



Teaching Guide

Identifying Data					2013/14
Subject (*)	Química Inorgánica 4	Code	610G01024		
Study programme	Grao en Química				
Descriptors					
Cycle	Period	Year	Type	Credits	
Graduate	2nd four-month period	Third	Obligatoria	6	
Language	SpanishGalicianEnglish				
Prerequisites					
Department	Química Fundamental				
Coordinador	Rodríguez Blas, Maria Teresa	E-mail	teresa.rodriguez.blas@udc.es		
Lecturers	Castro Garcia, Socorro Platas Iglesias, Carlos Rodríguez Blas, Maria Teresa	E-mail	socorro.castro.garcia@udc.es carlos.platas.iglesias@udc.es teresa.rodriguez.blas@udc.es		
Web					
General description	<p>DESCRIPCIÓN: Preparación e caracterización de compostos inorgánicos: compostos de coordinación e sólidos non moleculares.</p> <p>CONTEXTUALIZACIÓN: A materia encádrase no sexto semestre do Grao en Química (3º curso), e está intimamente relacionada coa materia do quinto semestre &quot;Química Inorgánica 3&quot;;. O conxunto das dúas materias constitúen o módulo &quot;Química Inorgánica Avanzada&quot;;, que pretende proporcionar unha adecuada formación ao alumnado nos ámbitos da Química de Coordinación e a Química do Estado Sólido.</p> <p>Esta asignatura forma parte do Plan Bilingüe do Grao, por lo que hai posibilidade de cursala en castelán/galego (Prof. responsable: Mª Teresa Rodríguez Blas) ou en inglés (Profs. responsables: Carlos Platas Iglesias e Socorro Castro García). Os alumnos poderán elixir a opción que desexen ao efectuar a súa matrícula. As actividades do grupo castelán/galego impartiranse en castelán.</p> <p>Preparation and characterization of inorganic compounds: Coordination compounds and non-molecular solids.</p> <p>CONTEXT: &quot;Inorganic Chemistry 4&quot;; is a compulsory course in the 6th semester-3rd year of the Degree in Chemistry, and it is closely related to the &quot;Inorganic Chemistry 3&quot;; (5th semester). Both courses will provide an adequate formation in the fields of Coordination Chemistry and Solid State Chemistry. &quot;Inorganic Chemistry 4&quot;; is part of the Bilingual plan for the Degree in Chemistry, which allows students to follow the course in Spanish/Galician (Prof. in charge: Mª Teresa Rodríguez Blas) or in English (Profs. in charge Carlos Platas Iglesias and Socorro Castro Garcia). Students may choose among one of these two options when filling their registration forms. The activities of the group in Spanish/Galician will be carried out in Spanish.</p>				

Study programme competences

Code	Study programme competences
A1	Utilizar a terminoloxía química, nomenclatura, convenios e unidades.
A3	Coñecer as características dos diferentes estados da materia e as teorías empregadas para describilos.
A4	Coñecer os tipos principais de reacción química e as súas principais características asociadas.
A5	Comprender os principios da termodinámica e as súas aplicacións en Química.
A9	Coñecer os rasgos estruturais dos compostos químicos, incluíndo a estereoquímica, así como as principais técnicas de investigación estrutural.
A12	Relacionar as propiedades macroscópicas coas de átomos e moléculas.
A14	Demostrar o coñecemento e comprensión de conceptos, principios e teorías relacionadas coa Química.
A15	Recoñecer e analizar novos problemas e planear estratexias para solucionarlos.
A16	Adquirir, avaliar e utilizar os datos e información bibliográfica e técnica relacionada coa Química.
A17	Traballar no laboratorio Químico con seguridade (manexo de materiais e eliminación de residuos).
A18	Valorar os riscos no uso de sustancias químicas e procedementos de laboratorio.
A19	Levar a cabo procedementos estándares e manexar a instrumentación científica.

A20	Interpretar os datos procedentes de observacións e medidas no laboratorio.
A21	Comprender os aspectos cualitativos e cuantitativos dos problemas químicos.
A22	Planificar, deseñar e desenvolver proxectos e experimentos.
A23	Desenvolver unha actitude crítica de perfeccionamento na labor experimental.
A24	Explicar, de xeito comprensible, fenómenos e procesos relacionados coa Química.
A26	Levar a cabo procedementos estándares de laboratorios implicados en traballos analíticos e sintéticos, en relación con sistemas orgánicos e inorgánicos.
B1	Aprender a aprender.
B2	Resolver problemas de forma efectiva.
B3	Aplicar un pensamento crítico, lóxico e creativo.
B4	Traballar de forma autónoma con iniciativa.
B5	Traballar de forma colaborativa.
B7	Comunicarse de maneira efectiva nun entorno de traballo.
C1	Expresarse correctamente, tanto de forma oral coma escrita, nas linguas oficiais da comunidade autónoma.
C2	Dominar a expresión e a comprensión de forma oral e escrita dun idioma estranxeiro.
C7	Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.
C8	Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.

Learning outcomes			
Subject competencies (Learning outcomes)	Study programme competences		
To identify problems associated with the synthesis and structural characterization of metal complexes and inorganic solids, and plan strategies to solve them.	A15		
To use properly the terminology and nomenclature in Coordination Chemistry and Solid State Chemistry.	A1		
To know and handle the literature on the structure, bonding, synthesis, reactivity, characterization, properties and applications of coordination compounds and non-molecular solids.	A16	B1 B4	
To understand and to carry out standard procedures for the synthesis of inorganic compounds, and to use scientific instrumentation for their characterization.	A17 A19		
To plan, design and carry out the synthesis and characterization of coordination compounds and non-molecular solids.	A22	B5	
To understand and explain the processes observed in the Inorganic Chemistry Laboratory.	A1 A18 A20 A21 A23 A24	B2 B3 B4 B7	C1 C7
To perform the synthesis and characterization of coordination compounds and non-molecular crystalline solids with ease, cleanliness and safety.	A17 A18 A26		
To understand the important contribution that the research in Inorganic Chemistry has on the socio-economic and cultural progress of society.			C8
To manage properly the waste generated in a laboratory devoted to the synthesis and characterization of inorganic compounds.	A17 A18 A23		
To know and to use the laboratory equipment and facilities for the synthesis and characterization of inorganic species.	A17	B7	C1

To prepare a laboratory notebook that gathers all relevant information making the necessary calculations.	A1 A15 A18 A20 A21 A23 A24	B3 B4 B7	C1
To know the structure of coordination compounds and molecular crystalline solids and to apply the techniques required for structure determination.	A9	B2 B4	
To prepare and present reports on the work and results obtained in a laboratory of inorganic chemistry .	A1 A3 A4 A5 A9 A12 A14 A20	B3 B4 B7	C1
To improve the use of spoken and written scientific English (For those students following the course in English).			C2

Contents	
Topic	Sub-topic
Preparation of Coordination Compounds	Methods for the preparation of metal complexes. Solvent effects. Speciation diagrams.
Structural determination of coordination compounds (I)	Chemical analysis. Mass spectrometry. Molar conductivity. Dipolar moments. Vibrational spectroscopy. NMR spectroscopy. Questions and exercises.
Structural determination of coordination compounds (II): Electronic Absorption Spectroscopy	Introduction. Selection rules. Origin of the bands: Ligand-ligand bands, charge transfer bands and d-d bands. Spectroscopic terms and electronic states. Orgell diagrams and Tanabe-Sugano diagrams. Analysis of electronic spectra and applications in structure determination. Questions, problems and exercises.
Structural determination of coordination compounds (III): magnetic properties	Diamagnetism and paramagnetism. Effective magnetic moment. Spin and orbital contributions. Applications in structure determination. Questions, problems and exercises.
Methods of preparation of non-molecular solids	Strategies for the preparation of crystalline non-molecular solids. Main synthesis methods: ceramic method, soft chemistry methods (co-precipitation, decomposition of nitrates, sol-gel method, intercalation reactions?), solvothermal method.
Methods for Characterization of non-molecular solids	General overview of the different diffractometric techniques (X-ray, electron and neutron diffraction), with emphasis on crystal powder X-ray diffraction. Spectroscopic techniques. Thermal methods. Electronic microscopy (scanning and transmission electron microscopies).
Preparation and Characterization of Coordination Compounds	Selection of the synthesis conditions. Selection of materials (reagents, solvents, instrumentation, glass equipment...). Assessment of the risks associated with the experiment and its prevention. Experimental procedure for the synthesis. Use of instrumental techniques for structural elucidation. Interpretation of the structural elucidation results. Preparation of a laboratory notebook. Preparation and presentation of a final report.



Preparation and Characterization of crystalline non-molecular solids	<p>Selection of the synthesis conditions.</p> <p>Selection of materials (reagents, solvents, instrumentation, glass equipment...).</p> <p>Assessment of the risks associated with the experiment and its prevention.</p> <p>Experimental procedure for the synthesis.</p> <p>Use of auxiliar software for structural elucidation.</p> <p>Interpretation of the structural elucidation results.</p> <p>Preparation of a laboratory notebook.</p> <p>Preparation and presentation of a final report.</p>
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Planning			
Methodologies / tests	Ordinary class hours	Student's personal work hours	Total hours
Guest lecture / keynote speech	10	30	40
Laboratory practice	34	0	34
Seminar	4	20	24
Supervised projects	2	28	30
Oral presentation	2	8	10
Mixed objective/subjective test	2	0	2
Summary	0	10	10
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	Lectures: oral presentations of the topics 1-6 of "Contents" section. These sessions involve also the active participation of the students and a continuous exchange of ideas between lecturer and students.
Laboratory practice	Laboratory practices (topics 7-8 in "Contents"): student's work in the laboratory, under the tutoring of the teacher. Students will synthesize and characterize coordination compounds and crystalline non-molecular solids.
Seminar	Seminars: sessions in small groups to solve problems and exercises related with the topics of the lectures. They also serve as a "feed-back" to the lecturer to assess the progress of students.
Supervised projects	The students must prepare the experiments, prior to start the work at the laboratory, using the literature. This process will be guided and supervised by the laboratory instructor.
Oral presentation	Group sessions to present the work done during the laboratory practice. Each student must summarize his/her work in a short time (around 5 minutes) and discuss it with the audience.
Mixed objective/subjective test	Tratarase dunha proba escrita que incluíra cuestións e problemas numéricos relacionados coa materia.
Summary	Each student must provide the laboratory notebook at the end of the laboratory practice, as well as brief report of each experiment, which will be evaluated and corrected by the laboratory instructor.

Personalized attention	
Methodologies	Description



Laboratory practice Seminar Supervised projects Oral presentation	<p>During the "laboratory practice" students will be individually interviewed by the teacher at different stages:</p> <p>i) Interviews prior to the start of the experimental work, once the student completes the literature review and the preparation of the experiments. A positive assessment of this work is required for the student to be allowed to start the experimental work.</p> <p>ii) A personal interview at the end of the laboratory practice to assess the work carried out and to solve possible deficiencies in the training.</p> <p>Moreover, students can ask for additional tutoring sessions that will take place at the tutoring hours of the teacher (the timetables will be indicated at the beginig of the course).</p>
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Assessment		
Methodologies	Description	Qualification
Laboratory practice	<p>The preparation and execution of the experimental part (laboratory practice) will represent 80% of the final mark. The approximate breakdown of this part is:</p> <ol style="list-style-type: none">1. Instructor's assessment of lab skills (planning, time management, skill and confidence in practical work) and results of the synthesis and characterization (20%).2. Preparation of each experiment, interpretation of the results and conclusions reached (assessed by personal interview) (35%).3. Oral presentations of the work carried out in the laboratory (15%).4. Laboratory notebook and reports on each experiment (30%).	80
Supervised projects	<p>The literatura review to prepare the experiments, the results of the experimental work and the conclusions reached will be assessed by personal interview.</p> <p>(Its approximate contribution to the overall mark is described in the previous section).</p>	0
Oral presentation	<p>In the oral presentation of the "Laboratory practice", the instructor will assess the analysis of the results and the conclusions, and the active participation of the students in the discussion after each presentation.</p> <p>(Its approximate contribution to the overall mark is given above).</p>	0
Summary	<p>The laboratory notebook and the reports will also be assessed.</p> <p>(Its approximate contribution to the overall mark is given above).</p>	0
Mixed objective/subjective test	<p>Tratarase dunha proba escrita que incluírá cuestións e problemas numéricos relacionados coa materia.</p>	20

Assessment comments



This is a course with much experimental work. Therefore, attendance to all scheduled classes is mandatory.

First opportunity (June): The maximum score is 10 points, and passing the course requires a minimum of 5 points. In each of the assessed parts, it is required a minimum of 40% of the maximum score possible for that part. The assessment process will start when the student begins the work in the lab.

Thus, every student that reaches this stage will obtain a mark even if the different activities of the course, including the laboratory practice, are not completed.

Second opportunity (July): The maximum score is 10 points, and passing the course requires obtaining 5 points. Students will be assessed by an objective

test, from which students can obtain up to 2 points, and a laboratory practice test (which counts

for a maximum of 8 points). The practical test will

consist of the preparation and

execution of a laboratory

experiment using the same criteria

detailed in the "methodology"

section, with the exception that the preparation

of the experiment will not be tutored. An inappropriate preparation of the

experimental work will result in a negative assessment (failed course) before beginning the laboratory work.

From the time the student begins the

preparation of the experiments, or

the realization of the objective test, it is considered that decided to be assessed, and therefore those students that reach these stages will obtain a mark even if the different activities of the course are not completed.

Students

can get up to an additional point on the basis of engagement, interest and participation

in the various activities of the course.

This qualification will only be added to the

final grade if the students get a minimum

of 4 points (out of a maximum of 10) for the whole

course.

Sources of information

Basic	
Complementary	

Recommendations

Subjects that it is recommended to have taken before

Química Inorgánica Avanzada/610G01025

Ciencia de Materiais/610G01035

Subjects that are recommended to be taken simultaneously

Subjects that continue the syllabus

Química Física 1/610G01016

Química Física 2/610G01017

Química Inorgánica 1/610G01021

Química Inorgánica 2/610G01022

Química Inorgánica 3/610G01023



Other comments

that those students who take the "Inorganic Chemistry 4" course have passed "Inorganic Chemistry 3", and have the knowledge and skills associated with "Inorganic Chemistry 1 and 2" and "Physical Chemistry 1 and 2."

(*)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.