Teaching Guide				
Identifying Data				2023/24
Subject (*)	Inorganic Chemistry 2		Code	610G01022
Study programme	Grao en Química			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Second	Obligatory	6
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Química			
Coordinador	Vazquez Garcia, Digna		E-mail	d.vazquezg@udc.es
Lecturers	Fernandez Lopez, Alberto A. Fernandez Sanchez, Jesus Jose Lopez Torres, Margarita Vazquez Garcia, Digna		E-mail	alberto.fernandez@udc.es jesus.fernandezs@udc.es margarita.lopez.torres@udc.es d.vazquezg@udc.es
Web	(En construcción)			
General description	Historically, the study of Chemistry has been divided in large areas of knowledge which included Inorganic Chemistry among them. This discipline includes experimental investigation and theoretical interpretation of the properties and reactivity of all elements of the periodic table as well as the compounds derived from them. Therefore, two of the most characteristic features of Inorganic Chemistry are in first place, the great diversity of contents and second, its interdisciplinary nature. The significance of Inorganic Chemistry goes beyond of purely academic boundaries. Thus, in our daily lives, we can find a great variety of inorganic products which are commonly used. It can be remarked the significant implications in industrial and technological processes which contribute decisively to the development of society. In the curriculum of the Degree in Chemistry of the UDC and according to academic organization criteria, Inorganic Chemistry is scheduled in the second year of the Degree and planned in two theoretical-practical courses: Inorganic Chemistry 1 and Inorganic Chemistry 2. Inorganic Chemistry 2 focuses on the systematic study and synthesis of the elements of groups 13 and 14 and the metallic elements, as well as the study of the synthesis and properties of the compounds derived from these elements. From an academic point of view, this course settles the basis for the advanced Inorganic Chemistry courses and for the majority of other areas of knowledge.			

Study programme competences	
Code	Study programme competences
A1	Ability to use chemistry terminology, nomenclature, conventions and units
A2	Ability to describe and account for trends in properties of chemical elements throughout the periodic table
A3	Knowledge of characteristics of the different states of matter and theories used to describe them
A4	Knowledge of main types of chemical reaction and characteristics of each
A5	Understanding of principles of thermodynamics and its applications in chemistry
A6	Knowledge of chemical elements and their compounds, synthesis, structure, properties and reactivity
A12	Ability to relate macroscopic properties of matter to its microscopic structure
A14	Ability to demonstrate knowledge and understanding of concepts, principles and theories in chemistry
A16	Ability to source, assess and apply technical bibliographical information and data relating to chemistry
A17	Ability to work safely in a chemistry laboratory (handling of materials, disposal of waste)
A18	Risk management in relation to use of chemical substances and laboratory procedures
A20	Ability to interpret data resulting from laboratory observation and measurement
A21	Understanding of qualitative and quantitative aspects of chemical problems
A22	Ability to plan, design and develop projects and experiments
A23	Critical standards of excellence in experimental technique and analysis
A26	Ability to follow standard laboratory procedures in relation to analysis and synthesis of organic and inorganic systems
B1	Learning to learn

B2	Effective problem solving
B3	Application of logical, critical, creative thinking
B4	Working independently on own initiative
C1	Ability to express oneself accurately in the official languages of Galicia (oral and in written)

Learning outcomes			
Learning outcomes	Study programme competences		
The student must know and rationalize the chemical behavior of the elements and their main compounds, as well as their individual properties and possibilities to be combined, using suitable models and theories and establishing relationships with their position in the periodic table.	A1 A2 A3 A4 A5 A6 A12 A14 A16 A21	B1 B3 B4	C1
The student must know the equipment and techniques of common use in a laboratory of Inorganic Chemistry, and develop the skills required to use them.	A17 A18 A20 A21 A22 A23 A26	B1 B2 B3 B4	C1
The student must be able to relate critically the theoretical knowledge with the experimental facts observed in the laboratory.	A14 A20	B1 B3 B4	C1
The student must know the bibliographic resources used in Inorganic Chemistry.	A16	B1 B3 B4	C1

Contents	
Topic	Sub-topic
Lesson 1. Metals: an overview.	1.1. General Characteristics of metals. 1.2. Structure and bonding. 1.3. Physical and chemical properties. Chemistry in aqueous solution. Aquated cations: formation and acidic properties. Pourbaix diagrams. 1.4. Preparation. Ellingham diagrams.
Lesson 2. Coordination Chemistry.	2.1. General considerations: Definition and terminology. 2.2. Types of ligands. 2.3. Bonding in complexes. 2.4. Coordination numbers and geometries. 2.5. Isomerism in coordination chemistry. 2.6. Ligand Topology.
Lesson 3. The Group 14 elements (C, Si, Ge, Sn, Pb).	3.1. Electronic structures of atoms and chemical behaviour. 3.2. The elements: structure and bonding, physical and chemical properties. Chemistry in aqueous solution. 3.3. Occurrence, extraction and uses. 3.4. Main compounds.

Lesson 4. The Group 13 elements (B, Al, Ga, In, Tl).	4.1. Electronic structures of atoms and chemical behaviour. 4.2. The elements: structure and bonding, physical and chemical properties. Chemistry in aqueous solution. 4.3. Occurrence, extraction and uses. 4.4. Main compounds.
Lesson 5. The Groups 1, 2 and 3.	5.1. Electronic structures of atoms and chemical behaviour. Diagonal relationships between Li and Mg, and between Be and Al. 5.2. The elements: structure and bonding, physical and chemical properties. Chemistry in aqueous solution. 5.3. Occurrence, extraction and uses. 5.4. Main compounds.
Lesson 6. d-Block metal chemistry: the first row metals.	6.1. The d-Block metals: General characteristics and classification. 6.2. Electronic structures of atoms and chemical behaviour. The most common oxidation states. 6.3. The elements: structure and bonding, physical and chemical properties. Chemistry in aqueous solution. 6.4. Occurrence, extraction and uses. 6.5. Main compounds.
Lesson 7. d-Block metal chemistry: the second and the third row metals.	7.1. Electronic structures of atoms and chemical behaviour. The most common oxidation states. 7.2. The elements: structure and bonding, physical and chemical properties. Chemistry in aqueous solution. 7.3. Occurrence, extraction and uses. 7.4. Main compounds.
Lesson 8. The f-block metals.	8.1. Lanthanides 8.2. Actinides 8.3 Postactinides
Lesson 9. Experimental Inorganic Chemistry.	Synthesis of inorganic elements and compounds.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Introductory activities	B1	2	0	2
Guest lecture / keynote speech	A1 A2 A3 A4 A5 A6 A12 A14 A21 B2 C1	22	44	66
Workshop	A1 A2 A3 A4 A5 A6 A12 A14 A16 A21 B2 B3 B4 C1	8	16	24
Laboratory practice	A14 A16 A17 A18 A20 A21 A22 A23 A26 B1 B2 B3 B4 C1	21	20	41
Multiple-choice questions	A1 A2 A3 A4 A5 A6 A12 A14 A21 B2 B3 C1	0	0	0
Document analysis	A1 A2 A3 A4 A5 A6 A12 A14 A21 B2 B3 C1	0	5	5
Mixed objective/subjective test	A1 A2 A3 A4 A5 A6 A12 A14 A21 B2 B3 C1	4	8	12

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**
Introductory activities	Presentation of the subject and its contents, the methodology that is used throughout the course and the criteria that will be used for the assessment.
Guest lecture / keynote speech	Classroom activity designed for relatively large groups of students (a maximum of sixty) in which the main contents of the course are presented. The lectures will require the participation of the students asking questions about the lecture and answering those questions raised by the instructor. It is advised that the students read in advance the literature associated to the topic that will be covered by the lecture.
Workshop	Classes where various activities will be carried out in which the student must actively participate. - In this activity, bulletins of questions and problems will be solved, which will have previously been given to the students and that, once in class, the students will discuss with their classmates the answers to the different questions, establishing a debate. - In the workshops, intermediate tests will also be carried out that combine questions of multiple response type, ordering, short answer, to complete, etc., which will help the student and the teacher to verify that the topics covered in previous classes were understood. - Before attending the workshop, and in order to participate and be evaluated in it, the student must deliver the bulletin through the online platform available for the subject.
Laboratory practice	It will focus on the synthesis and isolation of inorganic substances. - Before starting the practices, the student will have to carry out an initial study that includes both preparatory and theoretical aspects associated with the experiments to be carried out, applying their knowledge and relying at all times on the bibliographic review of the proposed texts. The results and conclusions of this autonomous work must be presented in a personal interview with the professor in charge before beginning the actual practices in the laboratory, in order to determine if the degree of knowledge acquired is sufficient to allow them to proceed to carry out with safety and use the experimental work. - During the development of the experiments, the student must demonstrate a responsible attitude with regard to safety regulations, as well as the rigorous and efficient characteristics of the scientific method. - The student must prepare a laboratory notebook that will consist of three parts: summary of the previous theoretical preparation (carried out during the initial study), detailed description of the execution and development of the experiment (laboratory diary), and a final comment on the results obtained and the conclusions that can be drawn from them.
Multiple-choice questions	A test will be carried out in the lectures at the end of each lesson, to evaluate the learning of the contents. This test will be made using platforms such as Moodle, Office 365 package tools and / or applications available on the Internet. For this purpose, questions will be asked as a direct question or an incomplete statement, and several options or response alternatives providing possible solutions, of which only one of them is valid, thus seeing the degree of assimilation of the contents of the course by the student.
Document analysis	This methodology will help the student to work on relevant content for the subject matter, with activities specifically designed on the platforms for their analysis through the use of audiovisual and / or bibliographic documents (fragments of documentary reports or films, current news, photographs, articles, etc.) available to the student through the online platforms.
Mixed objective/subjective test	Written test that may consist of a series of short questions, questions to develop, numerical problems and multiple choice questions related to the program of the subject.

Personalized attention	
Methodologies	**Description**

	The teaching-learning process is supported by individual attention to the student, and will take place at the most convenient time for the student and the teacher. Those students having a part-time dedication to the course, and thus waiver of assistance to the on-site academic activities according to the regulations of UDC, will be supported with specific individual attention in different forms: - Tutoring support upon request of the student. - The instructor will propose (upon student request) specific tasks to the student such as problem sheets related to the contents of the course. The student will solve the problems individually and then request a tutoring session to have convenient feedback from the instructor. - Tutoring support for the preparation of the experiments that the student will carry out in the laboratory and the preparation of the personal interview (see methodologies above). Again, these tutoring sessions will take place upon student request and scheduled at the convenience of the student.

Assessment			
Methodologies	**Competencies**	**Description**	**Qualification**
Laboratory practice	A14 A16 A17 A18 A20 A21 A22 A23 A26 B1 B2 B3 B4 C1	Previous to the beginning of the practices, in an initial interview, the teacher, in addition to guiding the student, will evaluate all the aspects related to the initial study of the practices and experimental or safety aspects at work (see Methodology section). The student will not be able to begin work in the laboratory until he or she has adequately completed this prior preparation. Work in the laboratory will be evaluated from the points of view of: - organization and security - knowledge of the material, preparatory techniques and their use - manual skill and, - especially, the ability to understand the processes observed from the previous preparation. The elaboration of a Laboratory Notebook will also be evaluated, which will consist of three parts: 1- Summary of the previous theoretical preparation (carried out during the initial study). 2- Detailed description of the execution and development of the experiments (laboratory diary). 3- Final comment on the results obtained and the conclusions that can be drawn from them.	20
Mixed objective/subjective test	A1 A2 A3 A4 A5 A6 A12 A14 A21 B2 B3 C1	Students will take the mixed test in the hours designed by the Faculty. It will consist of a number of questions and problems related to the subject's contents, according to the Methodology section.	60
Workshop	A1 A2 A3 A4 A5 A6 A12 A14 A16 A21 B2 B3 B4 C1	To be evaluated in the workshop, as indicated in the Methodology section, the student must deliver the bulletin through the online platform available for the subject. During the workshop the teacher will value the answers to the questions in the bulletin and the active participation in the debate with the other classmates. Intermediate multiple choice or short answer tests will also be evaluated, which will be carried out periodically in the workshops, in accordance with what is indicated in the Methodology section.	10
Multiple-choice questions	A1 A2 A3 A4 A5 A6 A12 A14 A21 B2 B3 C1	Periodically, short multiple-choice tests will be carried out through online platforms, according to what is indicated in the Methodology section.	5

Document analysis	A1 A2 A3 A4 A5 A6 A12 A14 A21 B2 B3 C1	Periodically, according to what is indicated in the methodology section, there will be activities in which, based on audiovisual and / or bibliographic documents, the student must answer questions related to the content through the online platforms available for the course.	5

Assessment comments

Students will be evaluated using the following grading system:- C1: Qualification of the mixed test: to pass the course, the student must obtain a minimum of 50% of the maximum mark in this section.
- C2: Qualification of the laboratory practices: to pass the course, the student must obtain a minimum of 45% of the maximum mark in this section.
- C3: Qualification of the workshops, multiple choice tests and analysis of documentary sources.
- C4: Qualification of the global evolution of the student's progression.

The student will pass the course if he obtains a minimum of 5 points in the following sum: 0.6 (C1) + 0.20 (C2) + 0.20 (C3). The qualification of the global evolution of the student's progression (C4) will be made once the remaining qualifications (C1, C2 and C3) have been made, and only for those students who passed the subject, and can be assessed with a maximum of one point, which it may be added to the final grade. In the event that a student exceeds, in the sum total of all grades, the ten points, a grade of 10.0 points will be assigned.

In the event that the qualification for the course is less than the sum of 0.80 (C1) + 0.20 (C2), the qualification will be replaced by the value of this sum. If the final qualification exceeds 5 points but does not reach 50% of the mark in section C1 and 45% of the mark in section C2, the mark that will appear in the minutes will be 4.5 (failed).

If the student attends the laboratory practices, he will not be able to obtain the qualification of "Not Presented".

The qualification obtained in the "first opportunity" (February), if it is positive (equal to or greater than 5), is final.

The grading scale for the "second opportunity" will be the same as that described for the "first opportunity", with the exception that the mixed qualification for the second opportunity will replace the mixed qualification for the first opportunity.

If the student does not reach 45% of the maximum mark in the laboratory practice section at the first opportunity, he will be able to carry out a work related to a new laboratory practice.

Students evaluated on the "second opportunity" will only be eligible for honors, if the maximum number of these for the course, in accordance with academic regulations, has not been fully covered on the "first opportunity ".

Those students who take advantage of the "recognition of part-time dedication and academic exemption of attendance exemption" in accordance with UDC regulations, will only be required to attend practical laboratory classes. The final qualification for these students will consist of two parts: the mark obtained in the laboratory practices, which will contribute 20% to the final mark, and the mark for the mixed test, which will count for the remaining 80%. These grade percentages will apply to both opportunities. The qualification of "not presented" will be awarded to those students admitted to the aforementioned exemption regime on the condition that they do

not appear for the mixed test.

The

entire teaching-learning process described in this guide, including the

assessment, refers solely and exclusively to the current academic year.

Sources of information	
Basic	- E.C. Housecroft y A.G. Sharpe (2006). Química Inorgánica. Madrid, Pearson 2ª Ed. (en inglés 4ª Ed 2012) - D.F. Shriver, P.W. Atkins, T.L. Overton, J.P. Rourke, H.T. Weller y F.A. Armstrong (2008). Química Inorgánica. México, McGraw-Hill 4ª Ed. (en inglés 6ª Ed. 2014) Bibliográfía de Prácticas: G. Brauer. "Preparative Inorganic Chemistry", vols. I y II. Academic Press, Nueva York (1963 y 1965). Versión en castellano de la 2ª ed. alemana: "Química Inorgánica Preparativa", Reverté, Barcelona (1958) G.C. Schlessinger. "Inorganic Laboratory Preparations". Chemical Pub. Co., Nueva York (1962). Versión en castellano: "Preparaciones de Compuestos Inorgánicos en el Laboratorio", Continental, México (1962) Z. Szafran, R.M. Pike y M. Singh. "Microscale Inorganic Chemistry: A Comprensive Laboratory Experience". Wiley & Sons, Nueva York (1991)
Complementary	- E. Gutiérrez Ríos (1984). Química Inorgánica . Barcelona, Reverté 2ª Ed. - S.M. Owen y A.T. Brooken (1991). A Guide to Modern Inorganic Chemistry. Harlow. Longman - J.D. Lee (1996). Concise Inorganic Chemistry. London, Chapman&Hall 6th Ed. - N.N. Greenwood y A. Earnshaw (1997). The Chemistry of the Elements. Oxford, Butterworth Heinemann 2nd Ed. - G.E. Rodgers (2002). Descriptive Inorganic Coordination and Solid State Chemistry . Melbourne, Thomson Learning 2ª Ed. [en castellano: 1ª Ed., 1995] - G. Rayner-Canham y T. Overton (2000). Química Inorgánica Descriptiva. Mexico, Pearson, 2ª Ed. [en inglés: 6ª Ed., 20014] - F.A. Cotton, G. Wilkinson, C.A. Murillo y M. Bochman (1999). Advanced Inorganic Chemistry. New York, Wiley&Sons 6th Ed. [en castellano: 4ª Ed., 1986] Bibliografía de teoría e prácticas de laboratorio enfocada cara á Química Inorgánica en xeral, a disposición pública na Biblioteca da Facultade de Ciencias.

Recommendations
Subjects that it is recommended to have taken before
General Chemistry 1/610G01007 General Chemistry 2/610G01008 General Chemistry 3/610G01009 Chemistry Laboratory 1/610G01010
Subjects that are recommended to be taken simultaneously
Inorganic Chemistry 1/610G01021
Subjects that continue the syllabus
Inorganic Chemistry 3/610G01023 Inorganic Chemistry 4/610G01024 Advanced Inorganic Chemistry/610G01025 Industrial Chemistry/610G01039
Other comments
As a complement to the face-to-face classes and the bibliographic material, instructors will make available for the students (through the means established in each case) the documentation related to the master sessions, exercise and problem sheets, guidance documents for laboratory practices and / or questionnaires of various kinds. Note: Attendance to all classes is advised, as well as active participation in all activities.