Teaching Guide				
Identifying Data				2020/21
Subject (*)	Chemistry: Structure and Bonding		Code	610G04005
Study programme	Grao en Nanociencia e Nanotecnoloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	First	Basic training	6
Language	Galician			
Teaching method	Hybrid			
Prerequisites				
Department	Química			
Coordinador	Sanchez Andujar, Manuel	E-mail	m.andujar@udc.es	
Lecturers	Platas Iglesias, Carlos Sanchez Andujar, Manuel	E-mail	carlos.platas.iglesias@udc.es m.andujar@udc.es	
Web				
General description	The main teaching objective of this subject is provide skills and knowledge at a basic level about concepts, principles and theories that describe the structure of the atom and matter, the knowledge of the different models of chemical bonding, the intermolecular forces and about the different states of aggregation of the matter. All these aspects are fundamental to undestand advanced aspects such as the properties of materials and to be able to manipulate and design chemical entities and understand chemical reactions and interactions. Therefore, the contents of this subject provide basic knowledge, which are essentials for an undergraduate in Nanoscience and Nanotechnology. Additionally, the knowledge and skills of this subject are complemented by the subjects Chemistry: equilibrium and Change and Integrated Basic Laboratory of the first year of the degree in Nanoscience and Nanotechnology. These three subjects constitute the basic training of students in Chemistry.			
Contingency plan	1. Modifications to the contents In principle, the contents are maintained in their entirety. But if it was necessary, a more general presentation of the same can be chosen, but in any case it will cover all the most relevant aspects of the subject. 2. Methodologies *Teaching methodologies that are maintained The methodologies will be maintained but it will be carried out in ?Online mode?, that is, using the ICT tools available by the Institution. In the event that part of the student body cannot connect and follow the classes in real time, asynchronous media will be used (email, recording of the expository sessions, more personalized tutorials ...). *Teaching methodologies that are modified The objective tests will be online tests that will be carried out using Moodle or equivalent platforms and monitoring them by Teams. 3. Mechanisms for personalized attention to students Students will be tutored through the Teams platform or through corporate email. 4. Modifications in the evaluation If all the students could continue with non-face-to-face teaching without difficulty, it will be evaluated in the same way as in face-to-face teaching. Students who cannot follow synchronous online activities will be evaluated for equivalent activities carried out asynchronously. *Evaluation observations: 5. Modifications to the bibliography or webgraphy There are no modifications in the bibliography / webgraphy			

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.
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
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.
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
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 / results		
To know the main particles that form the matter, from the point of view of the Chemist	A1 A2		C8
Know the main atomic models and their application to the study of periodic properties.	A1 A2	B1 B3	C9
Know the periodic table of the elements and properties of the atoms according to their position in the same.	A1 A2 A3	B6 B8	C3
Know the main bonding models and their application to the different types of chemical species.	A1 A3	B1 B6 B8	C3 C9
Know the characteristics of the different states of matter, the way in which some of their properties are obtained, the theories used to describe them, and the changes of state.	A1 A3	B1 B7 B9	C7
Formulate and name simple inorganic and organic substances.	A1	B1 B3	C3 C7

Contents	
Topic	Sub-topic

Introduction to Nanoscience and Nanotechnology	Definition of nanoscience, nanotechnology and nanomaterials. Nanoscale: the importance of size The multidisciplinary nature of nanoscience and nanotechnology. Nanomaterials Classification Pioneers in nanoscience and nanotechnology
Formulation and nomenclature	Formulation and nomenclature of organic and inorganic species
The structure of matter and particle models	Matter as set nucleus and electrons. Rutherford atomic model. Bohr atomic model for the hydrogen atom. Limitations of the Bohr atomic model. Uncertainty Principle
The wave mechanical model for the hydrogen atom	De Broglie's hypothesis. Stationary wave equation for Hydrogenoid System. Orbital functions. Orthonormality solutions to the equation and quantum numbers n, l ml. Electron energy Hydrogenoid System. Meaning of "Orbital Function". Comparison between models of Bohr and Schrödinger. The wave functions. Graphical representation of the orbitals
The wave mechanical model for polyelectronic atoms	The wave equation for an atom with more electrons. Orbital model approach. Determination of the effective nuclear charge. Slater rules. The energy of the orbitals of the electron atoms. The electron spin quantum number. The Pauli exclusion principle. Electronic configurations
Periodic Table and periodic properties of the elements	Electronic configuration and periodic table. Periodicity of atomic properties
Introduction to bonding models	The wave equation for polynuclear systems. Models bond between atoms. Link models adapted to the types of chemicals
Lewis Theory	Structure and properties of molecular substances. Lewis model. Bond order and bond strength and longitude. Resonance. Molecules that do not meet the octet rule. Limitations of the theory of Lewis
Valence-Shell Electron-Pair Repulsion Theory	The theory of pair repulsion electron valence shell. Application of the model. Application of the model species with more than one central atom
Valence Bond Theory	VTE in diatomic molecules. The model of "Electronic Cement". The valence bond model. Orbital hybridization. Resonance. Polar covalent bonds. The polarity of the bond in the VTE. Polar covalent bond strength
Intermolecular Forces	The absolute temperature scale. Solids, liquids and gases. Van der Waals force. Hydrogen bonds
Covalent Solids	Covalent solids. Some solid covalent structures
Structure and bonding in metals	Metals: Property characteristics. Structure of Metals. Electronic Cement. The metallic bond: electron sea model
Structure and bonding in salts	Definition and properties of salts. Structure salts. Ionic radii. A "Rule radios". Ionic bonding model. Calculation of the laticce energy. Covalent character of the bond in the salts. Electron density maps. Polarizing power and polarizability of the ions. Fajans rules. Consequences of participation in the covalent bond
Molecular Orbital Theory	Limitations of VTE. the wave equation for polynuclear systems. Molecular orbitals of polar species. Delocalized systems. Treatment of the electronic structure of metals by TOM: Bands model. The pattern of bands applied to covalent solids and salts.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 A2 A3 B1	32	56	88
Workshop	A1 A2 A3 B3 B6 B7 B8 B9 C3 C7 C8 C9	6	12	18
Mixed objective/subjective test	A1 A2 A3 B1 B7 B8 C9	3	3	6

Objective test	A1 A2 A3 B1 B3 B6 B7 B8 B9 C9	1	1	2
Problem solving	B3 B6 B7 B8 B9 C7 C9	9	27	36
Personalized attention		0	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**
Guest lecture / keynote speech	In the classes will review the contents of the relevant issues, indicating their most important aspects, particularly those fundamental or more difficult to understand concepts to students. So that students can make the most of the class, the corresponding issue must be first read followed by responses a test to based on this reading. The completion of these tests will be essential in order to be qualified in classes and workshops problems related contents.
Workshop	The workshops are designed as a set of eminently practical activities, carried out both in large group and small group, in which the student must participate actively. Its main objective is to complete and deepen the most relevant aspects and / or difficult to understand. They also resolve doubts about any aspect related to problem solving class and workshops, etc
Mixed objective/subjective test	The test be held on the date set in the timetable agreed by the Faculty Board. It aims to contribute to the assessment of the level of skills acquired by students in the whole course.
Objective test	Periodically, in classes, problem solving or workshops will conduct some short exercices both to assessing student achievement as the teacher's guidance on the issues learn in their class. Besides, this activity tends to encourage the student to perform continuously the effort required to study this subject.
Problem solving	Problem solving will be in small group and will be dedicated to solving problems and questions raised in advance of the student so that it can work on them before the corresponding session. Periodically in these sessions, the teacher will supervise the work done, not only for assessment purposes, but also to provide adequate support to the study of matter.

Personalized attention	
Methodologies	**Description**

Problem solving Workshop	The teaching methodology proposed is based on the student's work, which becomes the main protagonist of the teaching-learning process. For the student to obtain optimal performance of their effort it is that there is a continuous interaction and closer student-teacher, so that the latter can lead the first in this process capital. This interaction will especially in workshops and problem solving sessions. Through student-faculty interaction, as well as the different evaluation activities will be determined to what extent the students reached the competency targets set in each unit, and determine students who need personalized attention through individualized tutoring. Therefore, periodically or teachers may call students to tutoring, to be held in the most convenient times for each student, with the intention of receiving the necessary guidance. Regardless of the tutorials proposed by the teacher, the student may attend tutoring at his own request, as often as desired, and the time that is most suitable. According to the ""norma que regula o réxime de dedicación ao estudo dos estudantes de grao na UDC" (Art.3.b e 4.5) and ""normas de avaliación, revisión e reclamación das cualificacións dos estudos de grao e mestrado universitario? (Art. 3 e 8b), students with recognition of part-time dedication and assistance exemption should be able to participate in a training methodology and associated teaching activities that would allow the achievement of the training objectives. Therefore, in the subject Chemistry: structure and Bonding, the percentage of exemption would be preset in a first interview with the students, taking into account once known their personal situations. At this point, students can participate in a personalized tutorial system for guidance and evaluation, with at least five individualized sessions, which will serve for the orientation of students in their autonomous work as well as for monitoring their progression during the course and evaluating the degree of competence development reached. Regarding this last point, the tutorials will serve to carry out those activities included in the Objective Test methodology and which correspond to a 25% of the final grade for the course.

Assessment			
Methodologies	Competencies / Results	Description	**Qualification**
Problem solving	B3 B6 B7 B8 B9 C7 C9	Problem solving and the workshops together will a maximum of 15 points total. This activity will take into account student participation. Also could be evaluated some brief exercises that can be made in this class.	15
Workshop	A1 A2 A3 B3 B6 B7 B8 B9 C3 C7 C8 C9	Problem solving and workshops, will evaluated with maximum of 15 points total. This activity will take into account the participation and level of knowledge shown by the students. I could also take account some brief exercises that students can be made in class.	0
Mixed objective/subjective test	A1 A2 A3 B1 B7 B8 C9	It will consist of questions to develop both as test questions, formulation and problems, similar to solved during course. It will celebrate in the end of semester	60
Objective test	A1 A2 A3 B1 B3 B6 B7 B8 B9 C9	Periodically will some exercices of multiple choice or short answer according to what indicated in the methodology section will be made	25

Assessment comments

The rating is the sum of the following contributions:
- Mixed objective: up to 60 points
- Objective tests: up to 25 points
- problem solving and workshops: up to 15 points.
To pass the subject it will be necessary to get at least 50 points between the different assessment activities (mixed testing, objective testing, troubleshooting and workshops) and obtain a minimum score of 30 points (out of 60) in the mixed test in the firts and second oportunity. If is not possible to achieve the minimum score in the mixed test, although the average be greater than or equal to 50 points (out of 100) will be listed as not passing matter (4.5).
Since the rating is based on the model of continuous assessment, specifically assess student progression throughout the semester could be added maximum of 1 point to the final grade.
Students who do not participate in workshops and problem solvent will score zero points in this section on two occasions or oportunities.
Students to be evaluated in the so-called "second chance" can only obtain qualified with the maximun if the maximum number of these to the corresponding course was not fully covered in the "first chance."
In the case of exceptional circumstances objectivables and properly justified, the professor may waive in whole or in part the student for the continuous process. People in this circumstance must pass a specific test that leaves no doubt on the achievement of the competences of the subject.
For students with a part-time commitment and academic exemption for attendance exemption, the assessment obtained in the activities associated with the personalized tutoring system will correspond to the evaluation of the objective test methodology, that is to say with 25% of the final score. The remaining 75% of said final grade will be determined through the results obtained by the student in the mixed objective.

Sources of information	
Basic	- Petrucci, R. H.; Herring, F. G.; Madura, J. D.; Bissonnette, C (2017). Química General. Madrid - Petrucci, R. H.; Herring, F. G.; Madura, J. D.; Bissonnette, C (2011). Química General. Madrid - Petrucci, R. H.; Herring, F. G.; Madura, J. D.; Bissonnette, C (2003). Química General. Madrid
Complementary	- j. Casabó i Gispert (1996). estructura Atómica y Enlace Químico. barcelona - Emilio Quiñoá Cabana; Ricardo Riguera Vega; José Manuel Vila Abad. (2005). Nomenclatura y formulación de los compuestos orgánicos una guía de estudio y autoevaluación. Madrid - Emilio Quiñoá Cabana; Ricardo Riguera Vega; José Manuel Vila Abad. (2006). Nomenclatura y formulación de los compuestos inorgánicos una guía de estudio y autoevaluación. Madrid

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Integrated Basic Laboratory/610G04004
Subjects that continue the syllabus

Chemistry: Equilibrium and Change/610G04008
Other comments
To successfully on this course, the student needs the knowledge of chemistry from the secondary school.

(*)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.