Teaching Guide				
Identifying Data				2023/24
Subject (*)	Nanotechnology in Pharmacy		Code	610G04043
Study programme	Grao en Nanociencia e Nanotecnoloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Fourth	Optional	4.5
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Bioloxía			
Coordinador	Rey Rico, Ana	E-mail	ana.rey.rico@udc.es	
Lecturers	Barreiro Alonso, Aida Inés Franco Gacio, Anahir Gómez Pérez, Jennifer Iglesias Fente, Alba Rey Rico, Ana Vizoso Vázquez, Ángel José	E-mail	aida.barreiro@udc.es anahir.franco@udc.es i.jennifer.gomez@udc.es alba.iglesias.fente@udc.es ana.rey.rico@udc.es a.vizoso@udc.es	
Web	https://estudos.udc.es/es/subject/610G04V01/610G04043/2023			
General description	The contents of this subject will allow students to acquire knowledge in the field of pharmaceutical nanotechnology through the development of therapeutic nanosystems for the release and vectorization of drugs of chemical and biotechnological origin. To this end, a systematic study of the main nanomaterials used as well as the technology used for their production will be carried out. In addition, the main routes of administration of nanosystems and their main physiological barriers to obtaining a therapeutic effect will be addressed.			

Study programme competences	
Code	Study programme competences
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.
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.
A5	CE5 - Conocer los rasgos estructurales de los nanomateriales, incluyendo las principales técnicas para su identificación y caracterización
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.
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
B5	CB5 - Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía
B6	CG1 - Aprender a aprender

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.
B12	CG7 - Comunicarse de manera efectiva en un entorno de trabajo.
C1	CT1 - Expresarse correctamente, tanto de forma oral coma escrita, en las lenguas oficiales de la comunidad autónoma
C4	CT4 - Desarrollarse para el ejercicio de una ciudadanía respetuosa con la cultura democrática, los derechos humanos y la perspectiva de género
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		
To acquire knowledge and skills in the field of nanotechnology applied to the development of therapeutic nanosystems for the delivery and vectorization of drugs.	A1 A2 A3 A10	B3 B4 B6 B7 B8 B9 B10 B11 B12	C1 C4 C7 C8 C9
To know the main biomaterials and current technologies used for the development of therapeutic nanosystems.	A1 A5 A7 A10	B1 B2 B3 B5 B6 B7 B8	C1 C4 C7 C8
To understand the main physiological barriers to the release of nanosystems and the main strategies to overcome these barriers.	A1 A2 A10	B1 B2 B3 B5 B6 B7 B8	C1 C4 C7 C8
To know the main therapeutic nanosystems used for the delivery of genes and proteins.	A1 A2 A3 A10	B1 B2 B3 B5 B6 B7 B8	C1 C4 C7 C8

Contents	
Topic	Sub-topic
Topic 1: Pharmaceutical nanotechnology.	Introduction to Biopharmacy and relationship with Pharmaceutical Technology and Pharmacokinetics.
Topic 2: Basic aspects in Biopharmacy.	-Conventional and modified pharmaceutical release forms. -Profile absorption, distribution and elimination of drugs (ADME). -Routes of administration of therapeutic nanosystems.
Topic 3: Drug delivery nanosystems: types, preparation methods and characterization.	-Lipids, micelles, polymers, inorganic particles, carbon materials, etc. -Methods of preparation, functionalization, characterization and encapsulation of drugs.
Topic 4: Mechanisms of internalization, intracellular trafficking and endosomal escape strategies of nanosystems.	-Types of endocytosis of nanosystems. -Effect of protein corona formation in nanosystems. -Intracellular traffic and barriers to effective release. -Endosomal escape strategies.
Topic 5: Vectorization of nanosystems: Passive and active strategies of selective orientation.	-Passive vectoring strategies: Enhanced permeability and retention effect (EPR effect). Long circulating nanoparticles. -Active vectoring strategies: Transport mediated by ligand-receptor interactions. Stimulus-sensitive nanoplatforms.
Topic 6: Protein and gene delivery nanosystems.	-Protein expression and purification systems in the pharmaceutical industry. -Formulation strategies for protein loads. -Viral and non-viral gene therapy vectors; Nanovaccines, CAR-T therapy.
Topic 7: Ethical and legal aspects of nanosystems.	Main biosafety considerations of therapeutic nanosystems.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 A2 A3 A10 B1 B2 B3 B4 B5 B6 B7 B8 B9 B11 B12 C1 C7 C8 C9	18	35.5	53.5
Seminar	A1 A2 A3 A5 A7 A10 B1 B2 B3 B6 B7 B8 B9 B10 B11 B12 C1 C4 C7 C8 C9	10	20	30
Objective test	A1 A2 A3 A5 A7 A10 B1 B2 B3 B6 B7 B8 B9 B11 B12 C1 C7 C8 C9	2	2	4
Laboratory practice	A1 A2 A3 A5 A7 A10 B6 B7 B8 B9 B10 B12	10	15	25
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	The topics of the subject will be lectured by the teachers with the help of audiovisual media. The relevant documentation will be made available to students on the Virtual Campus.
Seminar	Realization and exposition of a supervised work focused on the design of a therapeutic nanosystem and its application in the treatment of a human pathology.

Objective test	Written test used to assess learning that can combine different types of questions including multiple-choice, association, explanatory, or problem-solving questions.
Laboratory practice	A series of activities will be carried out in the practical laboratory related to the encapsulation of drugs in various therapeutic nanosystems.

Personalized attention	
Methodologies	**Description**
Seminar Objective test Laboratory practice	The quality of the work and its presentation in class will be evaluated. Through an objective test, the knowledge acquired during the guest lectures will be evaluated. The report and/or tasks that students have to deliver to the teacher will be evaluated.

Assessment			
Methodologies	**Competencies**	**Description**	**Qualification**
Seminar	A1 A2 A3 A5 A7 A10 B1 B2 B3 B6 B7 B8 B9 B10 B11 B12 C1 C4 C7 C8 C9	The quality of the work and its presentation in class will be evaluated.	20
Objective test	A1 A2 A3 A5 A7 A10 B1 B2 B3 B6 B7 B8 B9 B11 B12 C1 C7 C8 C9	Through an objective test, the knowledge acquired during the expository classes will be evaluated.	60
Laboratory practice	A1 A2 A3 A5 A7 A10 B6 B7 B8 B9 B10 B12	The report and/or tasks that students have to deliver to the teacher will be evaluated.	20

Assessment comments
The final exam of the first call (at the end of the 2nd four-month-period) will represent 60% of the final grade and the remaining 40% will be made up of the practical memory and the exhibition of supervised work (20% and 20%, respectively). In order to apply the indicated percentages, the student must obtain a mark higher than 4 out of 10 in the exam. All those students who have participated in the Practices and delivered the evaluable work will be considered as presented students. The fraudulent performance of tests or evaluation activities, once verified, will directly imply the qualification of suspense in the call in which the offense is committed and with respect to the matter in which it was committed: the student will be graded as "failed" (numerical grade 0) in the corresponding call for the academic year, whether the infringement is carried out on the first opportunity or on the second. To do so, the qualification will be modified at the first opportunity, if necessary.

Sources of information

Basic	-Nanotechnology in Drug Delivery. Editors : Melgardt M. Villiers, Pornanong Aramwit, Glen S. Kwon (2008). Publisher Springer. ISBN: 978-0-387-77668-2 DOI https://doi.org/10.1007/978-0-387-77667-5- Nanobiotechnology in Diagnosis, Drug Delivery, and Treatment.Editors: Mahendra Rai, Mehdi Razzaghi-Abyaneh, Avinash P. Ingle (2021). John Wiley & Sons Ltd. India. ISBN:9781119671732|DOI:10.1002/9781119671732.-Physiological Pharmaceutics Barriers to Drug Absorption .Neena Washington;,Clive Washington;Clive Wilson. CRC press. ISBN 9780429204593-Nanotechnology in Drug Delivery. Editors : Melgardt M. Villiers, Pornanong Aramwit, Glen S. Kwon (2008). Publisher Springer. ISBN: 978-0-387-77668-2 DOI https://doi.org/10.1007/978-0-387-77667-5-Nanobiotechnology in Diagnosis, Drug Delivery, and Treatment.Editors: Mahendra Rai, Mehdi Razzaghi-Abyaneh, Avinash P. Ingle (2021). John Wiley & Sons Ltd. India. ISBN:9781119671732|DOI:10.1002/9781119671732.-Physiological Pharmaceutics Barriers to Drug Absorption .Neena Washington;,Clive Washington;Clive Wilson. CRC press. ISBN 9780429204593
Complementary	- Nanoparticulate Materials: Synthesis, Characterization, and Processing. Kathy Lu (2012). John Wiley & Sons, Inc. Estados Undos. ISBN:9781118408995 |DOI:10.1002/9781118408995- Tratado General de Biofarmacia y Farmacocinética, Domenech, J., Martínez, J. Peraire, C.Vol. 1 1ª Edición ISBN 9788499589527- The Handbook of Nanomedicine. Kewal J Jain. Humana Press ISBN: 978-1-60327-318-3

Recommendations
Subjects that it is recommended to have taken before
Techniques of Characterisation of Nanomaterials 2/610G04030 Techniques of Characterisation of Nanomaterials 1/610G04025 Fundamentals of Biotechnology/610G04029 Synthesis and Preparation of Nanomaterials/610G04020 Cell Biology/610G04003
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments
Recommendations Sustainability Environment, People and Gender Equality:To help achieve an immediate sustainable environment and meet the objective of action number 5: "Healthy and sustainable environmental and social teaching and research" of the "Green Campus Action Plan".1.- The supervised works that are carried out in this subject will be submitted through Moodle, in digital format without the need to print them.2.- The importance of ethical principles related to the values of sustainability in personal and professional behavior must be taken into account.3. Full integration will be facilitated for students who, for physical, sensory, mental or sociocultural reasons, experience difficulties in achieving suitable, equal and beneficial access to university life.4. Work will be done to identify and modify prejudices and sexist attitudes, and the environment will be influenced to modify them and promote values of respect and equality. Likewise, if adverse situations due to gender are identified, measures will be taken to correct them.5. It is understood that university students must have assumed the linguistic capacities in relation to oral and written expression. Therefore, spelling, grammatical and lexical correction (spelling, accentuation and punctuation) will be essential and compulsorily in the works and exams carried out as an essential condition to pass the subject.In this subject, the general criteria of the UDC will be applied, in its commitment to respect the gender perspective.