

Teaching Guide					
Identifying Data					2024/25
Subject (*)	Solid State			Code	610G04022
Study programme	Grao en Nanociencia e Nanotecr	noloxía			
		Descripto	ors		
Cycle	cle Period Year Type Cred			Credits	
Graduate	1st four-month period	Third		Obligatory	6
Language	SpanishGalician				
Teaching method	Face-to-face				
Prerequisites					
Department	Química				
Coordinador	Señaris Rodriguez, Maria Antonia E-mail m.senaris.rodriguez@udc.es				
Lecturers	Sanchez Andujar, Manuel E-mail m.andujar@udc.es		es		
	Señaris Rodriguez, Maria Antonia	a		m.senaris.rodriguez@udc.es	
Web				· · · · · · · · · · · · · · · · · · ·	
General description	Solid State is an obligatory subject of the first semester of the third year of the Nanoscience and Nanotechnology Degree. It				
	is clearly interdisciplinary character dedicated to the study of solid substances, mainly crystalline, and their relevant				
	properties (mechanical, electrical, magnetic, optical, etc.), which are rationalized through the establishment of				
	structure-micro/nanostructure-composition-properties relationships, and which derive the main technological applications of				
	these materials.				

	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.
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.
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
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
B5	CB5 - Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con
	un alto grado de autonomía
B8	CG3 - Aplicar un pensamiento crítico, lógico y creativo.
B9	CG4 - Trabajar de forma autónoma con iniciativa.
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
C2	CT2 - Dominar la expresión y la comprensión de forma oral y escrita de un idioma extranjero
C5	CT5 - Entender la importancia de la cultura emprendedora y conocer los medios al alcance de las personas emprendedoras
C8	CT8 - Valorar la importancia que tiene la investigación, la innovación y el desarrollo tecnológico en el avance socioeconómico y cultural
	de la sociedad

Learning outcomes



Learning outcomes		Study programme	
		competences /	
		results	
1. Acquire a general vision of Solid State Science, of its interdisciplinary nature as well as basic notions about different families	A1	B1	C1
of solids and different criteria for classifying materials.		B3	C5
		B8	
		B9	
		B12	
2. Know the structure and microstructure of crystalline solids, and the factors on which they depend. Know the nature of the	A1	B8	
bond in solids and their electronic structure.	A5	B9	
3. Know the most important physical properties of crystalline solids and be able to relate them to their composition, structure	A1	B3	C1
and micro/nanostructure.	A2		
4. Know the fundamentals and application of materials in the electrical and electronic industry, as well as magnetic and optical	A1	B3	C5
materials.	A3		C8
Develop criteria for the selection of materials based on their application.		B3	
		B5	
Know the usual work techniques and methodologies in a solid state and materials laboratory.	A3	B9	C2
	A4	B12	C8

Contents			
Торіс	Sub-topic		
I Introduction to Solid State	- Introduction to Solid State Chemistry and Physics and its relationship with other		
	disciplines		
	- Classification criteria for solids and properties		
	- Selection criteria		
II Basic aspects of crystalline solids	?Ideal Solids:		
	- Crystalline structures of solids and aspects on which they depend. lonic bond model		
	- Electronic structure of solids. bands model		
	?Real solids:		
	- Defects in solids and non-stoichiometric		
	- Consequences of the existence of defects and the influence of the nanometric scale		
	on its electronic structure		
III Properties and applications of solids	?Mechanical properties		
	?Magnetic properties:		
	- dia- e para-magnetism		
	- ferro-, ferri-, and antiferro-magnetism		
	Influence of particle size reduction: superparamagnetism		
	- main applications		
	?Electronic properties:		
	- electronic drivers		
	- semiconductors (p-n junctions, photovoltaic cells, LEDs)		
	- superconductors		
	- Insulators (dielectric, ferroelectric, piezoelectric, pyroelectric)		
	- Influence of particle size (quantum dots, etc.)		
	?lonic properties:		
	- ionic conductors (batteries, fuel cells)		
	- Influence of particle size		
	?Introduction to optical properties and their applications		
IV: New trends in Solid State and examples of material	? Biomaterials, MOFs, etc.		
selection	? Examples of material selection		



V:Solid State	Laboratory
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? Synthesis and processing of materials

? Characterization and study of the properties of materials

Planning				
Methodologies / tests	Competencies /	Teaching hours	Student?s personal	Total hours
	Results	(in-person & virtual)	work hours	
Problem solving	A1 A2 A3 A4 B1 B3	8	16	24
	B5 B8 B9 B12 C1 C8			
Events academic / information	A1 B5 B8 C5 C8	1	1.1	2.1
Objective test	A1 A2 A3 A5 B8 C1	0.5	0	0.5
Guest lecture / keynote speech	A1 A3 B8 C8	27	59.4	86.4
Laboratory practice	A1 A2 A3 A4 A5 B1	14	14	28
	B3 B5 B8 B9 B12 C2			
	C5 C8			
Mixed objective/subjective test	A1 A2 A3 A5 B8 B12	3	4.5	7.5
	C1			
Personalized attention		1.5	0	1.5
(*) The information in the algorithm table is for while	was automated as a set	tales but a second the l	and a second second first and show a first	des te

(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies		
Methodologies	Description	
Problem solving	The problem solving classes will be dedicated to solving problems and questions that were proposed in advance to the	
	students, so that they can work on them before the corresponding face-to-face session.	
Events academic /	The possibility is also contemplated, as complementary activities, of visiting centers related to the subject, attending scientific	
information	conferences, etc. These activities will be specified during the development of the course.	
Objective test	On a regular basis, in the problem-solving sessions, the students will carry out a series of short tests, multiple choice or short	
	answer, aimed both at evaluating the degree of acquisition of skills and at consolidating the content seen during the sessions.	
	masterful. This activity will allow not only to monitor the evolution of students, but will also serve to detect those aspects of the	
	subject that are more difficult to understand.	
Guest lecture /	In the guest lecture, the contents of the corresponding topics will be introduced, emphasizing their most important aspects and	
keynote speech	focusing particularly on those fundamental concepts and/or those that are most difficult for students to understand.	
Laboratory practice	Synthesis and processing work of different types of materials, their characterization and study of their properties under the	
	supervision of the teaching staff.	
Mixed	Subjective test that will be carried out in the calendar agreed by the Faculty Board. Its objective is to contribute to the	
objective/subjective	evaluation of the level of knowledge and skills acquired by the students and their ability to relate them and to obtain an	
test	overview of the subject.	

Personalized attention

Methodologies

Description



1	
Mixed	Personalized attention will be given mainly through activities carried out in reduced groups, and also in individualized tutorials,
objective/subjective	fundamentally associated with the methodologies "problem solving" and "laboratory practices".
test	
Laboratory practice	For students with "academic dispensation":
Guest lecture /	- the tutorials associated with "laboratory practices" will be the same as for the rest of the students;
keynote speech	- the rest of the tutorials may be replaced by personalized tutorials that will not be evaluated. These students would pass a
Problem solving	particular examination, in addition to the compulsory mixed test, which would leave no doubt about their level of knowledge,
Events academic /	competences, skills and abilities, and which would score 10% of the overall grade. In order to benefit from this system, the
information	student must notify the responsible teacher at the beginning of the course.
	Obviously, and apart from the tutorials proposed by the teacher, any student can carry out tutorials at their own request (face-to-face or virtual) within the 6 hours of weekly tutorial that the teacher makes available to the student and/or at the most convenient times for the student, by prior agreement with the teacher.

Assessment			
Methodologies	Competencies / Results	Description	Qualification
Mixed	A1 A2 A3 A5 B8 B12	It will consist of an ensemble test to be held at the end of the semester. It may consist	70
objective/subjective	C1	of both development questions, short or multiple choice questions and problems that	
test		will be similar to those made throughout the course.	
Laboratory practice	A1 A2 A3 A4 A5 B1	In order to be able to make the most of the work placement, students will have to	20
	B3 B5 B8 B9 B12 C2	prepare for it in advance and complete an initial interview/questionnaire, which they	
	C5 C8	will have to pass in order to enter the laboratory.	
		The laboratory work will be assessed from the following points of view: organisation	
		and safety, performance in the laboratory, knowledge of the techniques, manual skills	
		and especially the ability to understand and rationalise the processes carried out. In	
		addition, the preparation of the corresponding laboratory notebook will be assessed,	
		or an alternative submission established by the lecturers, which could also consist of a	
		practical exam that must be passed in order to pass the practical.	
Objective test	A1 A2 A3 A5 B8 C1	Sometimes, the student may be given short tests, multiple choice or short answer.	0
		These objective tests are designed both to assess the degree of acquisition of skills,	
		and to strengthen the content seen in the master sessions. This activity will not only	
		make it possible to monitor the evolution of the students, but it will also serve as a tool	
		to detect those aspects of the subject that are more difficult to understand.	
		It will be evaluated jointly: "master sessions" + "problem	
		solving" +	
		"scientific and/or informative events" + "objective evidence".	
Guest lecture /	A1 A3 B8 C8	The degree of prior preparation and follow-up of the students of the subject that is	0
keynote speech		being taught in these sessions, as well as their active participation in them, will be	
		assessed.	
		It will be evaluated jointly: "master sessions" + "problem	
		solving" +	
		"scientific and/or informative events" + "objective evidence".	



Problem solving	A1 A2 A3 A4 B1 B3	Both the answers of the students and their participation in the corresponding	10
	B5 B8 B9 B12 C1 C8	face-to-face activities will be valued. Occasionally and at the request of the teaching	
		staff, the students must submit the problem reports that can also be evaluated.	
		It will be evaluated jointly: "master sessions" + "problem	
		solving" +	
		"scientific and/or informative events" + "objective evidence".	
Events academic /	A1 B5 B8 C5 C8	The conclusions that the students draw from the corresponding activities are valued,	0
information		and that they will also be reflected in a summary that they must present after their	
		completion.	
		It will be evaluated jointly: "master sessions" + "problem	
		solving" +	
		"scientific and/or informative events" + "objective evidence".	

Assessment comments

The final grade will result from the addition of the following partial contributions:

- Final exam ("Prueba mixta"): up to a maximun of 7 points.

-Activities carried out during the different sessions (seminars, exercises, tutoring sessions, scientif events, etc): up to a maximum of 1 points. -Laboratory sessions: up to a maximum of 2 points.

A minimum of 5 points will be required to pass the Materials Science subject, with the restriction that a minimum of 3.15 (over a maximum of 6) will be necessary in the final exam ("prueba mixta"), as well as a minimum of 0.8 (over a maximum of 2) in the laboratory sessions. If these minima are not achieved the studentt will fail. When a sum of more than 5 points is obtained but the minimum required mark is not reached in one of the activities, the final grade will be "Failed: 4.5 points".

In addition, in order to pass the course, it will be compulsory to have attended all the laboratory classes.

As the assessment of this subject is based on a continuous evaluation model, the progression of the student throughout the semester will be taken into consideration with a maximum of 1 point.

Also, and according to this evaluation model, if the student has participated in activities whose relativeweight is more than a 25% of the total grade, he/she will be assessed.

In this same context, and according to the rules contained in ?Probas de Avaliación e Actas de Cualificación de Grao e Mestrado?, the so-called ?second opportunity of July? is understood as a second opportunity to carry out a final exam ("prueba mixta"). Nevertheless, and in very special cases, the teacher could also include a second part concerning aspects of the Laboratory Sessions. This mark will be considered together with the others obtained during the course corresponding to the other activities (seminars, exercises, scientific events, etc.). The percentages of the different contributions will be the same as those of the former "first opportunity".

The highest grade "Matricula de Honor" will be mainly given to students that pass the subject in the "first opportunity". And it will only be given in the so-called "second opportunity" if there are still any available.

In the case of exceptional, objective and adequately justified circumstances (such as in the case of students with an academic exemption of attendance), the responsible teacher could totally or partially exempt the student from attending the continuous assessment process. In any case, this student will have to undergo a particular examination (in addition to the compulsory mixed test) that will leave no doubt about their level of knowledge, competences, abilities and skills, and that will score 20% of the overall grade.

The teaching-learning process, including assessment, refers to an academic year (this implies that each year starts a new process, including all assessment activities and procedures).

All aspects related to "academic dispensation", "dedication to studies ","permanence" and "academic fraud" shall be governed in accordance with current academic regulations of the UDC.

Sources of information



Basic	- A.R. WEST (2014). Solid State Chemistry and its Applications. Chichester, John Wiley and Sons
	- A.R. WEST (1999). Solid State Chemistry. Chichester, John Wiley and Sons
	- L.E. SMART, E.A. MOORE (2005). Solid State Chemistry. Boca Raton, Taylor and Francis
	- L.E. SMART, E.A. MOORE (1995). Solid State Chemistry. Boca Raton, Taylor and Francis
	- S. ELLIOT (1998). The Physics and Chemistry of Solids. Chichester, John Wiley and Sons
	- A.G. SHACKELFORD (2009). INTRODUCTION TO MATERIALS SCIENCE FOR ENGINEERS. New York, Prentice
	Hall.
	- W.D. CALLISTER, D.G. RETHWISCH (2016). Ciencia e Ingeniería de los Materiales. Barcelona, Reverté
Complementary	- G. CAO (2004). Nanostructures and Nanomaterials. Singapore, Imperial College Press
	- D. VOLLAT (2013). Nanomaterials. Erlangen , Wiley-VCH
	- N. W. ASHCROFT, N. D. MERMIN (1976). Solid state physics. Forth Worth : Saunders College Publishers
	Os seguintes recursos bibliográficos están tamén dispoñibles como textos electrónicos a través de diferentes
	plataformas de consulta: - Solid State Chemistry (3rd edition), L. Smart, disp. vía: EBSChost Ebooks Inorganic
	Structural Chemistry (2nd edition), U. Müller, disp. vía: Wiley Ebooks (AP)Introducción a la Ciencia de Materiais
	para Ingenieros 7ª ed. J.F. SHACKELFORD, disp via INGEBOOK

Recommendations

Subjects that it is recommended to have taken before

Synthesis and Preparation of Nanomaterials/610G04020

Chemistry of the Elements/610G04011

Chemistry: Structure and Bonding/610G04005

Crystallography and Symmetry/610G04006

Subjects that are recommended to be taken simultaneously

Subjects that continue the syllabus

Other comments

Green Campus Program Faculty of Sciences To help achieve a sustainable immediate environment and comply with point 6 of the "Environmental Declaration of the Faculty of Sciences (2020)" the documentary work carried out on this matter: a.- They will be requested mostly in virtual format and computer support. b.- If done on paper: - No plastics will be used. - Double-sided printing will be done. - Recycled paper will be used. - Drafts will be avoided. Perspective of gender: such and as if it collects in the transversal competitions of the title (C4), will promote the development of a critical citizenship, opened and respectful with the diversity in the our society, highlighting the equality of rights of the students without discrimination by question of gender or sexual condition. It Will employ a language inclusiva in the material and in the development of the sessions. It Will work to identify and modify prexuizos and attitudes sexistas and will influence in the surroundings to modify 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.