Teaching Guide				
Identifying Data				2023/24
Subject (*)	Metals in Biological Processes		Code	610509314
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	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Química			
Coordinador	Avecilla Porto, Fernando Francisco	E-mail	fernando.avecilla@udc.es	
Lecturers	Avecilla Porto, Fernando Francisco Rodriguez Blas, Maria Teresa	E-mail	fernando.avecilla@udc.es teresa.rodriguez.blas@udc.es	
Web				
General description	DESCRIPTION: Preparation and characterization of inorganic compounds: Coordination compounds and non-molecular solids. CONTEXT: The course is fitted in the sixth semester of the Degree in Chemistry (3rd year), and is closely related to the subject of the fifth semester "Inorganic Chemistry 3." The two fields set up the module "Advanced Inorganic Chemistry", which will provide an adequate education to students in the fields of Coordination Chemistry and Solid State Chemistry.			

Study programme competences	
Code	Study programme competences
A1	Define concepts, principles, theories and specialized facts of different areas of chemistry.
A2	Suggest alternatives for solving complex chemical problems related to the different areas of chemistry.
A4	Apply materials and biomolecules in innovative fields of industry and chemical engineering.
B2	Students should apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
B4	Students should be able to communicate their conclusions, and the knowledge and the reasons that support them to specialists and non-specialists in a clear and unambiguous manner
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
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		
	AC1 AC2 AC4	BC2 BC4 BC5 BC7 BC10	CC1 CC3 CC4

Contents	
Topic	Sub-topic

TEMA 1. Iones metálicos implicados en funciones biológicas.	1.1 Definición da química Bioinorgánica. 1.2 Elementos esenciales: 1.2.1. Relación entre a abundancia, esencialidad y disponibilidad. 1.2.2. Elementos metálicos esenciales y tóxicos. 1.3. Metaloproteínas: Definición. Funciones. Tipos. 1.4. Metaloproteínas implicadas en el transporte y almacenamiento de substancias. 1.4.1. Hemoglobina, mioglobina y hemocianina. Transporte dioxígeno. 1.4.2. Metaloproteinas implicadas en la iniciación y regulación de los procesos: dedos de cinc y calmodulinas.
TEMA 2. Transporte y almacenamiento de iones metálicos en sistemas biológicos. Mecanismos de defensa y desintoxicación biológica.	2.1 Sistemas bioinorgánicos de iones metálicos de los elementos de los grupos 1 e 2. 2.2. Funciones biológicas específicas. 2.3. Transporte e almacenamiento de Fe y Cu. 2.4. Mecanismos de toxicidad asociados con metales pesados: avances recientes, defensa e procedimientos de desintoxicación aplicables.
TEMA 3. Metaloenzimas y compuestos modelo: Biotransformaciones catalizadas por iones metálicos. Reacciones de hidrólisis, transferencia de grupos y redox.	3.1 Metaloenzimas. Clasificación y funciones biológicas, centro activo. 3.2. Compuestos modelo. 3.3. Reacciones de hidrólisis. Metaloenzimas de Zn. 3.4. Enzimas implicadas en transferencia de grupos. 3.5. Sistemas bioinorgánicos de Fe, Cu, Mo y Mn implicados en reacciones redox. 3.6. Otros iones metálicos implicados en catálisis enzimática.
TEMA 4. Metales en Medicina.	4.1. Introdución. 4.2. Metalofármacos anticancerígenos. 4.3. Metalofármacos antiinflamatorios, antibacterianos, antivirales, antidiabéticos y antineurodegenerativos. 4.4 Aplicaciones de diagnóstico: imagen molecular. Los radiofármacos en diagnóstico y terapia.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Document analysis	A2 A4 B5 B7	1	10	11
Collaborative learning	B2 B4	1	10	11
Case study	B10 C1 C3	2	1	3
Guest lecture / keynote speech	A1 A4	12	12	24
Oral presentation	A4 B2 B4 B5	2	5	7
Objective test	B5 B7 C4	2	14	16
Introductory activities	A1	2	0	2
Personalized attention		1	0	1
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Document analysis	Análisis de fuentes bibliográficas para la realización de trabajos, tanto individualmente, como en grupo, sobre temas científicos relacionados con las distintas materias del Máster.
Collaborative learning	Realización de trabajos, tanto individualmente, como en grupo, sobre temas científicos relacionados con las distintas materias del Máster. Estudio personal basado en las diferentes fuentes de información.
Case study	Estudio personal basado en las diferentes fuentes de información

Guest lecture / keynote speech	Clases presenciales teóricas. Clases expositivas (utilización de pizarra, ordenador, cañón), complementadas con las herramientas propias de la docencia virtual.
Oral presentation	Exposición oral de trabajos, informes, etc., incluyendo debate con profesores y alumnos.
Objective test	Realización de las diferentes pruebas para la verificación de la obtención tanto de conocimientos teóricos como prácticos y la adquisición de habilidades y actitudes.
Introductory activities	Presentación de la asignatura

Personalized attention	
Methodologies	**Description**
Guest lecture / keynote speech Collaborative learning Case study Introductory activities	During the "laboratory practice" students will be individually interviewed by the teacher at different stages: 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. 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. Moreover, students can ask for additional tuttoring sessions that will take place at the tuttoring hours of the teacher (the timetables will be indicated at the beginig of the course).

Assessment			
Methodologies	**Competencies**	**Description**	**Qualification**
Oral presentation	A4 B2 B4 B5	Exposición oral de trabajos, informes, etc., incluyendo debate con profesores y alumnos.	10
Collaborative learning	B2 B4	En las actividades realizadas durante el curso se valorará la participación de los alumnos y su trabajo colaborativo.	5
Objective test	B5 B7 C4	Prueba que constará de preguntas tipo test y de desarrollo.	60
Case study	B10 C1 C3	Se propondrán trabajos relacionados con la busqueda bibliográfica de información sobre los temas presentados durante el curso.	10
Document analysis	A2 A4 B5 B7	Búsqueda bibliográfica dirigida y análisis de los resultados	5
Introductory activities	A1	Actividad que computa en la presencialidad. Es obligatoria la asistencia a clase y a todas la actividades programadas.	10

Assessment comments

This is a course with an important loading of 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 posible 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 2.5 points, and a laboratory practice test (which counts for a maximum of 7.5 points). The practical test will consist on 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. The student can only do the exam of the laboratory practice in the second opportunity, if he/she has performed the practical training during the course (minimum 75%). If the student obtained a minimum of 4 points in the Labortory Practice in the first opportunity will not have to perform the laboratory practice test in the second opportunity.
From the time the student begins the preparation of the experiments, or the realization of the objective test, it is considered that accepted 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.
Those students assessed in the second opportunity (July) can be awarded with honors only if the máximum number of students that finish the course with honors is not reached after the first opportunity (June).
Those students that fail the course and wish to take the course in comming academic years will have to participate again in all the activities of the course, and will be assessed accordingly.
NOTE 1: "Part-time Students": First and second opportunities: Attendance to DE and TGR activities is not mandatory but the "mixed test" is required and they have to got a minimum of 5 points (of 10) to pass this activity. Laboratory practice is mandatory and follows the same requirements applied to students at full time.
NOTE 2: Implications
of plagiarism in the qualification: The fraudulent realization of the tests or
other evaluation activities will directly imply the qualification of 0.0 points
in the course in the corresponding call, thus invalidating any grades obtained in all the activities for the extraordinary call, in
accordance with the provisions of the UDC Student Statute (article 35, point 3,
https://www.udc.es/es/normativa/estudantes/estatuto_estudantado/index.html
NOTE 3: December
Early call: The weighting in the evaluation of the different teaching
activities of the students who participate in the December early call, will be
adapted to the new evaluation percentages set out in this guide, if they differ
from each other in both academic courses.

Sources of information	
Basic	-J.S. Casas, V. Moreno, A. Sánchez, J.L. Sánchez, J. Sordo. Química Bioinorgánica. Síntesis, S.A., Madrid, 2002.-M. Vallet-Regí, J. Faus, E. García-España, J. Moratal. Introducción a la Química Bioinorgánica. Síntesis S.A., Madrid, 2003.- D. Rehder.Bioinorganic Chemistry, Oxford University Press, Oxford, 2014.- S.S. Krishna, I. Majumdar, N.V. Grishin. Structural classification of zinc fingers: survey and summary. Nucleic Acids Research,2003, 31 , 532.- A. Klug. The discovery of zinc fingers and their applications in gene regulation and genome manipulation.Annu. Rev. Biochem., 2010, 79 , 213.
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Applied Coordination Chemistry/610509110 Medicinal Chemistry/610509116
Subjects that continue the syllabus

Other comments
<p>It is advised 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.</p><p class="MsoNormal">Green Campus Program - Faculty of Sciences </p><p class="MsoNormal">To achieve an immediate sustainable environment and comply with point 6 of the "Environmental Declaration of the Faculty of Sciences (2020)", the documentary works carried out in this course:</p><p class="MsoNormal">a.- They will be requested mainly in virtual format and computer support.</p><p class="MsoNormal">b.- If paper is used:</p><p class="MsoNormal">- Plastics will not be used.</p><p class="MsoNormal">- Double-sided prints will be made.</p><p class="MsoNormal">- Recycled paper will be used.</p><p class="MsoNormal">- The preparation of drafts will be avoided.</p>