender
B7	CG2 - Resolver problemas de forma efectiva.
B8	CG3 - Aplicar un pensamiento crítico, lógico y creativo.
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
C5	CT5 - Entender la importancia de la cultura emprendedora y conocer los medios al alcance de las personas emprendedoras



C7	CT7 - Desarrollar la capacidad de trabajar en equipos interdisciplinarios o transdisciplinarios, 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	
Identify the main nanotechnology techniques for the prevention and treatment of contaminated environments.	A2	B1	C3
	A3	B2	C7
		B3	C9
		B6	
		B7	
Recognise the possibilities of nanotechnology applied to agriculture and eco-efficiency.	A2	B1	C3
	A3	B2	C5
		B3	C7
		B4	C8
		B7	
Apply nanotechnology to the environment and the agricultural sector.	A2	B2	C3
	A3	B7	C5
	A9	B8	C7
	A10		C8
Identify the life cycle and potential environmental impact of nanoparticles.	A3	B2	C3
	A9	B3	C5
	A10	B4	C7
		B7	C8
Recognise and apply ethical and legal principles within the field of study.	A10	B11	C5
			C7
			C8

Contents	
Topic	Sub-topic
TOPIC 1. Environmental Quality. Nanotechnology in the prevention and treatment of environmental pollution. Ethical and legal aspects.	Environmental quality and the importance of nanotechnology in its assessment, the protection of the environment and the treatment of contaminated environments. Regulations for the application of nanomaterials. Nanosensors with environmental applications. Introduction to integrated remediation methods.
TOPIC 2. Nanotechnology for pollution prevention and soil treatment	Soil quality criteria. Nanotechnologies and nanomaterials for soil control and decontamination of organic and inorganic pollutants. Nanosensors for detection and assessment of contaminants. Integrative methods for the remediation of contaminated soils.
TOPIC 3. Nanotechnology in agriculture.	Nanotechnology applications in agriculture. Legislation specific to the agricultural sector.



TOPIC 4. Nanotechnology for pollution prevention and water treatment.	Water quality criteria. Nanotechnologies and nanomaterials for the control, purification and removal of water pollutants. Nanosensors in water quality monitoring.
TOPIC 5. Nanotechnology for pollution prevention and air treatment.	Ambient and indoor air quality criteria and atmospheric emissions. Nanotechnologies and nanomaterials for air pollution control and abatement. Nanosensors for air quality assessment.
TOPIC 6. Nanoparticles: life cycle and environmental impact.	Sources and fate of nanoparticles in the environment. Life cycle of nanoparticles. Potential effects and environmental impact analysis of nanoparticles in the environment. Risk assessment.
TOPIC 7. Nanomaterials for ecological and energy efficiency.	Nanotechnology applications in improving eco-efficiency. Energy efficiency concepts. Applications of nanotechnology to improve energy efficiency.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student's personal work hours	Total hours
Seminar	A2 A3 A10 B2 B3 B4 B7 B8 C3 C5 C7 C8 C9	7	18	25
Laboratory practice	A2 A3 B2 B3 B6 B7 B11 C3 C7 C8	10	15	25
Mixed objective/subjective test	A2 A3 A10 B3 B7 B8	2.5	0	2.5
Guest lecture / keynote speech	A2 A9 A10 B1 B4 B6 B8 B11 C3 C9	18	40	58
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	The seminars will cover the content of the topic Nanotechnology in Agriculture. They will review the potential applications of nanotechnology in the agricultural sector, and students will develop ad hoc case studies, which will require knowledge and application not only of the technology, but also of the legislation specific to the agricultural sector.
Laboratory practice	The laboratory will be used to solve practical cases that will include a series of individual or small group activities so that the student learns to handle different techniques used in environmental nanotechnology. Continuous monitoring of nanoparticles in ambient air will be carried out at the facilities of the University Institute of the Environment (IUMA). The students will have to write a report with a critical and detailed analysis of the work carried out. A visit to a water treatment plant is planned.
Mixed objective/subjective test	Written test to assess the learning outcomes of the students. It includes multiple-choice, association, explanation and problem-solving questions.
Guest lecture / keynote speech	The fundamental theoretical content of each subject will be taught using audiovisual and/or computer media. Dialogue and participation will be encouraged for a correct understanding of the subject with practical examples and case studies. To get the best use of the course, students will have access to the teaching materials for each subject on the Virtual Campus.

Personalized attention	
Methodologies	Description



Seminar Laboratory practice	<p>Seminars and laboratory practices are designed as small group activities in which students will actively participate. In this way, students receive individual attention, which allows for better monitoring and guidance of learning.</p> <p>There will be individual tutorials for all students which will focus on the acquisition of basic knowledge, problem solving, the study of practical cases, the resolution of doubts and clarifications. The tutorial timetable will be given at the beginning of the course.</p> <p>Students with officially recognised part-time commitments and academic exemptions will be supervised in tutorials.</p>
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Assessment			
Methodologies	Competencies	Description	Qualification
Seminar	A2 A3 A10 B2 B3 B4 B7 B8 C3 C5 C7 C8 C9	Avaliación continua da elaboración polos alumnos dos casos prácticos, así como do correspondente informe escrito que terán que entregar no prazo establecido polo profesor. Ao comezo dos seminarios proporcionarase a rúbrica utilizada na avaliación desta actividade.	20
Laboratory practice	A2 A3 B2 B3 B6 B7 B11 C3 C7 C8	Valoraranse tanto o traballo experimental (destreza, actitude, orde, atención) como a elaboración dunha memoria de laboratorio. Terase en conta a comprensión das estratexias e metodoloxías utilizadas na execución de proxectos, a análise crítica e discusión dos resultados e as conclusións.	20
Mixed objective/subjective test	A2 A3 A10 B3 B7 B8	Proba escrita final onde se avaliarán os coñecementos adquiridos nas sesións maxistrais.	60

Assessment comments



In order to get the most out of the subject, students must attend all face-to-face activities.

Completion of the practical sessions is compulsory in order to pass the course.

First chance: In order to pass the subject, students must obtain a minimum mark of 4 (out of 10) in each of the examinable parts (laboratory practicals, seminars and mixed test). The final grade will be obtained by applying the percentages and restrictions previously established, with a final grade of 5 (out of 10) or higher being required.

The student will receive the grade of "not presented" if he/she does not attend either the laboratory practicals or the mixed test.

Second Opportunity: At the second opportunity, the mixed test will be taken and its grade will replace the grade obtained at the first opportunity, maintaining the grades of the lab practicals and seminars at the first opportunity. If a student has received a grade of less than 5 in the seminars and has attended at least 50% of the seminar hours, he/she may attempt to improve this grade through a non-attendance activity similar to that offered to students with academic exemptions. The final mark will be determined by applying the percentages and restrictions set out above, with a final mark of 5 or above (out of 10) required. Students assessed at the second opportunity will only be eligible for an honours degree if the maximum number of honours for the relevant course has not been fully covered at the first opportunity.

Advanced setting: the mixed examination will be taken, the qualification of which will replace that obtained in the previous year, maintaining the qualifications of the remaining assessable activities. The final grade will be obtained taking into account the percentages of the current year.

In any case, if a minimum mark of 4/10 is not achieved in each of the assessable parts, the subject will be failed, even if the final mark, calculated according to the corresponding percentages, is equal to or higher than 5/10. In this case, the final grade will be 4.5/10.

Successive academic years: the teaching-learning process, including the assessment, refers to an academic year, therefore it starts from scratch with each academic year.

Students with recognition of part-time commitment and an officially recognised academic exemption: the same assessment criteria will be applied as above (except for the part of the seminars where the student, after sending the lecturer the resolution granting the exemption, will receive the appropriate instructions to develop an alternative activity similar to the face-to-face one, but which can be carried out remotely). The practical sessions will be facilitated within the flexibility allowed by the coordination timetables and the material and human resources.

The use of any device with Internet access is prohibited at all times during the tests unless otherwise specified. If there is evidence of unauthorised use of these devices during the exam, the student will be removed from the classroom and dealt with in accordance with the regulations in force, the university coexistence and the disciplinary rules of the UDC student body.

The fraudulent performance of the tests and/or activities will directly imply the qualification of failure ("0") in the subject in the corresponding call, invalidating any qualification obtained in all the activities for the next opportunity, if any, within the same academic year.

Sources of information

Basic	<ul style="list-style-type: none"> - Barakat, Mohamed Abou El-Fetouh, and Rajeev Kumar. (2022). Nanomaterials for Environmental Applications.. Boca Raton, FL: CRC Press, Taylor & Francis Group - Kharisov, Boris I., Oxana V. Kharissova, and H. V. Rasika Dias. (2014). Nanomaterials for Environmental Protection.. Ed. Boris I. Kharisov, Oxana V. Kharissova, and H. V. Rasika Dias. Hoboken, New Jersey: John Wiley & - Thomas, Sabu, Merin Sara Thomas, and Laly A. Pothan. (2022). Nanotechnology for Environmental Remediation.. Ed. Sabu Thomas, Merin Sara Thomas, and Laly A. Pothan. Hoboken, New Jersey: John Wiley & Sons, <p>A primeira referencia bibliográfica está dispoñible na biblioteca da Facultade de Ciencias. A segunda e a terceira referencias está dispoñibles as súas versións en liña.</p>
Complementary	<ul style="list-style-type: none"> - Literatura científica e/o técnica actual sobre temas tratados na materia proporcionada polo profesorado (artigos de revisión, tutoriais, etc?). - Textos lexislativos (Diario Oficial UE, BOE, DOG etc...).

Recommendations

Subjects that it is recommended to have taken before

Techniques of Characterisation of Nanomaterials 2/610G04030

Techniques of Characterisation of Nanomaterials 1/610G04025

Subjects that are recommended to be taken simultaneously



Nanotoxicology/610G04032

Subjects that continue the syllabus

Other comments

It is recommended to keep up to date with the subject, prepare the seminars and laboratory practicals thoroughly and take advantage of them to clarify doubts and concepts, completing the necessary theoretical training. Knowledge of English and basic ICT tools. Green Campus Programme Faculty of Science: In order to help achieve an immediate sustainable environment and comply with point 6 of the "Environmental Declaration of the Faculty of Science (2020)", the documentary work to be carried out in this area: a) will be requested mainly in virtual format and computer support; b) if on paper: no plastics will be used, double-sided printing will be carried out, recycled paper will be used, whenever possible, and the printing of drafts will be avoided. Gender perspective: as stated in the transversal competences of the degree (C4), the development of a critical, open and respectful citizenship with diversity in our society will be encouraged, highlighting the equal rights of students without discrimination based on gender or sexual condition. Inclusive language will be used in the material and in the development of the sessions. We will work to identify and modify prejudices and sexist attitudes and influence the environment to change them and promote values of respect and equality.

(*)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.