Teaching Guide					
Identifying Data					2021/22
Subject (*)	Preparation of Nanomaterials			Code	610509120
Study programme	Mestrado Universitario en Investigación Química e Química Industrial (Plan 2020)				
Descriptors					
Cycle	Period		Year	Type	Credits
Official Master's Degree	1st four-month period		First	Optional	3
Language	Galician				
Teaching method	Face-to-face				
Prerequisites					
Department	Química				
Coordinador	Señaris Rodriguez, Maria Antonia		E-mail	m.senaris.rodriguez@udc.es	
Lecturers	Bermúdez García, Juan Manuel Señaris Rodriguez, Maria Antonia		E-mail	j.bermudez@udc.es m.senaris.rodriguez@udc.es	
Web					
General description	Introduction to the preparation of nanomaterials, both inorganic and organic nanomaterials. Key factors in the control and shape of nanomaterials. Relationships between shape and size and their properties. Introduction of the main applications of nanomaterials.				

Contingency plan	(i) Adaptation to be made in the event of non-attendance due to outbreaks of the disease: 1. Modifications in the contents. In principle, all contents will be maintained. If necessary for reasons of force majeure, it will be possible to opt for a more general presentation, which in any case will cover all the relevant aspects of the subject. 2. Methodologies * Teaching methodologies that are maintained The methodologies will be maintained, but will be carried out in "online mode", i.e. using the TIC tools available in the Institution. In the case that part of the students cannot connect and follow the classes in real time, asynchronous methods will be used (e-mail, recordings of the lectures, more personalized tutoring sessions...). * Teaching methodologies that change Objective tests will be online tests that will be conducted using Moodle or equivalent tools, tracked by TEAMS. 3. Mechanisms of personalized attention to students. Students will receive tutorials through the Teams platform or by corporate email. 4. Modifications in the evaluation. If all students could continue with the non-presential teaching without difficulty, it will be evaluated in the same way as in the presential teaching. Students who are unable to follow synchronous activities online will be assessed for equivalent activities performed asynchronously. * Evaluation observations: None. 5. Modifications to the bibliography or webgraphy. There are no changes in the bibliography/ webgraphy. (ii) Adaptation foreseen in the center for cases in which the capacity of the classroom assigned for the subject is exceeded: The adaptation will consist of assigning two or more classrooms to the subject and teaching the class through TEAMS for students who are not in the classroom with the teacher.

Study programme competences	
Code	Study programme competences
A3	Innovate in the methods of synthesis and chemical analysis related to the different areas of chemistry
A9	Promote innovation and entrepreneurship in the chemical industry and in research.
B1	Possess knowledge and understanding to provide a basis or opportunity for originality in developing and / or applying ideas, often within a research context
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.
B7	Identify information from scientific literature by using appropriate channels and integrate such information to raise and contextualize a research topic
B8	Evaluate responsibility in the management of information and knowledge in the field of Industrial Chemistry and Chemical Research
B9	Demonstrate ability to analyze, describe, organize, plan and manage projects
B10	Use of scientific terminology in English to explain the experimental results in the context of the chemical profession
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		
Describe the aspects of physical laws that predominate in the behavior of nanometer-sized systems.	AC9	BC1 BC3 BC8 BC9	CC3
Define which construction methods of nanostructures should be chosen based on the desired properties.	AC3	BC1 BC3 BC5	CC1
Describe some methods for the synthesis of nanoparticles.	AC3 AC9	BC7 BC10	CC1 CC4
Describe some methods for surface modification of nanoparticles.	AC3 AC9	BC8 BC9 BC10	CC1 CC4
Explain the phenomenon of self-assembly, describe the different procedures available to achieve this.	AC3 AC9	BC3 BC5 BC8	CC1 CC3
Know the current and potential applications of nanotechnology.	AC3 AC9	BC1 BC7 BC8 BC10	CC1 CC4

Contents	
Topic	Sub-topic
Theme 1.Introduction and historical perspective on advanced materials	This first topic will be a historical introduction on the development of nanomaterials. A classification of the materials will be established, as well as a brief description of the fields of activity of the different nanomaterials.
Theme 2. Strategies in the search for new materials	This topic will address the different strategies in the synthesis of nanomaterials, with special attention to those that allow us a control in the structure and composition.
Theme 3. Nanochemistry and nanomaterials	This topic will introduce the nanomaterials and the main methods of synthesis
Theme 4. Inorganic nanomaterials: metal, semiconductors, magnetic oxides	This topic will introduce the main methods of synthesis of nanomaterials with special emphasis on metallic, semiconductors, and magnetic oxides.
Theme 5. Organic Nanomaterials: Carbon Nanotubes, Graphene, Polymeric Materials	In this topic we will introduce the main methods of synthesis of nanomaterials with special emphasis on carbon nanotubes, graphene and polymeric materials.
Theme 6. Surface modification and hybrid materials	This topic will introduce the main methods of surface modification of nanomaterials. Different hybrid materials will also be introduced.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Seminar	A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4	7	21	28
Supervised projects	A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4	3	6	9
Mixed objective/subjective test	A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4	2	0	2

Guest lecture / keynote speech	A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4	12	24	36
Personalized attention		0		0
(*)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	Seminars carried out with their own teaching staff, or with invited professionals from the business sector, administration or other universities. Interactive sessions related to different subjects with discussions and exchange of opinions with students
Supervised projects	Work in small groups that will have the purpose of studying a topic, a case, etc. Through the discussion among the members of the group.
Mixed objective/subjective test	Proof that will be made in the calendar agreed by the Faculty Board. Its objective is to contribute to the evaluation of the knowledge and skills acquired by the students and the ability to relate to this and to obtain an overview of the subject.
Guest lecture / keynote speech	In the master session the contents of the corresponding topics will be introduced, highlighting their most important aspects and stopping particularly in the fundamental concepts and / or more difficult to understand for the students.

Personalized attention	
Methodologies	**Description**
Seminar	The teaching methodology proposed is based on the work of the student, who becomes the main responsible for its educational process.

Assessment			
Methodologies	**Competencies**	**Description**	**Qualification**
Seminar	A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4	Valoraranse tanto as respostas dos alumnos como a súa participación nas correspondentes actividades presenciais. Ocasionalmente e a requirimento do profesorado, o alumnado deberá entregar os boletíns de problemas que tamén poderán ser avaliados.	20
Supervised projects	A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4	Valoraranse tanto as respostas dos alumnos como a súa participación nas correspondentes actividades presenciais. Ocasionalmente e a requirimento do profesorado, o alumnado deberá entregar informes que tamén poderán ser avaliados.	25
Mixed objective/subjective test	A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4	Consistirá nunha proba de conxunto que se celebrará ó final do cuadrimestre. Poderá constar tanto de preguntas de desenvolvemento, como de preguntas curtas ou de tipo test e de problemas que serán semellantes ós realizados ó longo do curso.	55

Assessment comments

General considerations: -It is very important to attend all classes. -It is essential to consult the bibliography and try to complete with advanced aspects the most fundamental concepts that are explained in the class. -The evaluation of this subject will be done through continuous assessment and the completion of a final exam. -The continuous evaluation will have a weight of 45% in the grade of the subject. The rest will be assigned to the final exam result. Recommendations for evaluation The student should review the theoretical concepts introduced in the different topics using the support material provided by the teaching staff and the bibliography recommended for each topic. The degree of accuracy in the resolution of the proposed exercises provides a measure of the student's preparation to face the final exam of the subject. Those students who find important difficulties in working the proposed activities should consult the teacher, in order that the teacher can analyze the problem and help solve those difficulties.

Sources of information	
Basic	- G. A. Ozin (2008). Nanochemistry: A Chemical Approach to Nanomaterials. Royal Society of Chemistry - D. Vollath (2013). Nanomaterials: an introduction to synthesis, properties and applications. Wiley-VCH - Kenneth J. Klabunde (2009). Nanoscale materials in chemistry. Wiley-Interscience,
Complementary	- A.R. West (2014). Solid State Chemistry and its Applications. Wiley-VCH - C. N. R. Rao, Chintamani Nagesa Ramachandra Rao (1997). New Directions in Solid State Chemistry. Cambridge University Press - U. Schubert, N. Hüsing (2004). Synthesis of Inorganic Materials. Wiley-VCH - K. T. Ramesh (2009). Nanomaterials: Mechanics and Mechanisms. Springer-Verlag - C.N. R. Rao and B. Raveau (1998). Transition metal oxides. John Wiley & Sons

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 knowledge required for the completion of the master and those acquired in module 1.