



(*)Facultade de Química

Presentation

The studies of Chemistry have a large tradition at the University of Vigo, where it has been taught during more than 30 years. The establishment of the University System of Galicia in the 90s and the current process of implantation of the European Space of Higher Education (EEES) modified the offer of degrees, but not the pioneering spirit of the chemists in research or in the quest for a better service to the society.



Degrees given in the Faculty

Degree in Chemistry

- Masters And Doctorates:
 - Industry and Chemical Research and Industrial Chemistry
 - Theoretical chemistry and Computational Modelling
- Master:
 - Science and Technology of Conservation of Fishing Products

Web page

Information about the Faculty of Chemistry:

<http://quimica.uvigo.es>

Grado en Química

Subjects

Year 1st

Code	Name	Quadmester	Total Cr.
V11G201V01101	Biology: Biology	1st	6
V11G201V01102	Physics: Physics I	1st	6
V11G201V01103	Mathematics: Mathematics 1	1st	6
V11G201V01104	Chemistry: Chemistry 1	1st	6
V11G201V01105	Chemistry: Chemistry Lab I	1st	6
V11G201V01106	Geology: Geology	2nd	6
V11G201V01107	Physics: Physics 2	2nd	6
V11G201V01108	Mathematics: Mathematics 2	2nd	6

V11G201V01109	Chemistry: Chemistry 2	2nd	6
V11G201V01110	Chemistry: Chemistry Lab II	2nd	6

Year 2nd

Code	Name	Quadmester	Total Cr.
V11G201V01201	Biochemistry	1st	6
V11G201V01202	Analytical Chemistry I: Principles of Analytical Chemistry	1st	6
V11G201V01203	Physical chemistry I: Chemical thermodynamics	1st	6
V11G201V01204	Inorganic chemistry I	1st	6
V11G201V01205	Organic chemistry I	1st	6
V11G201V01206	Structural Determination	2nd	6
V11G201V01207	Analytical Chemistry II: Optical Methods of Analysis	2nd	6
V11G201V01208	Physical Chemistry II: Surfaces and Colloids	2nd	6
V11G201V01209	Inorganic chemistry II	2nd	6
V11G201V01210	Organic chemistry II	2nd	6

Year 3rd

Code	Name	Quadmester	Total Cr.
V11G201V01301	Chemical engineering	1st	6
V11G201V01302	Analytical Chemistry III: Electroanalytical Methods and Separations	1st	6
V11G201V01303	Physical Chemistry III: Quantum Chemistry	1st	6
V11G201V01304	Inorganic Chemistry III: Coordination Chemistry	1st	6
V11G201V01305	Organic Chemistry III: Concerted, Radical and Photochemical Reactions	1st	6
V11G201V01306	Analytical Chemistry IV: Chromatographic and Affine Methods	2nd	6
V11G201V01307	Physical Chemistry IV: Molecular Structure and Spectroscopy	2nd	6
V11G201V01308	Physical Chemistry V: Chemical Kinetics	2nd	6
V11G201V01309	Inorganic Chemistry IV: Transition Metals and Solid State	2nd	6
V11G201V01310	Organic Chemistry IV: Design of Organic Synthesis	2nd	6

Year 4th

Code	Name	Quadmester	Total Cr.
V11G201V01401	Project	1st	6
V11G201V01402	Chemistry of Materials	1st	6

V11G201V01403	Nanochemistry	1st	6
V11G201V01404	Organometallic Chemistry	1st	6
V11G201V01405	Stereoselective Synthesis of Bioactive Compounds	1st	6
V11G201V01406	Enhancement of Analytical Chemistry	2nd	6
V11G201V01407	Quality in Analytical Labs	1st	6
V11G201V01408	Industrial Chemistry	1st	6
V11G201V01410	Food, Agricultural and Environmental Analytical Chemistry	2nd	6
V11G201V01411	Computational Chemistry	2nd	6
V11G201V01412	Environmental and Bioinorganic Chemistry	2nd	6
V11G201V01413	Therapeutic Chemistry	2nd	6
V11G201V01415	Computing Techniques for Chemistry	2nd	6
V11G201V01417	Theory of Organic Reactions	2nd	6
V11G201V01419	Immunochemistry	2nd	6
V11G201V01981	Internships	2nd	6
V11G201V01991	Final Year Dissertation	2nd	18

IDENTIFYING DATA				
Biology: Biology				
Subject	Biology: Biology			
Code	V11G201V01101			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Arenas Busto, Miguel			
Lecturers	Arenas Busto, Miguel			
E-mail	marenas@uvigo.es			
Web	http://cinbio.es/CME			
General description	The subject of Biology aims preparing the students to understand and explain the composition and function of the organisms. Including how they are constituted and their functionalities at the molecular, cellular, and population levels. Indeed, how to study them and how to evaluate hypotheses with experimental results. English Friendly Subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code	
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
B1	Ability for autonomous learning
B3	Ability to manage information
C20	Know the structure and reactivity of the main classes of biomolecules and the chemistry of important biological processes
D1	Ability to solve problems

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Understand the cell as a fundamental unit in the organisms.	A2	B1 B3	C20	D1
Describe the cellular structure in prokaryotes and eukaryotes.	A2	B1 B3	C20	D1
Differentiate the properties, organisation and function of the distinct cellular organelles.	A2	B1 B3	C20	D1
Associate the cellular structures with the metabolism.	A2	B1 B3	C20	D1
Identify and relate the metabolic routes of the distinct organic molecules.	A2	B1 B3	C20	D1
Recognise the structure and function of the hereditary material and interpret the principles of the central dogma.	A2	B1 B3	C20	D1
Discuss the mutation processes and their implications for the evolution of organisms.	A2	B1 B3	C20	D1
Understand the methods of recombinant DNA.	A2	B1 B3	C20	D1
Understand the importance of the immune system.	A2	B1 B3	C20	D1

Contents

Topic	
1. The cellular structure of the organisms. The cell theory.	Size, form and cellular function. Cell classification. Cell Theory. Prokaryotic cell and eukaryotic cell.

2. Biomembranes and cellular transport systems.	Cell membrane: functions, biochemical composition, physicochemical properties. Synthesis of the cellular membrane. Transport systems through the biological membranes: pumps, protein transporters, and channels.
3. The cell nucleus and the chromosomes. The cell organelles.	Cell nucleus: structure, composition and functions. Structure and functions of the nucleus. Structures and functions of the chromatin and chromosomes. Structure, composition, and functions of: extracellular matrix, cytoskeleton and centrioles, endoplasmic reticulum, Golgi apparatus, endosomes and lysosomes, mitochondria, peroxisomes, and chloroplasts.
4. Cellular division and cellular cycle.	Definition and characteristics of mitosis. Differences between somatic and germinal cells. Phases of the cellular cycle. Biological meaning of the mitosis. Concept of apoptosis, cellular proliferation and cancer. Concept and differences between asexual and sexual reproduction. Definition and characteristics of meiosis. Phases of the meiosis. Origin of the genetic variability produced in the meiosis. Differences between mitosis and meiosis.
5. General design of the metabolism: catabolism and anabolism.	Concepts of enzyme, energetic metabolism, metabolic route, catabolism and anabolism. Functional blocks of metabolism and their coupling: catabolic block, anabolic block, growth and differentiation block. The ATP equivalent. Extraction of chemical energy from organic compounds: carbohydrates, fats, and proteins.
6. Photosynthesis.	The nature of light. Photosynthetic pigments. Stages of photosynthesis: light stage and dark stage (Calvin cycle). The problem of the photorespiration: C4 plants and CAM plants.
7. DNA: structure, function and techniques of recombinant DNA.	Composition and structure of the DNA. Function of the DNA. Replication of the DNA. Initiation to techniques of recombinant DNA.
8. RNA and expression of the genetic message.	Composition and structure of the RNA. Main types of RNA: messenger RNA (mRNA), transfer RNA (tRNA), and ribosomal RNA (rRNA). Other types of cell RNA and their functions. Transcription and translation processes. The language of the genetic information.
9. Mutation and evolution.	Genetic mutations: concept and types. Molecular consequences of genetic mutations. Structural chromosomal mutations: deletion, duplication, inversion, and translocation. Numerical chromosomal mutations: haploidy, polyploidy, and aneuploidy. Origin and consequences of mutations. Relation of mutations with diseases such as cancer. Evolutionary theories. Arguments that support the evolution.
10. The immune system.	Concept of the immune system. Components of the immune system. Mechanism of the innate defense of the immune system. Antibodies and interferons. Types of immune response. Alterations of the immune system. Vaccines and their importance.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	60	86
Problem solving	10	30	40
Mentored work	3	9	12
Essay questions exam	2	4	6
Essay questions exam	2	4	6

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

Methodologies	
	Description
Lecturing	In these classes, the professor explains the concepts and fundamentals of the contents to facilitate their understanding. The contents for each section will be provided to the students through the online platform with sufficient time. It is recommended that the student works on this material, also consulting the recommended bibliography.
Problem solving	These classes include the following aspects. a) Each student will have to perform a series of exercises to understand the topics of the subject. These exercises will be considered for the evaluation. b) Resolution of doubts on the previously explained concepts in the Lecture classes. c) The students, separately or in groups, will make illustrative schemes of the contents presented in the Lecture classes to have an overview of the subject, which will facilitate its understanding and interrelationships. d) Work in some concepts that, by experience, are more difficult to understand and require a higher didactic support. e) If necessary, these classes will also be used to present mentored team works.
Mentored work	Performance (find information, preparation, and presentation) of a work in a team. The work will be related to the fields of cellular biology, molecular biology, genetics, immunology, and biotechnology, and will be proposed by the professor. The professor could provide support and part of the necessary information for the performance of this activity. This activity will be considered for the evaluation.

Personalized assistance

Methodologies	Description
Mentored work	Activity of oral presentation of a work. Discussion and resolution of questions, exercises, and problems related to the activity. Each student may ask the instructor for any clarifications that consider necessary to better understand the activity and successfully complete the proposed tasks. These queries will be addressed in scheduled personalized sessions.
Problem solving	Discussion and solving of questions, exercises, and problems related to the subject. Each student may ask the instructor for any clarifications that consider necessary to better understand the activity and successfully complete the proposed tasks. These queries will be addressed in scheduled personalized sessions.

Assessment

	Description	Qualification	Training and Learning Results			
Problem solving	The student solves a series of problems and/or exercises on the subject (competences CB1, CG1, CG3, CE20, and CT1). Content comprehension is evaluated.	15	A2	B1	C20	D1
Mentored work	The student develops and orally presents a team work. The structure, organization, and complexity of the content presented will be evaluated, as well as the oral presentation and sources consulted (competences CB1, CG1, CG3, CE20, and CT1). For more information, see "Other comments on the Evaluation."	10	A2	B1	C20	B3
Essay questions exam	The student will perform a mid-course exam (partial exam) on the material explained in the lectures and seminars (competences CB1, CG1, CG3, CE20, and CT1). The exam will include short-answer questions, although it may also include some long-answer questions.	35	A2	B1	C20	D1
Essay questions exam	The student will perform an exam at the end of the course (final exam) on the material explained in the lectures and seminars (competences CB1, CG1, CG3, CE20, and CT1). The exam will include short-answer questions, although it may also include some long-answer questions.	40	A2	B1	C20	D1

Other comments on the Evaluation

A student who performs any of the qualifying activities will be considered as presented.

To pass the subject, the weighted average must be equal to or greater than 5.0.

In the second call, the evaluation will follow any of these two options (selecting that one that would be better for the student):

1. The scores reached by the student during the course in the supervised works and solved problems is conserved (25% of the final score). None of them are recoverable. An exam similar to that done at the end of the semester, which will include all the contents of the subject (skills CB1, CG1, CG3, CE20 and CT1), will provide the 75% of the final score.

2. An exam similar to that done at the end of the semester, which will include all the contents of the subject (skills CB1, CG1, CG3, CE20 and CT1), will provide the 100% of the final score.

Evaluation of the Mentored work

The student performs an oral presentation of a previously prepared work related to the subject (10% of the final score). The structure, organization, and complexity of the content presented will be evaluated, as well as the oral presentation and sources consulted (competences CB1, CG1, CG3, CE20, and CT1).

Global evaluation

The students who request it can be evaluated by a global evaluation, where the score will be based on an exam (covering all the contents of the subject) done at the end of the course.

Evaluation of students of the Seniors Programme

Students from the Senior Programme will be evaluated as follows:

- Mandatory attendance to the 75% of the theoretical classes and seminars.
- Preparation and oral presentation, individually or in a team, of a work related to the subject, which will be used to obtain the score (competencies CB1, CG1, CG3, CE20 and CT1).

Sources of information

Basic Bibliography

Bruce Alberts, **Introducción a la Biología Celular**, 978-607-8546-44-2, Quinta edición, Editorial Médica Panamericana, 2021

James D. Watson, **Biología Molecular del gen**, 978-607-9356-89-7, Séptima edición, Editorial Médica Panamericana, 2016

Leonardo Fainboin, Jorge Geffner, **Introducción a la Inmunología Humana**, 978-950-06-0270-9, Sexta Edición, Editorial Médica Panamericana, 2012

Mathews C. K., Van Holde K. E., Appling D. R., Anthony-Cahill S. J., **Bioquímica**, 978-84-9035-311-0, Cuarta edición, Pearson, 2013

Complementary Bibliography

Helmut Plattner, Joachim Hentschal, **Biología Celular**, 978-84-9835-521-5, Cuarta Edición, Editorial Médica Panamericana, 2014

John W. Kimball, <http://biology-pages.info/>,

Peter J. Russell, **iGenetics. A molecular approach**, 978-1-292-02633-6, Third Edition, Pearson, 2014

Recommendations

Subjects that continue the syllabus

Therapeutic Chemistry/V11G201V01413

Environmental and Bioinorganic Chemistry/V11G201V01412

Biochemistry/V11G201V01201

Immunochemistry/V11G201V01419

Subjects that are recommended to be taken simultaneously

Chemistry: Chemistry 1/V11G201V01104

Physics: Physics I/V11G201V01102

Mathematics: Mathematics 1/V11G201V01103

Other comments

It is recommended to have studied the subject "Biology" of Bachillerato (high school).

IDENTIFYING DATA				
Physics: Physics I				
Subject	Physics: Physics I			
Code	V11G201V01102			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Martínez Piñeiro, Manuel			
Lecturers	Fernández Fernández, Ángel Manuel Martínez Piñeiro, Manuel Sánchez Carnero, Noela Belén			
E-mail	mmpineiro@uvigo.es			
Web	http://fatic.uvigo.es			
General description	Physics of first course in the Chemistry Degree, with contents of kinematics, Newton laws and waves			

Training and Learning Results	
Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
B1	Ability for autonomous learning
C22	Know and apply the foundations of Physics necessary to understand the theoretical and practical aspects of Chemistry that need it
C29	Demonstrate ability for numerical calculations and interpretation of experimental data, with correct use of units and estimation of uncertainty
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject	
Expected results from this subject	Training and Learning Results
1. Describe the frame of validity of Classical mechanics.	A1 B1 C22 D3 A2 C29
2. Calculate, from the initial state of a mechanical system, the values of his distinct dynamic magnitudes (energy, linear and angular moments).	A1 B1 C22 D3 A2 C29
3. Calculate, given a group of strengths that act on a mechanical system, his temporary evolution, obtaining the corresponding paths and the temporary variation of his physical properties.	A1 B1 C22 D3 A2 C29
4. Explain the importance of the theorems of conservation and apply any of them.	A1 B1 C22 D3 A2 C29
5. Calculate the strength of push on an object in a fluid and relate the pressure, the height and the speed in a fluid in movement.	A1 B1 C22 D3 A2 C29
6. Define and calculate the parameters that characterise the harmonic and standing waves.	A1 B1 C22 D3 A2 C29
7. Determine experimentally different physical magnitudes (density of solids and liquids, superficial tension, specific heat, etc.).	A1 B1 C22 D3 A2 C29

Contents	
Topic	
Topic 1. Introduction	1. The nature of Physics 2. Consistency and unit conversion 3. Uncertainty and significant figures 4. Vectors (vector sum, vector components, unit vectors, vector product)

Topic 2. Kinematics of a point particle	1. Motion in one dimension Position, median and instant velocity Median and instant acceleration Motion with constant acceleration 2. Motion in two and three dimensions Position and velocity vectors Acceleration vector Parabolic motion Circular motion
Topic 3. Newton's laws of motion	1. Force and interactions 2. First law of Newton 3. Second law of Newton 4. Third law of Newton 5. Linear and angular momentum
Topic 4. Work and kinetic energy	1. Work done by a force. Power 2. Kinetic energy 3. Conservative and non-conservative forces 4. Potential energy 5. Potential energy in the gravitational field 6. Mechanical energy 7. Force and potential energy 8. Principle of conservation of the mechanical energy
Topic 5. Rigid body kinetics	1. System 2. Rigid body 3. Translation motion 4. Rotation motion around a fixed axis
Topic 6. Particulate system kinetics	1. Systems of particles 2. Center of mass of the system. Motion of c.m.s 3. Equations of motion of a system of particles 4. Linear momentum. Conservation of linear momentum 5. Angular momentum. Conservation of angular momentum 6. Work and power 7. Potential and kinetic energy 8. Total mechanical energy
Topic 7. Rigid body dynamics	1. Rotation of a rigid body 2. Moment of inertia 3. Calculation of moment of inertia 4. Theorem of Steiner 5. Momentum of force and of pair of forces 6. Equations of motion of the rigid body 7. Kinetic energy of the rigid body 8. Work 9. Angular momentum. Conservation
Topic 8. Periodic motion	1. Oscillations 2. Simple harmonic motion (SHM) 3. Energy of SHM 4. Applications of the SHM 5. Pendulum 6. Damped oscillations 7. Driven oscillations. Resonance
Topic 9. Mechanical waves	1. Mechanical waves 2. Periodic waves 3. Mathematical description of a wave 4. Velocity of a transverse wave 5. Energy of the wave motion 6. Interference, superposition 7. Stationary waves 8. Normal modes
Lab. Introduction to error analysis	Lab exercises for the introduction to error analysis: 1. Geometrical dimensions 2. Density of a liquid and a solid 3. Surface tension 4. Viscosity

Planning			
	Class hours	Hours outside the classroom	Total hours
Presentation	1	0	1

Lecturing	26	52	78
Seminars	23	34	57
Laboratory practical	12	0	12
Objective questions exam	1	0	1
Essay questions exam	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	
	Description
Presentation	general description of the subject, including content, methodology, development and evaluation
Lecturing	In the FAITIC platform information and materials concerning the theoretical lessons will be available for students . a) The specific objectives in each subject are detailed, indicating their motivation and possible applications. b) The methods proposed to reach the different objectives are explained. c) Suggested bibliographic references are listed and commented.
Seminars	a) Exercises and problems, available previously in FAITC platform, will be solved b) Doubts and concepts of difficult understanding will be discussed and explained in detail c) Different problems of the bulletins will be proposed for the students to be resolved individually
Laboratory practical	A script is proposed to prepare the experimental setting, intended to obtain a series of experimental measures on a physical magnitude. Then, the statistical analysis of the data is explained, to determine the uncertainty of the measures made, and the propagation of statistical errors from the experimental data until the final values of the magnitudes to be calculated

Personalized assistance	
Methodologies	Description
Seminars	Bulletins of questions and problems to be solved by the students will be proposed, and in case of necessity, students may attend to personal tutories to clarify concepts and help them with their resolutions.
Lecturing	Concepts related with the theory sessions will be asked to the students. In case of need students may attend to personal tutories to clarify concepts and help them with their resolutions.
Tests	Description
Objective questions exam	Short questions and problems to be solved by the students
Essay questions exam	

Assessment							
	Description	Qualification	Training and Learning Results				
Lecturing	Answers to concepts proposed during the session	0					
Seminars	Realisation of exercises of individual form or in group and assistance	0					
Laboratory practical	Preparation of a report containing a description of the experimental setting made, experimental data measured, derivative properties calculated, and statistical analysis of errors of each one of the magnitudes analysed	20	A2	B1	C29	D3	
Objective questions exam	1 short proof written at half term	40	A1	B1	C22	D3	
Essay questions exam	Proben and case study resolution exam at the end of the semester	40	A2	B1	C29	D3	

Other comments on the Evaluation

- If the student does not have qualification along the semester in any in the different sections he will be qualified as Non Presented, (NP).

- July. Evaluation of the second call,a) The qualification of the first partial examination will be conserved if it has been passedb) The student will have the opportunity to pass the subject by doing only this final written examination, or alternatively may apply to this call to improve the global qualification

Sources of information
Basic Bibliography
Young H.D., Freedman R.A., Física universitaria , 12, Pearson Educación, 2013
Tipler, P.A., Mosca G., Física para la ciencia y la tecnología (Vol. 2) , Reverté, 2010
Taylor, J. R., An introduction to Error Analysis , 2, University Science Books, 1997

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Physics: Physics 2/V11G201V01107

Subjects that are recommended to be taken simultaneously

Mathematics: Mathematics 1/V11G201V01103

IDENTIFYING DATA**Mathematics: Mathematics 1**

Subject	Mathematics: Mathematics 1			
Code	V11G201V01103			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	#EnglishFriendly Galician			
Department				
Coordinator	Quinteiro Sandomingo, María del Carmen			
Lecturers	Quinteiro Sandomingo, María del Carmen			
E-mail	quinteir@uvigo.gal			
Web	http://moovi.uvigo.gal/			
General description	"Machine translation into English of the original teaching guide". The course has theoretical contents, as well as practical, of linear algebra, multivariable calculus and integration. Undertaking this course will allow the students to improve his/her capacity to understand and use of mathematical language and let them to acquire certain proficiency in calculus and initiate oneself in the use of related computer applications. English Friendly course. International students may request from the teachers: a) material and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
B4	Ability for analysis and synthesis
C21	Know mathematical concepts based on previous ones and be able to use them in the different contexts of Chemistry
D1	Ability to solve problems

Expected results from this subject

Expected results from this subject	Training and Learning Results			
To calculate eigenvalues of a square matrix and classify quadratic forms attending to the sign.			C21	D1
To operate with real and complex numbers.			C21	D1
To apply the differential calculus to the local approximation of functions and to the resolution of optimization problems.	A1	B4	C21	D1
Employ integral calculus to determine areas and volumes.			C21	D1
To handle computing programs of calculus and graphic representation.			C21	D1

Contents

Topic	
Real numbers and complex numbers	The real numbers and the real line. Operations with real numbers. Complex numbers. Operations with complex numbers.
Eigenvalues and symmetric matrices	Computation of eigenvalues of a matrix. Diagonalizable matrices. Quadratic forms. Sign of a quadratic form.
Calculus of several variables	Introduction to the real functions of several variables. Differentiable functions. Higher order derivatives. The chain rule. Implicit differentiation. Computation of extreme points
Integration in one and several variables	Riemann integral. Fundamental Theorem of the Integral Calculus. Calculation of primitives. Integrals of functions of several variables on bounded domains.

Planning

	Class hours	Hours outside the classroom	Total hours

Lecturing	22	28	50
Problem solving	26	26	52
Practices through ICT	6	3	9
Problem and/or exercise solving	0	10	10
Problem and/or exercise solving	0	7	7
Essay questions exam	2	20	22

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

Methodologies	
	Description
Lecturing	The teaching staff will expose the theoretical bases of the subject. They will present possible applications, formulate problems, questions and exercises. They will propose tasks and activities oriented towards the methods and techniques to employ to carry them out.
Problem solving	Activity in which we will propose problems and/or exercises related with the subject. The student should develop the correct solutions by means of exercise of routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. It will be employed as a supplement of the lectures.
Practices through ICT	Activities oriented towards learning and handling mathematical computer programs, for calculus and graphical representation of functions and data.

Personalized assistance

Methodologies	Description
Lecturing	Each student will request the teaching staff the clarifications that he/she sees fit for a better understanding of the subject and successfully develop the proposed tasks. These queries will be responded during the tutorials. The tutorial sessions will be able to be realized remotely having made a previous agreement with the professor.
Practices through ICT	Each student will request the teaching staff the clarifications that he/she sees fit for a better understanding of the subject and successfully develop the proposed tasks. These queries will be responded during the tutorials. The tutorial sessions will be able to be realized remotely having made a previous agreement with the professor.
Problem solving	Each student will request the teaching staff the clarifications that he/she sees fit for a better understanding of the subject and successfully develop the proposed tasks. These queries will be responded during the tutorials. The tutorial sessions will be able to be realized remotely having made a previous agreement with the professor.

Assessment					
	Description	Qualification	Training and Learning Results		
Problem and/or exercise solving	Each student should resolve given tasks during the time and under the conditions established by the teaching staff. These activities will be related to the first three lessons of the program and will be done during the class hours corresponding to Lecturing or Problem solving.	35	A1		D1
Problem and/or exercise solving	Each student should resolve given tasks during the time and under the conditions established by the teaching staff. These activities will be related to the last lessons of the program and to the handling of computer programs. It will be done during the class hours corresponding to Lecturing, Problem solving or Practices through ICT .	25	A1		D1
Essay questions exam	Final exam. It will include questions and exercises that the students will answer organizing and presenting the knowledge that they have on the subject. It will take place on the official exam dates for each evaluation opportunity.	40	A1	B4 C21	D1

Other comments on the Evaluation

The final qualification of the subject (NF) will be computed by the formula:

$$NF=A+(10-A)E/10$$

where A is the sum of the scores obtained by "Problem and/or exercise solving" (up to 6 points) and E is the "Essay questions exam" score (up to 10 points).

To pass the subject the final score has to be greater or equal to 5 points ($NF \geq 5$). The students who fail to pass the subject on the first opportunity, and want to do it on the second one, will have to repeat the "Essay questions exam". The score obtained by "Problem and/or exercise solving" will be the same for the second opportunity.

The qualification NOT PRESENTED can not be given to a student who attended at least one of the final exams.

Sources of information

Basic Bibliography

Adams, R. A., **Cálculo**, 6ª, Pearson, 2009

Besada, M.; García, J.; Mirás, M.; Quinteiro, C.; Vázquez, C., **MAReMÁTICAS. Contidos matemáticos para os estudos universitarios de Ciencias**, Servicio de Publicacións. Universidade de Vigo, 2024

Larson, R.; Hostetler, R.; Edwards, B., **Cálculo esencial**, Cengage Learning, cop., 2010

Rogawski, J., **Cálculo: una variable**, 2ª, Editorial Reverté, 2016

Rogawski, J., **Cálculo: varias variables**, 2ª, Editorial Reverté, 2012

Steiner, E., **The Chemistry Maths Book**, Oxford University Press, 2008

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Mathematics: Mathematics 2/V11G201V01108

Subjects that are recommended to be taken simultaneously

Biology: Biology/V11G201V01101

Chemistry: Chemistry Lab I/V11G201V01105

Chemistry: Chemistry 1/V11G201V01104

Physics: Physics I/V11G201V01102

IDENTIFYING DATA				
Chemistry: Chemistry 1				
Subject	Chemistry: Chemistry 1			
Code	V11G201V01104			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Silva López, Carlos Talavera Nevado, María			
Lecturers	Silva López, Carlos Talavera Nevado, María			
E-mail	carlos.silva@uvigo.es matalaveran@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	t is a six-credit subject that is taught in the first semester of the first year and belongs to the basic subjects module of the Degree in Chemistry. The objective of the subject is to provide the student with the knowledge as well as the skills in chemistry necessary so that he can successfully continue learning the subjects Analytical Chemistry, Physical Chemistry, Inorganic Chemistry and Organic Chemistry, of subsequent courses.			
	English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code	
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
B1	Ability for autonomous learning
B2	Organization and planning capacity
C1	Ability to know and understand essential facts, concepts, principles and theories related to Chemistry
C2	Use correctly chemical terminology, nomenclature, conversions and units
C8	Know the characteristic properties of the elements and their compounds, including the relations between groups and their variations in the periodic table
C9	Know the structural aspects of chemical elements and their compounds, including stereochemistry
D1	Ability to solve problems

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Balance chemical equations and use stoichiometric methods.	A2	B1 B2	C2	D1
Describe the electronic structure of any atom or ion.	A2	B1 B2	C1 C8 C9	D1
To establish how the bonds between the atoms of a molecule are formed according to the different theories, as well as the origin of the intermolecular forces.	A2	B1 B2	C1 C2 C8 C9	D1
Relate the bonding theories with the characteristics and structures of the chemical compounds.	A2	B1 B2	C1 C2 C9	D1
Explain the properties of gases, liquids and solids, as well as phase changes.	A2	B1 B2	C1 C2 C9	D1
Recognize the main functional groups of organic compounds, know the nomenclature and basic organic formulation and identify the stereochemical aspects and the three-dimensional representation of organic molecules.	A2	B1 B2	C1 C2 C8 C9	D1

Contents

Topic

CHAPTER 0. INORGANIC CHEMISTRY NOMENCLATURE	Binary compounds, hydroxides, oxoacids, thioacids, peroxyacids, ions, salts, oxides, double salts, and other compounds
CHAPTER 1. CHEMICAL REACTIONS.	Chemical equations. Stoichiometric methods. Limiting reagent. Theoretical yields. Gases in chemical reactions. Properties of ideal and real gases. Kinetic-molecular theory.
CHAPTER 2. ATOMIC STRUCTURE.	Subatomic particles. The electronic structure of atoms.
CHAPTER 3. THE PERIODIC TABLE AND PERIODICITY.	Periodic properties of the elements.
CHAPTER 4. CHEMICAL BONDING I.	Basic concepts. Ionic bond and energetic aspects. Metallic bond.
CHAPTER 5. CHEMICAL BONDING II.	Covalent bond. Lewis structures. Molecular geometry and bond theories.
CHAPTER 6. INTERMOLECULAR vs INTRAMOLECULAR FORCES. STATE OF MATTER.	Factors that determine the presence and nature of intermolecular interactions. Properties of compounds according to the types of interactions present in the system.
CHAPTER 7. THE STRUCTURE AND GEOMETRY OF ORGANIC COMPOUNDS.	Functional groups: nature, representation and nomenclature.
CHAPTER 8. ISOMERISM IN ORGANIC COMPOUNDS.	Conformational isomerism, structural isomerism, and stereoisomerism.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	26	52
Problem solving	26	32	58
Essay questions exam	1	19	20
Essay questions exam	1	19	20

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

Methodologies

	Description
Lecturing	Presentation by the teacher of the contents on the subject under study, theoretical and / or guidelines for a job, exercise or project to be developed by the student.
Problem solving	Activity in which they formulate problems and/or exercises related with the contents under study. The student has to develop the correct solutions by reasoning and the logic in addition to being able to make a correct interpretation of the results. It will be used as a complement of the lecture.

Personalized assistance

Methodologies	Description
Problem solving	Each student will be able to request from the teacher the clarifications he deems appropriate for a better understanding of the subject and the successful development of the exercises and problems proposed. This consultation can also be attended during tutorials. The time and place, in which the tutorials of each teacher take place, is collected on the website of the center.
Lecturing	Each student will be able to request from the teacher the clarifications he deems appropriate for a better understanding of the subject and the successful development of the exercises and problems proposed. This consultation can also be attended during tutorials. The schedule and the place, in which the tutorials of each teacher take place, is collected on the website of the center.

Tests	Description
Essay questions exam	Each student has tutorials with teachers of the subject to solve individually the doubts that may arise throughout the course in any of its aspects: Theory classes, seminar classes or problem solving and / or autonomous activities that should perform the students. The objective of these tutorials is to help students to consolidate their knowledge and face the different evaluation activities that are proposed in better conditions (written tests, resolution of exercises).
Essay questions exam	

Assessment

Description	Qualification	Training and Learning Results
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Problem solving	For each subject, problems, exercises and/or self-assessed tests will be proposed, which the students must solve in the seminar classes or outside the classroom. The score of this section will only be considered if in the essay questions exam the grade is equal to or greater than 5 out of 10.	20	A2	B1 B2	C1 C2 C8 C9	D1
Essay questions exam	A written exam about the contents taught until chapter 4. To pass the subject, a minimum grade of 4 out of 10 has to be obtained in the final written exam.	40	A2	B1 B2	C1 C2 C8 C9	D1
Essay questions exam	A written exam about the contents taught between chapter 5 and 8. To pass the subject, a minimum grade of 4 out of 10 has to be obtained in the final written exam.	40	A2	B1 B2	C1 C2 C8 C9	D1

Other comments on the Evaluation

In any assessment modality, in case of doubt regarding the students' acquisition of learning outcomes, additional oral assessment tests may be conducted.

Continuous assessment:

In the two essay-question exams, a minimum grade of four points must be achieved. If the required minimum grade is not obtained in any of these tests, the final overall grade will be the grade obtained in that written test.

It is understood that a student has submitted to the evaluation of the subject and, therefore, a grade will be assigned, in the following cases:

1. If you take an exam with development questions.
2. If you participate in tests or continuous assessment activities beyond the deadlines established by the center for the request for global assessment modality. A minimum grade of 5 out of 10 is required to pass the subject.

Students who do not pass one or both of the written tests conducted during the semester must retake the corresponding part in the resit session (June-July). The remaining assessment components are not recoverable

Global assessment:

The students who have been granted the global evaluation by the deanship will have an exam of development questions (100%) that will be carried out on the official exam date for each evaluation opportunity. Within the official testing period marked in the academic calendar of each course. A minimum score of 5 out of 10 is required to pass the subject.

Evaluation of the students of the Integrated Cycle of the Senior Program:

- Completion of self-assessment problems, exercises or tests.
- Completion of a project on a topic related to the subject.

Sources of information

Basic Bibliography

Chang, R. y Goldsby, K.A., **Química**, 13ª, McGraw-Hill, 2021

Chang, R. y Goldsby, K.A., **Química**.

https://www.ingebook.com/ib/NPcd/IB_Escritorio_Visualizar?cod_primaria=1000193&libro=10619, 13ª, McGraw-Hill, 2021

Petrucci, R.H., et al., **Química General: principios y aplicaciones modernas**, 11ª, Pearson Educación, 2017

Petrucci, R.H., et al., **Química General: principios y aplicaciones modernas**.

https://www.ingebook.com/ib/NPcd/IB_Escritorio_Visualizar?cod_primaria=1000193&libro=6751, 11ª, Pearson Educación, 2017

Quiñóá, E. y Riguera, R., **Nomenclatura y representación de los compuestos orgánicos**, 2ª, McGraw-Hill Interamericana, 2005

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Chemistry: Chemistry 2/V11G201V01109

Subjects that are recommended to be taken simultaneously

Chemistry: Chemistry Lab I/V11G201V01105

Mathematics: Mathematics 1/V11G201V01103

IDENTIFYING DATA				
Chemistry: Chemistry Lab I				
Subject	Chemistry: Chemistry Lab I			
Code	V11G201V01105			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Galician			
Department				
Coordinator	Couce Fortúnez, María Delfina Silva López, Carlos			
Lecturers	Besada Pereira, Pedro Couce Fortúnez, María Delfina Fernández Rodríguez, Diego Martínez Estévez, Mónica Silva López, Carlos Talavera Nevado, María Teijeira Bautista, Marta Vázquez López, Ezequiel Manuel			
E-mail	delfina@uvigo.es carlos.silva@uvigo.es			
Web	http://https://moovi.uvigo.gal/course/view.php?id=9853			
General description	The aim of this subject is that the students learn to work in a chemistry laboratory. Safety regulations must be respected and the suitable material used. Students will also study the chemical behaviour of different compounds as well as the synthesis of some of them. Finally, they will learn to interpret the data obtained and to collect the experiences in the laboratory notebook.			

Training and Learning Results				
Code				
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study			
B2	Organization and planning capacity			
C25	Safely handle chemical substances, considering their physical and chemical properties, evaluating the risks associated with their use and laboratory procedures and including their environmental repercussions			
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work			
C27	Demonstrate the ability to observe, monitor and measure chemical processes, by systematically and reliably recording them and presenting reports of the work done			
C28	Interpret data derived from laboratory observations and measurements in terms of their meaning and relate them to the appropriate theory			
C29	Demonstrate ability for numerical calculations and interpretation of experimental data, with correct use of units and estimation of uncertainty			
D2	Capacity for teamwork			
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English			

Expected results from this subject				
Expected results from this subject	Training and Learning Results			
Apply the norms of safety in the laboratory.			C25	
			C26	
Use properly the basic material of laboratory, included the one of measurement, and manipulate properly the chemical products and waste.			C25	
			C26	
Employ basic laboratory technics and interpret the data obtained.	A2	B2	C25	D2
			C26	D3
			C27	
			C28	
			C29	
Elaborate the laboratory notebook.			C27	D2
			C28	D3
			C29	
Recognise the structure of the main chemical compounds and relate them with their reactivity.	A2			
Apply nomenclature norms for chemical compounds.	A2			D3

Carry out the synthesis of simple chemical compounds.

A2 B2 C25 D2
C26 D3
C27
C28
C29

Contents

Topic

P1. Laboratory safety and laboratory material recognition
P2. Preparation of solutions
P3. Reactions in organic solvents
P4. Separation by crystallization
P5. Distillation of solvents
P6. Liquid-liquid extraction
P7. Separation by liquid-liquid extraction
P8. Molecular models
P9. Separation by thin layer chromatography
P10. Formation of polymers
P11. Reactions in aqueous solutions
P12. Obtaining calcium carbonate
P13. Obtaining double salt
P14. Determination of water content in a salt
P15. Separation of the three components of a mixture
P16. Determining the stoichiometry of a chemical reaction
P17. Obtaining copper(II) oxide
P18. Obtaining a solubility curve

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	0	36	36
Laboratory practical	54	0	54
Problem solving	0	18	18
Laboratory practice	3	18	21
Laboratory practice	3	18	21

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

Methodologies

	Description
Introductory activities	Each laboratory practice will be associated with a theoretical explanation that facilitates the students' understanding and realisation of it. Students must complete an initial questionnaire related to this experiment previously to the laboratory session, which can be found on Moovi.
Laboratory practical	Experimental practice. The laboratory experiments will be carried out individually, in sessions of 3 hours. The experimental procedure will be available to students on Moovi. It will be necessary the preparation of a laboratory notebook in accordance with the norms that are collected in Moovi.
Problem solving	After completing each practical session, the student will have to solve some questions found on Moovi.

Personalized assistance

Methodologies	Description
Laboratory practical	During the practical sessions, the professor will resolve the questions regarding the experiment as well as the preparation of the laboratory notebook.
Introductory activities	The professor will resolve any doubts related to the introductory questions of each practical session prior to carrying them out. Students can consult and/or request tutorials at the following link: http://quimica.uvigo.es/en/teaching/teaching-staff/
Problem solving	The students will be able to consult the doubts related to the realisation of the final questionnaire for each practice. Students can consult and/or request tutorials at the following link: http://quimica.uvigo.es/en/teaching/teaching-staff/
Tests	Description

Laboratory practice	In the schedule of tutorials, students will be able to consult with the professor the questions related to the exam. Students can consult and/or request tutorials at the following link: http://quimica.uvigo.es/en/teaching/teaching-staff/
Laboratory practice	In the schedule of tutorials, students will be able to consult with the professor the questions related to the exam. Students can consult and/or request tutorials at the following link: http://quimica.uvigo.es/en/teaching/teaching-staff/

Assessment						
	Description	Qualification	Training and Learning Results			
Introductory activities	A questionnaire carried out in Moovi on the material provided for each practice will be evaluated before the beginning of each session	10	A2	C29	D3	
Laboratory practical	The realisation of experiments in the laboratory as well as the preparation of the laboratory notebook will be evaluated. Ignoring basic safety and hygiene rules in the laboratory, reckless or irresponsible work behavior, or failing to follow the instructions of the teaching staff may result in expulsion from the laboratory and a grade of zero points in this section.	30	A2	B2	C25 C26 C27 C28 C29	D3
Problem solving	The questions that the student will have to do in Moovi, after the completion of each practice, will be evaluated.	10	A2	C29	D3	
Laboratory practice	The student will take a practical laboratory exam in the middle of the semester	25		B2	C25 C26 C27 C28 C29	D3
Laboratory practice	The student will take a practical laboratory exam at the end of the semester	25		B2	C25 C26 C27 C28 C29	D3

Other comments on the Evaluation

A minimum grade of 3.5 out of 10 will be required in each two practical exams, as well as in each other two evaluation sections (introductory activities, laboratory practices and problem solving). If some of the parts do not exceed this minimum, the final grade will be a weighted grade (50%) of two practical laboratory exams.

Attendance at all laboratory sessions is mandatory. The absences must be justified.

Participation in continuous assessment test or activities or attendance at laboratory sessions after the deadline established by the center for the global evaluation modality request, implies on condition of being presented.

If the student waives the continuous evaluation and opts for a global evaluation, he must take a practical test in the laboratory (qualification 100%). In the global evaluation mode, attendance at all laboratory sessions is also mandatory as they are experimental practices.

In the call for June-July, a practical laboratory test will be carried out (qualification 100%).

Sources of information

Basic Bibliography

Brown, T.L.; Lemay, H.E.; Bursten, B.E.; Murphy, C.J.; Woodward, P.M.; Stoltzfus, **Chemistry: The Central Science**, 15, Pearson Education Limited, 2021

Chang, R.; Overby, J., **Química**, 13, McGrawHill, 2020

Martínez Grau, M. A. y Csáky, A. G., **Técnicas experimentales en síntesis orgánica**, Sintesis, 2001

Petrucchi, R.; Herring, F.; Madura, J.; Bissonnette, C., **General Chemistry: Principles and Modern Applications**, 12, Pearson Education Limited, 2023

Whitten, K.W., **Química**, 10, Cengage Learning, 2015

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Chemistry: Chemistry Lab II/V11G201V01110

Subjects that are recommended to be taken simultaneously

IDENTIFYING DATA				
Geology: Geology				
Subject	Geology: Geology			
Code	V11G201V01106			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Gil Lozano, Carolina			
Lecturers	Gil Lozano, Carolina			
E-mail	carolina.gil.lozano@uvigo.es			
Web	http://moovi.uvigo.gal/login/index.php			
General description	The study of the structure of matter in a crystalline state -objective of Crystallography- is of great relevance for the understanding of the most diverse phenomena in the field of Chemistry, therefore, after a general view of the Earth as a geochemical system, the Approach of the subject Geology corresponding to the first year of the degree in Chemistry is mainly oriented towards the study of crystalline structures and crystallization mechanisms. These topics are approached from the point of view of Crystallography, Mineralogy and Geochemistry. Starting from the thermodynamic and kinetic mechanisms that lead to the formation of crystalline phases, structural aspects, crystallographic notation and diffraction are studied. As a corollary, the importance of these processes is introduced for the study of natural (mineral) crystals and synthetic materials, such as semiconductors, pharmaceuticals, biological macromolecules, and ceramic materials, among others. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
B1	Ability for autonomous learning
B3	Ability to manage information
B4	Ability for analysis and synthesis
C4	Use computer tools properly to obtain information, process data, perform computational calculations and calculate matter properties
C9	Know the structural aspects of chemical elements and their compounds, including stereochemistry
C10	Know the characteristics of the different states of matter and the theories used to describe them
C15	Know the main techniques of structural research, including spectroscopy
C16	Know the relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids, crystals and other materials
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject				
Expected results from this subject	Training and Learning Results			
Describe and explain the Earth as a system.	A2 A3	B4	C10 C16	D3
Differentiate the processes that generate minerals and rocks in nature.	A3	B3	C9 C10 C15 C16	
Distinguish the stages of nucleation and crystalline growth in the crystallization process.			C9 C10 C16	
Use concepts as periodicity, symmetry and morphology to describe crystals.	A2		C9 C10 C15 C16	

Use of the crystallographic notation and its application to the structural characterisation of crystalline solids.	A3	B3 B4	C9 C15	D3
Describe and apply the basic principles of diffraction for structural analysis.			C4 C9 C10 C16	
Use isotopic analysis techniques for measuring the geological time and following geochemical processes.	A2	B1 B3 B4	C4 C15	

Contents

Topic	
The Earth as a Geochemical System: Rocks forming minerals	Geochemical evolution of the Earth. Plate Tectonic. The rocks cycle. Comparison of Earth with other planets in the solar system: The case of Mars.
The crystallization process: thermodynamic and kinetic aspects.	Differences between nucleation and crystal growth. Crystal growth kinetics. Structural aspects.
Characterization of crystalline solids: structure vs. morphology.	Microscopic and macroscopic approaches to crystalline solids
Isotopes in Geology: Measuring the geological time with radioactive isotopes. Analyzing kinetic processes by fractionation of stable isotopes.	Radioactive isotopes and stable isotopes. Isotopic dating techniques. The Isochrone method. Kinetic tracking of processes using stable isotopic techniques. Notation and units. Rayleigh fractionation.
Geometric crystallography: Periodicity and symmetry in the crystals.	Two-dimensional lattices. Point symmetry. Schoenflies and Hermann-Mauguin notations of point symmetry elements and classes. Bravais lattices. Microscopic symmetry Space groups. Miller indices and zone axes. Fractional coordinates
X-ray crystallography: Bragg's Law and the Phase problem	The physical basis of diffraction. Diffraction by crystals lattices and radiation sources. The Bragg Law The reciprocal lattice. Diffraction Patterns. Indexing of diffraction diagrams. powder diagrams and monocrystal diagrams Quantitative Analysis. The Phase problem. Methods of resolution of structures from diffraction datasets.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	70	96
Mentored work	1	5	6
Laboratory practical	6	0	6
Problem solving	6	34	40
Objective questions exam	1	0	1
Problem and/or exercise solving	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

	Description
Lecturing	First, we provide a description of the geological cycle and the main types of rock, analysing the basic principles of crystallisation from geological and thermodynamic points of view. Next, the fundamentals of isotope geochemistry are introduced to the student. Themes devoted to the structural characterisation of crystals then analyse the concepts of periodicity and symmetry in 2D and 3D crystalline lattices. Finally, we introduce the principles and practical aspects of diffraction techniques applied to structural analysis.
Mentored work	A short paper will be written by groups summarizing the laboratory work. Some guidelines concerning formats and content will be given before the realization. A seminar will be assigned to guide each working group in this task.
Laboratory practical	They will be dedicated to the study of the crystallization process, analyzing three aspects: (1) Crystallization in nature: mineral recognition (2) Optical microscopy with polarized light. (3) Crystal growth from solutions and silica gels in the laboratory.
Problem solving	Seminars will be used to solve practical exercises about nucleation and crystal process and to solve issues related to crystallographic notation and concepts

Personalized assistance

Methodologies Description

Problem solving	The resolution of exercises will be carried out during the seminars by answering to the questions raised in class.
Mentored work	They will be developed in the computer classroom and in theoretical class as well as through the realization of tutorials or consultations using the Tema platform or the electronic mail.

Assessment

	Description	Qualification	Training and Learning Results
Mentored work	The completion of a report/work whose content will be related to the activity carried out in the laboratory and seminars will be evaluated.	10	
Laboratory practical	The activity carried out in the mineralogy laboratory and in the completion of exercises and questionnaires proposed through the Moovi platform will be evaluated.	30	
Problem solving	The seminars will also include exercises and/or problems.	20	
Objective questions exam	Exam with short questions and multiple choice questions, exercises, as well as a topic about the content of the theoretical classes and/or seminars.	40	

Other comments on the Evaluation

For the global assessment, the exam will differ from that used in continuous assessment and will include questionnaires and practical exercises taken by students in the continuous assessment modality.

Sources of information

Basic Bibliography

Andrew Putnis, **Introduction to Mineral Sciences**, 6ª, Cambridge University Press, 2008

Edward Tarbuck y Frederick Lutgens, **Ciencias de la Tierra. Una introducción a la Geología Física**, 10ª, Pearson, 2013

Complementary Bibliography

Christofer Hammond, **The Basic of Crystallography and Diffraction**, 3ª, Oxford University Press, 2009

Jose Luis Amorós, **La gran aventura del cristal**, 1ª, Ediciones Complutense, 2017

Carmelo Giacovazzo et al., **Fundamentals of Crystallography**, 2ª, Oxford University Press,

Recommendations

Subjects that continue the syllabus

Chemistry: Chemistry 2/V11G201V01109

Subjects that are recommended to be taken simultaneously

Chemistry: Chemistry Lab II/V11G201V01110

Chemistry: Chemistry 2/V11G201V01109

Mathematics: Mathematics 2/V11G201V01108

Physics: Physics 2/V11G201V01107

Subjects that it is recommended to have taken before

Biology: Biology/V11G201V01101

Chemistry: Chemistry Lab I/V11G201V01105

Physics: Physics I/V11G201V01102

Mathematics: Mathematics 1/V11G201V01103

IDENTIFYING DATA				
Physics: Physics 2				
Subject	Physics: Physics 2			
Code	V11G201V01107			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Pérez Iglesias, María Teresa			
Lecturers	Fernández Fernández, Ángel Manuel Pérez Iglesias, María Teresa Rodríguez García, Brais			
E-mail	tpigles@uvigo.es			
Web	http://http://fatic.uvigo.es/			
General description	Broadly Physics is the general scientific analysis of nature, with the goal of understanding how the universe behaves. It is fundamentally an experimental science. The theories that are developed are tested with observations. From such a wide definition, different perspectives or application levels can be adopted, from microscopic phenomena to macroscopic ones. Physics is thus the basis of innumerable scientific and technological applications. In particular for the student of Chemistry, it is a fundamental tool to understand theories and methods belonging to that of domain of science. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
B1	Ability for autonomous learning
C22	Know and apply the foundations of Physics necessary to understand the theoretical and practical aspects of Chemistry that need it
C29	Demonstrate ability for numerical calculations and interpretation of experimental data, with correct use of units and estimation of uncertainty
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Analyze scalar and vector fields using the concepts of scalar potential, flux, circulation, divergence and curl, interpreting their physical meaning.	A1	B1	C22	
Determine the electric field produced by discrete and continuous charge distributions, using Coulomb's Law and applying Gauss's Law when the symmetry of the distribution allows it.	A2	B1	C22	D3
Determine the electrostatic potential associated with charge distributions and relate it to the electric field and electrostatic potential energy.	A2	B1	C22	
Describe the effect of an electrostatic field on dielectrics and conductors.	A1 A2	B1	C22	D3
Describe the physical effects of electrical currents and solve simple direct current (DC) electric circuits applying Ohm's, Joule's, and Kirchhoff's laws.	A2	B1	C22	D3
Determine magnetic fields produced by electric currents and calculate the characteristics and type of trajectory of charged particles in electric and/or magnetic fields.	A1 A2	B1	C22	D3
Apply Faraday's and Lenz's laws to describe electromagnetic induction, including self-induction and mutual induction.	A2	B1	C22	D3
Interpret Maxwell's equations as a unified description of electromagnetic phenomena.	A1 A2	B1	C22	D3
Characterize electromagnetic waves and relate the electromagnetic spectrum to scientific applications.	A2	B1	C22	D3
Use standard electromagnetism laboratory instrumentation to obtain, analyze, and interpret experimental results and compare them with theoretical models.	A2	B1	C22 C29	D3

Contents	
Topic	
1.-BASIC THEORY OF FIELDS.	- Vector functions - Scalar and vector fields - Line integral - Conservative fields. Potential - Central fields - Flux, divergence and curl of a vector field
2. ELECTROSTATICS	- Electric charge. - Coulomb's Law - Superposition principle. Electric Potential - Electric field - Potential and field created by an electric dipole. - Effect of electric field on a dipole - Gauss' law
3. ELECTRIC FIELDS IN CONDUCTORS AND DIELECTRICS.	- Effect of electric field on a conductor - Charge distributions on electrostatic conductors - Capacitors and capacitance - Effect of a dielectric between the plates of a capacitor - Effect of electric field on a dielectric
4. DIRECT CURRENT	- Direct Current. Current Density - Ohm's Law. Conductivity - Joule's Law - Electromotive force - Kirchhoff's Laws
5. MAGNETIC FIELD	- Phenomenology. Causes of magnetism - Biot and Savart's Law. Examples - Ampère's theorem - Charged particles in a static magnetic field - Introduction to magnetism in matter
6. ELECTROMAGNETIC INDUCTION	- Magnetic Flux. Ampère's Law - Phenomenology - Faraday's law. Lenz's law - Mutual inductance and self-inductance
7. ELECTROMAGNETIC WAVES	- Maxwell's Equations. Ampère-Maxwell's law - Plane Electromagnetic Waves - Energy of the electromagnetic waves - Electromagnetic spectrum

Planning			
	Class hours	Hours outside the classroom	Total hours
Seminars	26	33.2	59.2
Laboratory practical	12	13.2	25.2
Lecturing	26	28.6	54.6
Essay questions exam	1	2	3
Objective questions exam	0	4	4
Problem and/or exercise solving	1	3	4

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

Methodologies	
	Description
Seminars	a) The exercises and problems will be solved, by the students or by the teacher. a) Problem sheets will be available with sufficient anticipation, either at the course web page or in printed form. b) The different tasks that the students have to carry out will be programmed. c) The different tasks that students have to carry out, as presentations based on discussions or the first test, will be assessed.
Laboratory practical	a) Laboratory activities will be carried out in groups. b) In order that the students have a clear idea of the objectives to reach and the available material, information about laboratory work will be provided with enough time in advance. c) In the laboratory, students will be assisted by a teacher.

Lecturing	a) In each topic the specific objectives will be analyzed. Its need and the possible applications will be indicated. b) The way to reach objectives will be indicated. Emphasis will be made on those aspects that are more problematic and difficult. Different examples will be solved. c) Bibliographic references will be proposed d) Diverse tasks that students have to carry out will be programmed.
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Personalized assistance

Methodologies	Description
Seminars	Doubts will be discussed and clarified individually or during the debates that may arise.
Laboratory practical	The questions that can arise during the conduct of the practices will be clarified .

Assessment

	Description	Qualification	Training and Learning Results			
Laboratory practical	Practices of laboratory: a) They are compulsory for all the students. b) They are compulsory to pass the subject. c) The minimum mark to pass will be of 5 out of 10. d) The student's laboratory work will be monitored and given a mark. e) The report of the practices, elaborated by the student, will be assessed.	20	A2	B1	C22	D3
Essay questions exam	Continuous evaluation. Three written tests.They will be 35% of the final mark: a) The minimum qualification to pass each one of these tests will be of 5 out of 10. b) The third test will be done with the first term final exam. c) The marks of the two first tests will be kept until the first term final exam. d) At the first term's final exam each student will have the opportunity to repeat the test he/ she has failed. e) Students who have not passed the three written tests but whose grade is 5, or higher, will appear with a grade of 4 in the records. The students who do not wish to follow the continuous evaluation will have one written test, which will contribute 40% of the final mark: a) The exam will have three parts. b) It is necessary to pass each one of these parts to pass the subject. The minimum qualification to pass each part will be of 5 out of 10.	35/40	A1 A2	B1	C22	D3
Objective questions exam	Intended for students who wish to follow the continuous evaluation: sort written tests related with the contents of the subject will be carried out during seminar time.	10	A1 A2		C22	D3
Problem and/or exercise solving	Continuous evaluation. Three written tests.They will be 35% of the final mark: a) The minimum qualification to pass each one of these tests will be of 5 out of 10. b) The third test will be done with the first term final exam. c) The marks of the two first tests will be kept until the first term final exam. d) At the first term's final exam each student will have the opportunity to repeat the tests he/ she has failed . e) Students who have not passed the three written tests but whose grade is 5, or higher, will appear with a grade of 4 in the records. The students who do not wish to follow the continuous evaluation will have one written test, which will contribute 40% of the final mark: a) The exam will have three parts. b) It is necessary to pass each one of these parts to pass the subject. The minimum qualification to pass each part will be of 5 out of 10.	35/40	A1 A2	B1	C22	D3

Other comments on the Evaluation

Sources of information

Basic Bibliography

José M^a de Juana, **Física General** , vol. 2, 2^a edición, Pearson,

Serway & Jewett, **Física para ciencias e ingeniería**, vol. 2,, 9^a edición, Cengage Learning,

Gettys E.; Keller F.; Skove M., **Física para Ingeniería y Ciencias**, 2ª edición, McGraw-Hill Interamericana,

Tipler P.A.; Mosca G., **Física para la Ciencia y la Tecnología , vol. 2**, 6ª edición, Reverté,

Young & Freedman, **Física Universitaria vol. 2**, 12ª edición, Pearson Educación,

Complementary Bibliography

Recommendations

Subjects that are recommended to be taken simultaneously

Chemistry: Chemistry 2/V11G201V01109

Mathematics: Mathematics 2/V11G201V01108

Subjects that it is recommended to have taken before

Chemistry: Chemistry 1/V11G201V01104

Physics: Physics I/V11G201V01102

Mathematics: Mathematics 1/V11G201V01103

IDENTIFYING DATA				
Mathematics: Mathematics 2				
Subject	Mathematics: Mathematics 2			
Code	V11G201V01108			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Mirás Calvo, Miguel Ángel			
Lecturers	Mirás Calvo, Miguel Ángel			
E-mail	mmiras@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The subject is a basic introduction to vector calculus, differential equations and statistics. It will be oriented to apply the mathematical models studied to specific problems of the scientific fields.			

Training and Learning Results				
Code				
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study			
B4	Ability for analysis and synthesis			
C21	Know mathematical concepts based on previous ones and be able to use them in the different contexts of Chemistry			
D1	Ability to solve problems			

Expected results from this subject				
Expected results from this subject			Training and Learning Results	
To use vector calculus to compute lengths of curves, areas of surfaces and the curl of a vector field.	A1	B4	C21	D1
To build and solve differential equation models of simple systems from physics or chemistry.	A1	B4	C21	D1
To compute probabilities associated to discreet and continuous random variables that follow well known probability distributions.	A1	B4	C21	D1
To use computer programs for mathematical computations and graphic representation.		B4		D1

Contents	
Topic	
Line and surface integrals	Curves and parametrizations Line integrals Parametric surfaces Surface integrals and flux integrals
Ordinary differential equations	Mathematical models and methods for solving first-order differential equations Linear models of higher order
Basic probability theory	Probability spaces Random variables

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	22	33	55
Practices through ICT	0	6	6
Problem solving	16	26	42
Problem solving	16	26	42
Essay questions exam	2	3	5

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

Methodologies
Description

Lecturing	The teachers will present the theoretical foundations of the different topics; showing possible applications; formulating problems, questions and exercises; and proposing tasks and activities with orientations on the methods and techniques to employ to carry them out.
Practices through ICT	Activities oriented to learn how to handle computer programs for the calculation and graphic representation of functions and data.
Problem solving	The students will have to solve the proposed problems and exercises on vector calculus.
Problem solving	The students will have to solve the proposed problems and exercises on differential equations and probability.

Personalized assistance

Methodologies	Description
Lecturing	The doubts concerning the theoretical concepts presented in the classes will be attended in tutoring hours.
Problem solving	The doubts relative to vector calculus will be attended during the classes and in the scheduled tutoring hours.
Practices through ICT	The doubts relative to the laboratory classes will be attended in the scheduled tutoring hours.
Problem solving	The doubts relative to differential equations and probability will be attended during the classes and in the scheduled tutoring hours.
Tests	Description
Essay questions exam	The doubts relative to the final examinations will be attended in the scheduled tutoring hours.

Assessment

	Description	Qualification	Training and Learning Results
Problem solving	Tasks (that conform the so called continuous evaluation) in which each student will have to solve applied problems or exercises of vector calculus.	30	A1 D1
Problem solving	Tasks (that conform the so called continuous evaluation) in which each student will have to solve applied problems or exercises of ordinary differential equations and probability.	30	A1 D1
Essay questions exam	Final examination. Individual exam that will take place right after the class period and that will include theoretical questions and exercises.	40	C21

Other comments on the Evaluation

The final qualification of the subject (NF) will be compute by the formula:

$$NF=A+(10-A)E/10$$

where A is the continuous evaluation score and E is the final examination score.

To pass the matter the final score has to be bigger or equal than 5 points ($NF \geq 5$). The students who fail to pass the matter at the first opportunity and want to do it in July, will have to repeat the final examination. The continuous evaluation score will be the same for the July evaluation.

The qualification NOT PRESENTED could not be assigned to a student who attended at least one of the final exams.

Sources of information

Basic Bibliography

Besada, M.; García, J.; Mirás, M.; Quinteiro, C.; Vázquez, C., **MARemÁTICAS. Contidos matemáticos para os estudos universitarios de Ciencias**, 1, Servicio de Publicacións Universidade de Vigo, 2024

Mirás Calvo, Miguel Ángel; Sánchez Rodríguez, María Estela, **Técnicas estadísticas con hoja de cálculo y R: azar y variabilidad en las ciencias naturales**, 1, Servicio de Publicacións Universidade de Vigo, 2018

Adams, Robert A., **Cálculo**, 6, Addison Wesley, 2009

Simmons, George F., **Ecuaciones diferenciales: con aplicaciones y notas históricas**, 2, McGraw-Hill, 2002

Complementary Bibliography

Recommendations

Subjects that are recommended to be taken simultaneously

Chemistry: Chemistry Lab II/V11G201V01110

Chemistry: Chemistry 2/V11G201V01109

Geology: Geology/V11G201V01106

Physics: Physics 2/V11G201V01107

Subjects that it is recommended to have taken before

Biology: Biology/V11G201V01101

Chemistry: Chemistry Lab I/V11G201V01105

Chemistry: Chemistry 1/V11G201V01104

Physics: Physics I/V11G201V01102

Mathematics: Mathematics 1/V11G201V01103

IDENTIFYING DATA				
Chemistry: Chemistry 2				
Subject	Chemistry: Chemistry 2			
Code	V11G201V01109			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Galician			
Department				
Coordinator	Pérez Juste, Ignacio Peña Gallego, María de los Ángeles			
Lecturers	Peña Gallego, María de los Ángeles Pérez Juste, Ignacio			
E-mail	mpena@uvigo.es uviqpij@uvigo.es			
Web	http://quimica.uvigo.es			
General description	Química II, taught in the second semester of the first course, belongs to the module of basic matters and pretends to provide to the students the basic concepts of chemical thermodynamics, chemical equilibrium and chemical kinetics necessary so that they can continue successfully the learning of Analytical Chemical, Physical Chemistry, Inorganic Chemistry and Organic Chemistry of upper courses.			

Training and Learning Results	
Code	
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
B1	Ability for autonomous learning
B2	Organization and planning capacity
C1	Ability to know and understand essential facts, concepts, principles and theories related to Chemistry
C2	Use correctly chemical terminology, nomenclature, conversions and units
C11	Know the principles of Thermodynamics and its applications in Chemistry
C12	Know the kinetics of chemical change, including catalysis and reaction mechanisms
D1	Ability to solve problems

Expected results from this subject				
Expected results from this subject	Training and Learning Results			
Determine the variations of thermodynamic magnitudes in chemical reactions	A2	B1 B2	C1 C2 C11	D1
Identify the properties of electrolyte and non-electrolyte solutions	A2	B1 B2	C1 C2	D1
Interpret and recognise the concepts of chemical equilibrium and, in particular, those corresponding to chemical equilibrium in aqueous solution	A2	B1 B2	C1 C2 C11	D1
Calculate the kinetical parameters of simple reactions	A2	B1 B2	C1 C2 C12	D1

Contents	
Topic	
1. SOLUTIONS	General characteristics. Expression of the concentration. Microscopic interpretation of the solution process. Solubility. Colligative properties.
2. THERMODYNAMICS	Heat, work, and internal energy. First law of thermodynamics. Calorimetry. Thermochemistry. Entropy. Second law of thermodynamics. Spontaneity of chemical processes: Gibbs energy.
3. CHEMICAL EQUILIBRIUM	Chemical equilibrium. Equilibrium constant. Factors that affect to the chemical equilibrium. Dependence of the equilibrium constant on temperature.
4. ACIDS AND BASES	Definitions of acids and bases. Acid-base equilibria. pH concept. Hydrolysis reactions. Buffer solutions. Acid-base indicators. Acid-base titrations.

5. SOLUBILITY	Solubility of ionic solids. Solubility equilibrium and solubility product. Common ion effect. Effect of pH. Complex formation.
6. ELECTROCHEMISTRY	Oxidation-reduction reactions. Thermodynamic aspects of redox reactions: The Nernst equation. Electrode potential. Galvanic cells. Electrolytic cells. Electrolytic cells: Faraday's law. Electrodeposition.
7. CHEMICAL KINETICS	Reaction rate. Rate law. Analysis of kinetic data. The effect of temperature on the reaction rate. Reaction mechanisms. Catalysis. Nuclear chemistry.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	0	26
Seminars	26	0	26
Essay questions exam	2	66	68
Essay questions exam	0	0	0
Problem and/or exercise solving	0	20	20
Self-assessment	0	10	10

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

Methodologies

	Description
Lecturing	Presentation of fundamental contents of each subject, employing the available material in the platform MOOVI. Formulation of numerical problems that help to comprise and settle concepts. This methodology also includes the Introductory Activities directed to take contact and gather information on the students, as well as to present the matter. During these classes Artificial Intelligence (AI) tools can be used to exemplify the correct and ethical use in the fields related with the subject.
Seminars	Seminars are dedicated to the resolution of numerical problems and, if necessary, to deepen on those contents that present greater difficulties. This activity is complementary of the theoretical lessons and allows to deepen or complement the contents of the matter. During these classes Artificial Intelligence (AI) tools can be used to exemplify the correct and ethical use in the fields related with the subject.

Personalized assistance

Methodologies	Description
Lecturing	In the office hours with the teaching staff, any student doubts that may arise throughout the course in the theoretical classes will be resolved in an individualized and more personal way. The aim of these office hours is to help students to reinforce their knowledge so that they can face in better conditions to the different evaluation activities.

Assessment

	Description	Qualification	Training and Learning Results
Essay questions exam	At the middle of the semester a first written proof will be proposed about the matter given until then in the theoretical sessions and the seminars. The qualification of this proof will suppose the first-half of the corresponding qualification to the written proofs. This proof will eliminate matter if it reaches a minimum qualification of 5 points on 10.	Mínimum 35	A2 B1 C2 D1 B2 C11
Essay questions exam	At the end of the semester, a second written proof will be proposed in the following conditions: - If the first written proof was passed, the second proof will include the matter given since then in the theoretical sessions and seminars. - The qualification of this proof will suppose the second half of the corresponding qualification to the written proofs. - If the first written proof was not passed, the second proof will include all the contents of the matter. The qualification of this proof will suppose the whole of the corresponding qualification to the proofs written. To pass the subject a minimum qualification of 5 points on 10 must be achieved in this written proof.	Mínimum 35	A2 B1 C2 D1 B2 C11 C12

Problem and/or exercise solving	For each subject, problems will be proposed to the students to be solved individually in class or at home. The punctuation in this section will be only considered if half of these activities is completed and if in the written proofs an equal or upper qualification to 4 points on 10 is achieved.	Maximum 15	B1 C2 D1 C11 C12
Self-assessment	For each subject, self available tests will be proposed through the MOOVI platform to be solved individually. The punctuation in this section will be only considered if half of these activities is completed and if in the written proofs an equal or upper qualification to 4 points on 10 is achieved.	Máximo 15	B1 C1 C2 C11 C12

Other comments on the Evaluation

- Dates for the written proofs are included in the calendar of academic activities of the Faculty of Chemistry.
- Attendance to one of the written proof is the minimum condition to be assessed in the matter.
- In the successive editions of the matter, previous qualifications will be maintained, except in case of teacher change (who will responsible for establishing new norms).

* Use of Artificial Intelligence (AI):

Química II allows with restrictions the use of tools of artificial intelligence (like Copilot, ChatGPT, Claude, Gemini, etc.) under the following conditions:

Uses allowed:

- * Searching information on theoretical concepts, practical examples or bibliographic data related with the contents of the matter.
- * Practicing to solve quantitative problems on contents of the matter.
- * Elaborate or correct texts required on contents of the matter.

Uses forbidden:

- * Searching for concrete answers to test questions proposed.
- * Generate answers or complete solutions to the problems proposed.
- * Write complete texts without supervision on contents of the matter.

Requirements of transparency:

- * In any case, students must declare and quote clearly the use of AI in their works, indicating the prompts and processes used to obtain the information.

According to all the previous, the teachers of the matter can require an oral complementary evaluation on any delivery or proof made, with the aim to confirm the correct competence acquisition associated to each evaluation and to verify that the use of AI was adjusted to the conditions established for the corresponding activity.

Sources of information

Basic Bibliography

PETRUCCI, R. H., **Química general: principios y aplicaciones modernas**, 11, Pearson Educación, 2017

CHANG, R., **Química**, 13, McGraw-Hill, 2020

WHITTEN, K. W.; DAVIS, R. E.; PECK, M.; STANLEY G. G., **Química**, 10, Cengage Learning, 2015

LÓPEZ CANCIO, J. A., **Problemas de Química: Cuestiones y Ejercicios**, 1, Prentice Hall, 2000

Complementary Bibliography

BROWN, T. L.; LEMAY, E., **Química: la ciencia central**, 12, Pearson Educación, 2014

ATKINS, P. W., **Principios de Química. Los Caminos del Descubrimiento**, 8, Médica Panamericana, 2026

Recommendations

Subjects that are recommended to be taken simultaneously

Chemistry: Chemistry Lab II/V11G201V01110

Geology: Geology/V11G201V01106

Mathematics: Mathematics 2/V11G201V01108

Physics: Physics 2/V11G201V01107

Subjects that it is recommended to have taken before

Chemistry: Chemistry Lab I/V11G201V01105

Chemistry: Chemistry 1/V11G201V01104

IDENTIFYING DATA**Chemistry: Chemistry Lab II**

Subject	Chemistry: Chemistry Lab II			
Code	V11G201V01110			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Losada Barreiro, Sonia Pena Pereira, Francisco Javier			
Lecturers	Calle González, Inmaculada de la Estévez Guiance, Laura Losada Barreiro, Sonia Martínez Senra, Tamara Pena Pereira, Francisco Javier Pérez Cid, Benita Rodríguez da Silva, Sara Villarino García, Nerea			
E-mail	sonia@uvigo.es fjpena@uvigo.es			
Web	http://http://quimica.uvigo.es			
General description	In this subject it is intended that students start in the chemical laboratory and learn criteria and essential manipulations to work properly, safely and respectfully with the environment. The student will become familiar with the glassware, the instrumentation and the basic operations, achieving a learning that will allow him/her to approach other more specialized laboratories. Emphasis will also be placed on the observation and preparation of a laboratory notebook.			

Training and Learning Results

Code				
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study			
B2	Organization and planning capacity			
C25	Safely handle chemical substances, considering their physical and chemical properties, evaluating the risks associated with their use and laboratory procedures and including their environmental repercussions			
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work			
C27	Demonstrate the ability to observe, monitor and measure chemical processes, by systematically and reliably recording them and presenting reports of the work done			
C28	Interpret data derived from laboratory observations and measurements in terms of their meaning and relate them to the appropriate theory			
C29	Demonstrate ability for numerical calculations and interpretation of experimental data, with correct use of units and estimation of uncertainty			
D2	Capacity for teamwork			
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English			

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Use basic laboratory techniques and interpret the obtained data	A2	B2	C25 C26 C27 C28 C29	D2
Elaborate a notebook and/or an internship report	A2	B2	C27 C28 C29	D3
Measure chemical properties	A2	B2	C26 C27 C28 C29	D2

Contents

Topic	
Separation and identification of metals in aqueous solution	- Metals that precipitate as chlorides [Ag(I), Hg(I) and Pb(II)] (1 session) - Metals that precipitate as sulfates [Ca(II), Pb(II) and Ba(II)] (1 session) - Metals that precipitate as hydroxides [Fe(III), Cr(III) and Bi(III)] (1 session) - Metals that form amino complexes [Cu(II), Ni(II), Co(II) and Hg(II)] and alkaline earth metals [(Mg(II))] (1 session) - Identification of the metals present in a sample of unknown composition (1 session)
Titration	- Acid-base titrations: standardization of a solution of sodium hydroxide with potassium hydrogen phthalate and determination of total acidity in juices (2 sessions) - Redox titrations: standardization of a solution of potassium permanganate with sodium oxalate and determination of iron sulphate in tablets (2 sessions)
Determination of chemical properties	- Equation of state of ideal gases (1 session) - Colligative properties: Ebullioscopy (1-2 sessions) - Determination of the electromotive force in galvanic cells (1-2 sessions) - Electrolytic cells: Faraday laws (1-2 sessions)
Calorimetry	- Determination of heat of solution (1 session) - Determination of heat of neutralization (2 sessions)
Chemical equilibrium	- Study of a dissociation equilibrium (2-3 sessions)
Chemical kinetics	- Kinetic study of a chemical reaction (2 sessions)

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	4	0	4
Laboratory practical	25	25	50
Laboratory practical	25	25	50
Laboratory practice	3	25	28
Essay questions exam	3	15	18

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

Methodologies

	Description
Introductory activities	At the beginning of each laboratory session, the teacher will present the contents to be developed by the students.
Laboratory practical	- Laboratory experiments corresponding to separation and identification of metals in aqueous solution and titrations will be carried out in 9 sessions of 3 hours. - Prior to the beginning of each practice, the student will find support material on MOOVI for the preparation of the experiments to be carried out. The student will be provided with questionnaires to be fill in before the start of the first practice session, where key content is collected for carrying out the practices. - During the development of the practices, the student will elaborate a laboratory notebook in which he / she must write down all the observations related to the experiment carried out.

Laboratory practical	- Laboratory experiments corresponding to the determination of chemical properties, calorimetry, chemical equilibrium and chemical kinetics will be carried out in 9 sessions of 3 hours. - Prior to the beginning of each practice, the student will find support material on MOOVI for the preparation of the experiments to be carried out. The student will be provided with questionnaires to be fill in before the start of the first practice session, where key content is collected for carrying out the practices. - During the development of the practices, the student will elaborate a laboratory notebook in which he / she must write down all the observations related to the experiment carried out.
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Personalized assistance

Methodologies	Description
Laboratory practical	Each student will be able to request from the teacher the clarifications that it deems appropriate for a better understanding of the subject and the successful development of the proposed tasks. These consultations will be attended during tutorials.
Tests	Description
Laboratory practice	Each student will be able to request from the teacher the clarifications that it deems appropriate for a better understanding of the subject and the successful development of the proposed tasks. These consultations will be attended during tutorials.
Essay questions exam	Each student will be able to request from the teacher the clarifications that it deems appropriate for a better understanding of the subject and the successful development of the proposed tasks. These consultations will be attended during tutorials.

Assessment

	Description	Qualification	Training and Learning Results			
Laboratory practical	- The teacher will monitor the experimental work done by the student in the laboratory sessions corresponding to separation and identification of metals in aqueous solution and titrations through observation, questionnaires and / or the laboratory notebook. - Since it is a experimental subject, the ATTENDANCE to the laboratory sessions is COMPULSORY.	30	A2	B2	C25 C26 C27 C28 C29	D2 D3
Laboratory practical	- The teacher will monitor the experimental work done by the student in the laboratory sessions corresponding to the determination of chemical properties, calorimetry, chemical equilibrium and chemical kinetics through observation, questionnaires, tasks and / or the laboratory notebook. - Since it is a experimental subject, the ATTENDANCE to the laboratory sessions is COMPULSORY.	20	A2	B2	C25 C26 C27 C28 C29	D2 D3
Laboratory practice	Two practical laboratory tests will be carried out to assess the competences and skills acquired by the student.	30	A2	B2	C25 C26 C27 C28 C29	D3
Essay questions exam	Once all the practical sessions are finished, two short written tests will be carried out regarding the concrete aspects of the operations carried out in the laboratory.	20	A2	B2	C28 C29	D3

Other comments on the Evaluation

- The absences in laboratory sessions must be duly justified by an official document. These absences will penalize the grade.
- One unexcused absence implies the direct failure of the subject.
- More than 3 excused absences will mean failing the subject.

First ordinary examination call

- Attendance at more than two laboratory sessions implies that the student is already being evaluated, so that his/her qualification in the record can not be "not presented".
- It is necessary to obtain a grade higher than 4 (out of 10) in each of the sections of the evaluation to make an average. This criterion will also be applied in second call.

- The final grade will be the sum of the grades of all the sections provided that the required minimums are exceeded.
- It will be necessary to obtain a mark of more than 3 out of 10 in each of the practical laboratory tests and reach the minimum mark required in the "Laboratory practice" section (mark of more than 4 out of 10) to be able to average the rest of the evaluation elements.
- It will be necessary to obtain a mark of more than 3 out of 10 in each of the short written tests and reach the minimum mark required in the "Essay questions exam" section (mark of more than 4 out of 10) to be able to average the rest of the evaluation elements.
- In the case of not passing the subject, the grade of the record will be the weighted grade of the practical laboratory test and essay question exam.

Second ordinary examination call

In second call, the evaluation will be carried out in the following way: the score obtained by the student during the course will be kept in the section "laboratory practices" (not recoverable). The rest of the sections (laboratory practice, exam) can be recovered. In the event of having passed any of the practical and/or short written tests (marks of 5 out of 10 or more), the marks obtained by the student will be retained so that he/she will only have to repeat those tests that have not been passed in the first ordinary exam call. The final grade will be the sum of the grades of all the sections as long as the required minimums are exceeded. If the subject is not passed, the grade of the record will be the weighted grade of the practical laboratory test and essay question exam.

Sources of information

Basic Bibliography

J. Guiteras, R. Rubio, G. Fonrodona, **Curso Experimental en Química Analítica**, 1, Síntesis, 2003
 F. Burriel, F. Lucena, S. Arribas, J. Hernández, **Química Analítica Cualitativa**, 18, Thomson Paraninfo, S.A., 2006
 S. Arribas, **Análisis Cualitativo Inorgánico**, 5, Paraninfo, 1993
 P. Atkins, L. Jones, **Principios de Química**, 5, Panamérica, 2012
 R. Chang, K. A. Goldsby, **Química**, 12, McGraw-Hill, 2016
 R. H. Petrucci, F. G. Herring, J. D. Madura, C. Bissonnette, **Química General**, 11, Pearson, 2017

Complementary Bibliography

D. P. Shoemaker, C. W. Garland, J. W. Nibler, **Experiments in Physical Chemistry**, 8, McGraw-Hill, 2008

Recommendations

Subjects that are recommended to be taken simultaneously

Chemistry: Chemistry 2/V11G201V01109
 Geology: Geology/V11G201V01106
 Mathematics: Mathematics 2/V11G201V01108
 Physics: Physics 2/V11G201V01107

Subjects that it is recommended to have taken before

Biology: Biology/V11G201V01101
 Chemistry: Chemistry Lab I/V11G201V01105
 Chemistry: Chemistry 1/V11G201V01104
 Physics: Physics I/V11G201V01102
 Mathematics: Mathematics 1/V11G201V01103

IDENTIFYING DATA				
Biochemistry				
Subject	Biochemistry			
Code	V11G201V01201			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Zoni , Valeria			
Lecturers	San Juan Serrano, María Fuencisla Zoni , Valeria			
E-mail	valeria.zoni92@gmail.com			
Web	http://faitic.es			
General description	The objective of Biochemistry is to provide students with the basic knowledge about the structure and function of biomolecules, as well as about their corresponding biosynthesis and degradation routes. It also enables them to analyze and identify biomolecules.			

Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
B1	Ability for autonomous learning
B3	Ability to manage information
B4	Ability for analysis and synthesis
C20	Know the structure and reactivity of the main classes of biomolecules and the chemistry of important biological processes
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Identify and recognise the structure of the distinct types of biomolecules and represent them properly.	A1 A3 A5	B1	C20	D3
Recognise the different biological activities of the distinct types of biomolecules.	A1 A3 A5	B1	C20	D3
Define the kinetical enzymatic of the reactions catalized by enzymes as well as his general mechanisms.	A1 A3 A5	B1	C20	D3
Relate the vitamins with the corresponding coenzymes of enzymatic reactions.	A1 A3 A5	B1	C20	D3
Explain the concept of Bioenergetics. Conceptually reason the importance of the coupling of endergonic and exergonic processes in biological systems.	A1 A3 A5	B1	C20	D3
It enumerate the main structural appearances of the ATP that determine his paper in the transfer of energy. It describes the cycle ATP.	A1 A3 A5	B1	C20	D3
Distinguish the metabolic roads of the biomolecules, as well as his interrelationships and regulation.	A1 A3 A5	B1	C20	D3
Justify the application of the different instrumental technicians in the analysis of biomolecules.	A1 A3 A5	B1 B3 B4	C20	D3
Distinguish and propose analytical protocols to apply the technicians mentioned for the analysis of biomolecules in diverse areas (clinical, pharmaceutical, biomedical, ...)	A1 A3 A5	B1 B3 B4	C20	D3

Contents	
Topic	
Subject 1. Amino acids and peptides	Amino acids: structure and classification. The peptide bond. Natural peptides of biological interest.
Subject 2. Proteins	General concept. Main functions of the proteins. Structural levels of the proteins
Subject 3. Enzymes and catalysis enzymatic	Concept, nomenclature and classification of the enzymes. Characteristics of the active centre. Kinetic of the enzymatic reactions: equation of Michaelis-Menten. Kinetic of the allosteric enzymes. Other mechanisms of the modulation of the enzymatic activities
Subject 4. Glucides	Monosaccharides: aldoses and ketoses. Linear structure. Structure cyclic and space formings. Monosaccharides of biological interest. Oligosaccharides and polysaccharides: general characteristics, structure and types more important to biological level.
Subject 5. Lipids	General characteristics and biological importance of the lipids. General classification. Characteristics and structure of the fatty acids. Saponifiable lipids: neutral and polar. Unsaponifiable lipids: eicosanoids, isoprenoids and steroids.
Subject 6. Vitamins and coenzymes	Structure and function of vitamins and coenzymes in metabolic reactions.
Subject 7. Nucleotides: structure and function	Biological importance. Composition and structure of nucleosides and nucleotides. Functions of the nucleotides.
Subject 8. Introduction to the metabolism.	General concepts of the energetic metabolism. The equivalent of the ATP. Definition of metabolic route: catabolic, anabolic and amphibole routes. Importance of the regulation of the metabolic routes.
Subject 9. Glycolysis and pyruvate metabolic destination	Stages and reactions of the glycolysis. Biological importance of this universal route. The glycolysis how amphibole route. Pyruvate metabolic destinations in anaerobiosis (fermentation lactic and alcoholic) and aerobiosis (acetylCoA synthesis in the mitochondrial matrix). Reoxidation of the cytosolic NADH. Stoichiometry and energetic balance of the glycolysis.
Subject 10. Cycle of the tricarboxylic acids (cycle of Krebs) and Pentose phosphate pathway	Central position of the acetylCoA molecule in the energetic metabolism. Reactions of the cycle of Krebs. Paper of the cycle of Krebs like amphibole route. Energetic balance of the cycle Krebs and of the aerobic degradation of the glucose. Pentose phosphate pathway
Subject 11. Chain of electronic transport and oxidative phosphorylation	Chain of electronic transport: components, location and sequence of the electronic transport. Oxidative phosphorylation: ATP synthase enzymatic complex.
Subject 12. Gluconeogenesis	Overview of the synthesis of glucose de novo. Main gluconeogenic substrates. Own reactions of the gluconeogenesis.
Subject 13. Metabolism of the fatty acids	Activation and intracellular transport of the fatty acids. The beta-oxidation of the fatty acids. Energetic balance of the acid palmitic. Biosynthesis of acids fatty: acetylCoA carboxylase and Fatty acid synthase reaction. Elongation and desaturation of fatty acids.
Subject 14. Degradation of the amino acids and destination of the ammonium ion .	Overview of the catabolism of the amino acids: transamination and oxidative desamination reactions. Destination of the carbon skeleton of the amino acids. Form of excretion of the ammonium ion in the alive organisms: the urea cycle
Subject 15. Aminoacids anabolism.	Nitrogen cycle in the nature. Incorporation of the ammonium ion to the biomolecules through the glutamate and glutamine. Aminoacids biosynthesis.
Subject 16. Experimental methods in Biochemistry	Techniques used in the field of protein study: homogenization, subcellular fractionation, precipitation with salts, chromatographic, electrophoretic ...

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	12	24	36
Problem solving	24	54	78
Mentored work	0	10	10
Objective questions exam	1	12	13
Essay questions exam	1	12	13

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

Methodologies	
	Description
Lecturing	In these classes the professor will explain and will develop the concepts listed in the "temario" and basic foundations in a clear form to facilitate understanding. The contents of each subject will be available in the platform MOOVI with sufficient time so that the students can consult them. The student is recommended to work on this material, consulting the bibliography recommended.
Problem solving	In this section we will try to: a) Each student of individual way or in groups will have to do a series of exercises to strengthen the study and understanding of the matter. These exercises will be considered for the evaluation. b) Clarify the doubts of the concepts previously explained in the master classes and in the seminars. c) In this section, we will also work on some contents related to energy metabolism, which, due to their difficult understanding, require didactic support.
Mentored work	Realization (search for information, preparation and presentation) of two work groups of 5 students. The works will be related to some of the contents of the subject of Biochemistry and will be proposed by the teacher. The teacher will be able to provide some of the information necessary for its execution. The work will be considered for evaluation. .

Personalized assistance	
Methodologies	Description
Lecturing	To resolve any doubts that may arise regarding the masterclasses, students have personalized tutorials at their disposal, which will take place during the established schedule.
Problem solving	To resolve all the doubts that can arise in relation to the seminars, the students have to his disposal personalized tutorials that will take place during the established schedule.
Mentored work	To resolve any doubts that may arise regarding the completion of the work, students have personalized tutorials at their disposal, which will take place during the established schedule.
Tests	Description
Objective questions exam	To address any doubts that may arise in relation to the examinations, students will have personalized tutorials at their disposal, which will take during the established schedule.
Essay questions exam	To address any doubts that may arise in relation to the examinations, students will have personalized tutorials at their disposal, which will take place during the established schedule.

Assessment				
	Description	Qualification	Training and Learning Results	
Problem solving	The assistance the masterclasses and seminars is very recommended for the back realization of a series of exercises: multiple choice questions, reasoning questions and various calculations that will reinforce the content acquired by the student. The realization of the exercises of each subject is obligatory and always in groups of 2 or 3 students. They are not individual. It is essential to obtain a minimum score of 6.0 out of 10 to be able to consider the rest of the sections. This activity is not recoverable if the required minimum is not reached.	20	A1 A3	B1 C20 D3
Mentored work	The realization of the works is obligatory, always in groups of 4 or 5 students and they will deal with some of the contents of the subject of Biochemistry. Both individual student work and group work will be assessed. The structure, originality, use of language in general and scientific terminology will be taken into account. The adequacy of the format previously required will also be taken into account. The works may be presented in the languages: Galician or Spanish. It is essential to obtain a minimum score of 7.0 out of 10 to be able to consider the rest of the sections. This activity is not recoverable if the required minimum is not reached.	20	A3 A5 B4	B1 C20 D3

Objective questions exam	There will be a partial test in the middle of the academic year, which will consist of test questions and short questions, and will represent 20% of the Biochemistry subject. It is essential to obtain a minimum grade of 5.0 out of 10 to be able to weigh with the rest of the sections. For students who passed the previous partial test, the final exam will cover the syllabus from the first partial onwards, and will represent 40% of the final grade. For students who did not pass the previous test, this exam will correspond to the entire Biochemistry syllabus and will account for 60% of the final grade. In any case, it is essential to obtain in this section a minimum grade of 4.0 out of 10 to be able to pass the Biochemistry subject, as well as weigh with the rest of the sections. If the minimum grade (4 out of 19) is not reached, this part will be included in the final exam in January and July.	25	A1 B1 C20 D3 B3
Essay questions exam	There will be a second partial written test corresponding to the Metabolic Biochemistry part (items 8 - 15) on the date approved by the Faculty Board (consult the center's website). This test will consist of multiple choice questions, a metabolism integration question that includes the calculation of ATP performance. It is essential to obtain a minimum grade of 4.0 out of 10 in order to be weighted with the rest of the sections. This test will account for 35% of the final grade for the Biochemistry subject.	35	A3 B1 C20 D3 A5 B3 B4

Other comments on the Evaluation

The evaluation of the subject of Biochemistry is continuous throughout the entire academic year. To be evaluated in this way, the student must carry out all the evaluable activities (problem solving, tutored work and two partial written tests).

The particular situations of each student that prevent participation in these activities on a regular basis (Example: employment contract, illness... etc) must be communicated as soon as possible to the responsible teacher to find a solution.

To pass the Biochemistry course (final grade as the sum of the weighted grades) it is essential to have obtained a grade equal to or higher than the minimum grade required in each of the activities that can be evaluated separately. If this is not the case, the total calculation will not be carried out and the grade that will appear in the Biochemistry report will be the highest of the failed sections, and the student must take the entire subject exam in the second call (July).

The final exam in the xullo call is equivalent to 60% of the final grade and is considered approved when a grade equal to or greater than 4.0 out of 10 is achieved.

It is important to note that problem solving activities and tutored work are not recoverable.

In the event that the student does not participate in any of the evaluable activities, he will appear as NOT PRESENTED in the Biochemistry certificate in both calls (January and July). On the contrary, participation in some of the evaluable activities but not in all of them will automatically imply a fail in the Biochemistry Act (both calls).

These criteria will be applied identically in the two calls (January and July).

The notes of the activities carried out during the course (solving exercises, supervised works and partial examination of objective questions) are kept throughout the academic year, as long as they have reached the required minimum grade.

Schedule: <http://química.uvigo.es/eres/docencia/horariosExaminations>: <http://química.uvigo.es/eres/docencia/examenes>

Sources of information

Basic Bibliography

J.M. Berg; J.L. Tymoczko; G.J. Gatto Jr; Stryer, L., **Biochemistry**, 9th, MacMillan, 2019

NELSON D. L. & COX M. M., **Lehninger. Principles of Biochemistry. International edition**, 7th, W.H.Freman & Co Ltd, 2017

Complementary Bibliography

José M^a Teijón Rivera y M^a Dolores Blanco Gaitán, **Fundamentos de la Bioquímica metabólica**, 4^a, Tebar, 2016

José M^a Teijón Rivera y M^a Dolores Blanco Gaitán, **Fundamentos de la Bioquímica estructural**, 3^a, Tebar, 2017

NELSON D. L. & COX M. M., **Lehninger. Principios de Bioquímica**, 7^a, Omega, 2019

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics I/V11G201V01102

IDENTIFYING DATA**Analytical Chemistry I: Principles of Analytical Chemistry**

Subject	Analytical Chemistry I: Principles of Analytical Chemistry			
Code	V11G201V01202			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Pérez Cid, Benita			
Lecturers	Pena Pereira, Francisco Javier Pérez Cid, Benita Villarino García, Nerea			
E-mail	benita@uvigo.es			
Web				
General description	The main objective of this matter is that the students achieve the competences to be able to handle volumetric and gravimetric chemical analysis, both in the theoretical and applied aspects. The theory classes are complemented with seminars and laboratory practices.			

Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
B4	Ability for analysis and synthesis
C6	Know the basics and tools for resolution of analytical problems and characterization of chemical substances
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work
C29	Demonstrate ability for numerical calculations and interpretation of experimental data, with correct use of units and estimation of uncertainty
D1	Ability to solve problems

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Describe the fundamental steps of the analytical process like methodology for the resolution of analytical problems.	A3	B4	C6	D1
Identify basic analytical properties and errors that can affect analytical results.	A3	B4	C6 C29	D1
Solve the possible interaction between concurrent reactions in solution (acid-base, complexes, precipitation and redox).	A1	B4	C6 C29	D1
Construct and interpret titration curves (acid-base, complex, precipitation and redox) and select the most appropriate indicators in each case.	A3	B4	C6 C29	D1
Handle the systematic calculation in volumetric and gravimetric analysis and interpret the results.	A3	B4	C6 C26 C29	D1
Experimentally apply volumetric and gravimetric analysis procedures and correctly express the results obtained.	A1 A3	B4	C6 C26 C29	D1
Appropriately handle the material used in the analytical laboratory and apply the safety standards required.	A1		C26	D1

Contents

Topic	
Subject 1: Analytical Chemistry and analytical process	Analytical chemistry as a metrological science. Classification of analytical methods. The analytical process: stages.

Subject 2: Evaluation of the analytical results	Analytical properties. Errors in Analytical Chemistry: Classification. Basic statistics applied to the expression of the analytical results. Comparison and rejection of results.
Subject 3: Introduction to volumetric and gravimetric quantitative analysis	Volumetric reactions. Standard solutions. Direct, indirect and back titrations. Formation, properties and purity of precipitates. Calculations of gravimetric and volumetric analysis.
Subject 4: Acid-base titrations	Behavior of monoprotic, polyprotic and amphoteric species. Titration curves. End point detection: acid-base indicators. Titran reagents. Analytical applications.
Subject 5: Complexometric titrations	Stability of the complexes. Masking reactions. Titration curves. Detection of the end point: metallochromic indicators. Analytical applications.
Subject 6: Precipitation titrations.	Factors affecting the solubility of precipitates. Titration curves. Detection of the end point: Mohr, Volhard and Fajans methods. Analytical applications.
Subject 7: Redox titrations	Factors influencing the redox potential. Titration curves. Detection of the end point: redox and specific indicators. Analytical applications.
Gravimetric analysis (Laboratory)	Gravimetric determination of nickel with dimethylglyoxime. (1 session)
Acid-base titrations (Laboratory)	Determination of the acidity of a vinegar sample. (1 session)
	Determination of acetylsalicylic acid in analgesics (1 session)
Complexation titrations (Laboratory)	Determination of the hardness of a water sample . (1 session)
Precipitation titrations (Laboratory)	Determination of chloride in seawater using the Mohr method. (1 session)
Redox titrations (Laboratory)	Determination of wealth in oxygen in a hydrogen peroxide sample. (1session)
	Determination of active chlorine in a bleach sample. (1 session)
Resolution of a practical case (Laboratory)	Analysis of a problem sample of unknown composition. (1 session)

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	24	48
Seminars	12	24	36
Laboratory practical	24.5	12	36.5
Essay questions exam	2	7	9
Essay questions exam	0	12	12
Laboratory practice	3.5	5	8.5

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

Methodologies

	Description
Lecturing	They are theoretical classes in which the professor will explain each one of the topics of the program, emphasizing in the most relevant aspects and in those with more difficulty for the student. The classes will be developed interactively with the students, commenting the on-line material (available in Moovi) and the most appropriate bibliography for the preparation, in depth, of each topic.
Seminars	In the seminars, numerical exercises will be solved to reinforce the knowledge acquired in the theoretical classes. These exercises will be available in Moovi, as worksheets. The teacher may request the students to provide, individually, some of the proposed exercises to be reviewed and evaluated.
Laboratory practical	Laboratory experiments will be carried out in sessions of 3.5 h each. The students will have the guidelines of practices with sufficient anticipation (on-line material), so that they can have a previous knowledge of the experiments to performe. During the development of the practices the student will elaborate a notebook in which they will annotate all the relative to the experiment carried out (reactions, procedures, observations, results, etc.).Those students who have passed the laboratory practices in the academic years 2024-25 and 2025-26, do not need to repeat them. In this case, the marks reached in the laboratory sessions will be maintained.

Personalized assistance

Methodologies	Description
Seminars	Time dedicated by the professor to attend to all the doubts and questions made by the student during the course. The available time will be informed in the presentation of the course.

Lecturing	Time dedicated by the professor to attend to all the doubts and questions made by the student during the course. The available time will be informed in the presentation of the course.
Laboratory practical	Time dedicated by the professor to attend to all the doubts and questions made by the student during the course. The available time will be informed in the presentation of the course.

Assessment

Description		Qualification Training and Learning Results			
Seminars	It will value the resolution, by part of the students, of some of the problems and/or exercises proposed in the worksheets, that have to be delivered to the professor.	15	A1 A3	C6 C29	D1
Laboratory practical	The professor will made an evaluation of the experimental work carried out by the students in the laboratory sessions, evaluating the skills acquired as well as the results of each experiment. It is important to indicate that it is COMPULSORY the assistance to all the laboratory sessions. The lack of assistance will penalize the mark and when the number of absences is upper than 25 % of the laboratory sessions, students will not be allowed to pass the practical part of the course.	15	A1 A3	C6 C26 C29	D1
Essay questions exam	SHORT PROOF: A first written proff will be held when the first part of the programme has been given, in which the competences acquired up to that point will be assessed. This exam will not eliminate subject matter and will be carried out on the date indicated in the academic programme of the course, approved by the Faculty Meeting.	15	A1 A3	C6 C29	D1
Essay questions exam	FINAL EXAM: At the end of the course there will be a written proof consisting of theoretical questions and numerical exercises. In order to average both parts it will be necessary to achieve a minimum mark of 3 points out of 10 in each of them. In addition, the student must achieve in this exam a minimum mark of 4 points out of 10 to be added to the rest of the evaluation elements. This test will be carried out on the date indicated in the academic programme of the course, approved by the Faculty Meeting.	40	A1 A3	C6 C29	D1
Laboratory practice	In the last laboratory session, it will make a laboratory proof that will allow to evaluate all the competences and skills acquired by the student during the laboratory sessions. It is mandatory to overcome this exam, with a minimum mark of 5 points out of 10, to pass the practical part of the course.	15	A1 A3	C6 C26 C29	D1

Other comments on the Evaluation

First opportunity (continuous evaluation): To pass the course, it is compulsory to pass individually each one of the parts: theory and laboratory practices. For this, it is necessary to achieve a minimum mark of 4 points out of 10 in the final exam (at the end of the course) and 5 points out of 10 in the laboratory proof. The mark corresponding to the practical part of the curse (laboratory) will be only taken into account in the final mark once the theory has been passed. The participation of the student in written exams and the assistance to laboratory sesions (two or more) will involve the condition of presented and, therefore, the assignment of a mark.

Second opportunity (continuous evaluation): In the second opportunity (July) the student may repeat those exams (theory and/or laboratory) that have not passed in the first opportunity. It will be preserved the mark reached by the student, during the course, in the laboratory practicals (15%). In this announcement, the exam corresponding to the theoretical part of the course will represent the 70% of the final mark and the laboratory proof the 15%, always following the same considerations established for the first opportunity.

Global evaluation mode (non-continuous): Students who wish to use this evaluation mode must inform, by writing, within the period established in the Faculty at the beginning of the course. In this case, the evaluation will consist of the following parts: laboratory practices (30%) and global evaluation exam (70%). To pass the course, students must obtain a minimum mark of 5 points out of 10 on the laboratory proof and 4 points out of 10 on the theory exam, always reaching an overall final mark of at least 5 points out of 10. The theory exam will be subject to the same considerations specified in the assessment section for the continuous evaluation modality.

Sources of information

Basic Bibliography

D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, **Fundamentos de Química Analítica**, 9ª Ed., Cengage Learning, 2015
 Gary D. Christian, **Química Analítica**, 6ª Ed., McGraw-Hill, 2009
 D.C. Harris, **Análisis Químico Cuantitativo**, 3ª Ed., Reverté, 2007
 F. Burriel, S. Arribas, F. Lucena y J. Hernández, **Química Analítica Cualitativa**, 18ª Ed., Paraninfo, 2002
 J.N. Miller, J.C. Miller, R.D Miller, **Statistics and Chemometrics for Analytical Chemistry**, 7ª Ed., Pearson, 2018

P. Yañez-Sedeño Orive, J.M. Pingarrón Carrazón, A. González Cortés, **300 Problemas Resueltos de Química Analítica**, 1ª Ed., Síntesis, 2022

J. Guiteras, R. Rubio, G. Fonrodona, **Curso Experimental en Química Analítica**, 1ª Ed., Síntesis, 2003

Complementary Bibliography

D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, **Química Analítica**, 7ª Ed., McGraw-Hill, 2001

D. Harvey, **Química Analítica Moderna**, 1ª Ed., McGraw-Hill, 2002

J. A. López Cancio, **Problemas Resueltos de Química Analítica**, 1ª Ed., Paraninfo, 2005

J.N. Miller, J.C. Miller, **Estadística y Quimiometría para Química Analítica**, 4ª Ed., Prentice Hall, 2002

Recommendations**Subjects that continue the syllabus**

Analytical Chemistry II: Optical Methods of Analysis/V11G201V01207

Subjects that are recommended to be taken simultaneously

Physical chemistry I: Chemical thermodynamics/V11G201V01203

Inorganic chemistry I/V11G201V01204

Organic chemistry I/V11G201V01205

Subjects that it is recommended to have taken before

Chemistry: Chemistry Lab I/V11G201V01105

Chemistry: Chemistry 1/V11G201V01104

Chemistry: Chemistry Lab II/V11G201V01110

Chemistry: Chemistry 2/V11G201V01109

Mathematics: Mathematics 2/V11G201V01108

Mathematics: Mathematics 1/V11G201V01103

IDENTIFYING DATA				
Physical chemistry I: Chemical thermodynamics				
Subject	Physical chemistry I: Chemical thermodynamics			
Code	V11G201V01203			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Galician			
Department				
Coordinator	Mandado Alonso, Marcos Tojo Suárez, María Concepción			
Lecturers	Fernández Nóvoa, Alejandro Mandado Alonso, Marcos Pastoriza Santos, Isabel Pérez Juste, Jorge Ramos Berdullas, Nicolás Tojo Suárez, María Concepción			
E-mail	mandado@uvigo.es ctojo@uvigo.es			
Web				
General description	The subject "Physical Chemistry I" is one of the first contacts of the students of the "Degree in Chemistry" with Physical Chemistry. This discipline studies the properties and behavior of chemical systems using the methods of Physics. The subject deals with the rigorous macroscopic treatment of chemical systems in equilibrium, systems already introduced in the subject "Chemistry II". Taking advantage of the basic knowledge of the principles of Thermodynamics, they will be applied to systems of chemical interest to have a quantitative description of them. For this quantitative treatment it is essential to be familiar with the differential calculus of more than one variable and the integral calculus of one variable, aspects addressed in the subject "Mathematics I". The knowledge about the macroscopic description of the chemical systems that will be achieved in this subject is complemented with the contents of the "Physical Chemistry II" of the second semester and with the subject "Physical Chemistry V" of the third year.			

Training and Learning Results

Code				
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study			
B1	Ability for autonomous learning			
B3	Ability to manage information			
C11	Know the principles of Thermodynamics and its applications in Chemistry			
C13	Know the principles and applications of electrochemistry			
C28	Interpret data derived from laboratory observations and measurements in terms of their meaning and relate them to the appropriate theory			
C29	Demonstrate ability for numerical calculations and interpretation of experimental data, with correct use of units and estimation of uncertainty			
D1	Ability to solve problems			
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English			

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Explain the energetic exchanges in the thermodynamic systems in function of the changes in the variables of state.	A1	B1 B3	C11 C28 C29	D1 D3
Establish if a thermodynamic process that is spontaneous or not from the calculation of the variations of the thermodynamic properties.	A1	B1 B3	C11 C29	D1 D3
Handle thermodynamic tables to obtain values of the functions of thermodynamic state of reaction to different temperatures.	A1	B1 B3	C11 C28 C29	D1 D3
Determine the thermodynamic characteristics of a change of phase, and know the interval of applicability of the equations employed	A1	B1 B3	C11 C29	D1 D3

Calculate the thermodynamic properties of an ideal solution from his composition	A1	B1 B3	C11 C29	D1 D3
Analyse the colligative properties of a solution from the concentration of the solute and the properties of the dissolvent.	A1	B1 B3	C11 C28 C29	D1 D3
Describe of the behaviour of the real solutions employing the concepts of activity and coefficient of activity and be able to calculate them from experimental data and theoretical models.	A1	B1 B3	C11 C28 C29	D1 D3
Calculate the thermodynamic constant of reactions, from the concentrations or activities of the species and relate it with the thermodynamic functions.	A1	B1 B3	C11 C13 C28 C29	D1 D3

Contents

Topic

The laws of the Thermodynamic in Chemistry.	First Law of Thermodynamics. Internal energy. Enthalpy. Heat capacities . Thermochemistry.
Thermodynamic functions.	Second law of Thermodynamics. Entropy. Third law of Thermodynamics. Gibbs Equations. Maxwell relationships. Calculation of variations of the state functions . Partial Molar quantities. Chemical potential of ideal and real gases.
Phase equilibrium in one component systems.	Phases Rule. First order transitions. Clapeyron and Clausius-Clapeyron Equations.
Ideal Solutions.	Molar partial Volume. Ideal solutions: Raoult's law. Ideal diluted solutions: Henry's Law. Colligative Properties
Non-ideal Solutions.	Deviations of the Raoult's law. Activity and activity coefficient . Electrolytic solutions. Debye-Hückel theory.
Chemical equilibrium.	Equilibrium in gas phase reactions. Response of equilibrium to temperature and pressure changes. Acid-base equilibria. Solubility Product. Electrochemical systems.
Laboratory Practices.	- Experimental determination of equilibrium constants using spectrophotometric or potentiometric techniques. - Experimental determination of enthalpies of combustion, dissolution, neutralization, fusion or vaporization. - Experimental determination of colligative properties.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	33	57
Seminars	24	33	57
Laboratory practical	14	2.5	16.5
Problem and/or exercise solving	0	8.5	8.5
Self-assessment	0	4	4
Essay questions exam	2	0	2
Essay questions exam	2	2	4
Report of practices, practicum and external practices	0	5	5

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

Methodologies

	Description
Lecturing	They will consist of an exposition by the teacher of the fundamental aspects of each topic, based on the material available on the MOOVI platform. Numerical problems will also be formulated to help understand and settle concepts.
Seminars	The seminar classes will be devoted mainly to solving problems and, when necessary, to delve into the aspects of the topics that present the greatest difficulties for the students.
Laboratory practical	Carrying out, under the supervision of the teaching staff but independently, of laboratory practices in sessions of 3.5 hours. With enough time in advance, the students will have the scripts for the practices to be carried out on the MOOVI platform, along with all the additional material necessary. The script will present the essential elements to carry out the practice at an experimental level, as well as the basic points of its theoretical foundation and data treatment. At the end of the practices, and within the term set by the teaching staff, it will be necessary to deliver the report of one of them, prepared following the guidelines given by the teaching staff.

Personalized assistance

Methodologies	Description
Lecturing	In the teacher's tutoring schedule, those doubts of the students that may arise throughout the course in the theory classes will be resolved individually and more personally.
Seminars	In the teacher's tutoring schedule, those doubts of the students that may arise throughout the course in the seminar classes will be resolved individually and more personally.
Laboratory practical	In the teacher's tutoring schedule, those doubts of the students that may arise during the course in the laboratory classes or during the preparation of the corresponding practical reports will be resolved individually and on a more personal basis.
Tests	Description
Essay questions exam	In the teacher's tutoring schedule, those doubts of the students that may arise throughout the course during the preparation of the first written exam will be resolved individually and more personally.
Report of practices, practicum and external practices	In the teacher's tutoring schedule, those doubts of the students that may arise during the course in the laboratory classes or during the preparation of the corresponding practical reports will be resolved individually and on a more personal basis.
Essay questions exam	In the teacher's tutoring schedule, those doubts of the students that may arise throughout the course during the preparation of the second written exam will be resolved individually and more personally.

Assessment							
	Description	Qualification	Training and Learning Results				
Laboratory practical	It marks here together with the effort and the attitude, the skills and the competitions developed by the students during the realisation of the distinct practical. Attendance at the practical sessions is mandatory and, therefore, it is not possible to pass the subject if it is not completed.	5	A1	B1	C11	D1	B3 C28 C29
Problem and/or exercise solving	In addition to the problem bulletins, at the end of each topic or group of topics, some "Assessable Exercises" will be proposed. The students must solve them independently and deliver within the deadline set by the teaching staff.	12	A1	B1	C11	D1	B3 C13 C29
Self-assessment	At the end of each topic, students will have the possibility of answering, through the MOOVI platform, a self-correcting "Self-Assessment Test".	8	A1	B1	C11	D1	B3 C13 C29
Essay questions exam	There will be a written exam halfway through the semester on the date approved by the Faculty Board. This test will cover the contents of subjects I, II and III.	35	A1	B1	C11	D1	B3 C29 D3
Essay questions exam	A written exam will be carried out at the end of the semester on the date approved by the Faculty Board (the date will coincide with that of the Global Test for students of the Global Assessment modality). This test will cover the contents of subjects IV, V and VI.	35	A1	B1	C11	D1	B3 C13 C29
Report of practices, practicum and external practices	The report of a practice proposed by the teaching staff will be made, which must be presented taking care of the formal aspects related to the organization, the correct use of the units, the correct preparation of the graphics and the presentation of the results. The critical analysis of these and drawing conclusions will also be valued.	5	A1	B1	C11	D1	B3 C28 C29

Other comments on the Evaluation

Continuous assessment:

- The voluntary work of the student ("*Self-assessment Test*" and "*Evaluable Exercises*") may constitute up to 20% of the final grade provided that the student performs at least half of the activities proposed throughout the course.
- To pass the subject, it is an essential requirement that the average of the marks in the written exams be equal to or greater than 4.0 out of 10.0 points. In the case of not reaching said score, the qualification that will be reflected in the minutes will only be the average of the qualifications of the tests, not counting any of the other sections.
- To pass the subject, it is an essential requirement to carry out the laboratory practices and obtain in them a minimum global qualification of 5.0 out of 10 points (50% laboratory work, 50% report). In the case of not reaching said score, the grade that will be reflected in the minutes may not exceed 4.0 points.
- Attendance to the practical sessions is mandatory and, therefore, it is not possible to pass the subject if it has not been done.
- To pass the subject, it is an essential requirement to obtain a grade equal to or greater than 5.0 points out of 10 in its

overall grade (10% laboratory practices, 12% evaluable exercises, 8% self-assessment questionnaires and 70% written tests).

Overall evaluation:

Students who, within the term set by the Faculty, opt for the Global Assessment modality, will take a global written exam on the date set by the Xunta de Facultade. This overall written test will account for 85% of the grade for the subject.

In this global evaluation, the Laboratory Practices will constitute 7% of the qualification of the subject and 8% the corresponding reports.

- To pass the subject, it is an essential requirement to obtain a grade equal to or greater than 4.0 out of 10.0 in the overall written exam. In case of not reaching said score, the qualification that will be reflected in the minutes will only be the qualification of the global test, not counting any of the other sections.

-To pass the subject, it is an essential requirement to carry out the laboratory practices and obtain an overall minimum grade of 5.0 out of 10 points (47% laboratory work, 53% report). In the case of not reaching said score, the grade that will be reflected in the minutes may not exceed 4.0 points

- To pass the subject, it is an essential requirement to obtain a grade equal to or greater than 5.0 points out of 10 in its overall grade (85% overall test, 7% laboratory practices and 8% practice reports).

Examined/Not Examined Status:The participation of the students in one of the two written tests or the attendance of more than two laboratory sessions will imply the condition of "taked exam" and, therefore, the assignment of a qualification.

Second opportunity:In the case of the Continuous Evaluation for the evaluation of the second opportunity, the qualifications of the "Evaluable Exercises", of the "Self-assessment Test", of the laboratory practices and of the corresponding reports will be maintained.

In the case of the Global Evaluation for the evaluation of the second opportunity, the qualifications of the laboratory practices and the corresponding reports will be maintained.

Sources of information

Basic Bibliography

Levine, I. N., "Principios de Fisicoquímica", 6ª Ed, McGraw-Hill Education, 2014

Engel, T.; Reid, P., "Química Física", 1ª Ed, Pearson, Addison Wesley, 2006

Atkins, P.W.; De Paula, J., "Química Física", 8ª Ed, Editorial Médica Panamericana, 2008

Complementary Bibliography

Levine, I.N., "Problemas de Fisicoquímica", 1ª Ed, McGraw-Hill Interamericana, 2005

Rodríguez Renuncio, J.A., "Termodinámica Química", 2ª Ed, Síntesis, 2000

Rodríguez Renuncio, J.A., "Problemas resueltos de Termodinámica Química", 1ª Ed, Síntesis, 2000

Chang, R., "Fisicoquímica", 3ª Ed, McGraw-Hill Interamericana, 2008

Metz, C.R., "Fisicoquímica. Problemas y Soluciones", 1ª Ed, McGraw-Hill Interamericana, 1991

Recommendations

Subjects that continue the syllabus

Physical Chemistry II: Surfaces and Colloids/V11G201V01208

Physical Chemistry V: Chemical Kinetics/V11G201V01308

Subjects that it is recommended to have taken before

Chemistry: Chemistry 2/V11G201V01109

Mathematics: Mathematics 1/V11G201V01103

IDENTIFYING DATA				
Inorganic chemistry I				
Subject	Inorganic chemistry I			
Code	V11G201V01204			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Castro Fojo, Jesús Antonio			
Lecturers	Carballo Rial, Rosa Castro Fojo, Jesús Antonio Valencia Matarranz, Laura María			
E-mail	jesusc@uvigo.es			
Web				
General description	In this subject pretends give an overview of the chemical behaviour of the no metallic elements of the main groups and of his more important compounds.			

Training and Learning Results

Code	
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
B1	Ability for autonomous learning
B3	Ability to manage information
B4	Ability for analysis and synthesis
C8	Know the characteristic properties of the elements and their compounds, including the relations between groups and their variations in the periodic table
C9	Know the structural aspects of chemical elements and their compounds, including stereochemistry
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work
D2	Capacity for teamwork

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Deduce the physical properties of an element or compound from the type of link and/or intermolecular strengths	A2 A3	B1 B3 B4	C8 C9	
Choose the general method more adapted for the obtaining of the no metallic elements and his more important compounds	A2 A3	B1 B3 B4	C8 C9	
Know the structure and the most stood out reactivity of the no metallic elements and his compounds	A2 A3	B1 B3 B4	C8 C9	
Relate the physical and chemical properties of some substances of interest with his applications	A2 A3	B1 B3 B4	C8 C9	
Carry out in the laboratory the preparation of some elements and of his compounds, as well as the study of some of his physical and chemical properties		B1 B3 B4	C26	D2

Contents

Topic	
1. Hydrogen	Obtaining. Physical and chemical properties. Hydrides: classification and general study of the same. The water.
2. Noble gases	General characteristics. Properties and uses. Xenon fluorides. Combinations of xenon with oxygen.

3. Halogens	General characteristics. Obtaining, properties and reactivity. Halides. Oxides, oxo acids and oxosalts. Interhalogen compounds and ions polyhalide. Fluorocarbons.
4. The Group 16 elements	General characteristics. Oxygen and ozone. Obtaining, properties and reactivity. Derived ions. Hydrogen peroxide. Sulfur. Obtaining, properties and reactivity. Hydrogenated and halogenated combinations of sulfur. Sulfur oxides, oxoacids and oxosalts.
5. The Group 15 elements	General characteristics. Nitrogen and phosphorous. Obtaining, properties and reactivity. Hydrogenated and halogenated combinations. Oxides, oxoacids and oxosalts of nitrogen and phosphorus
6. The Group 14 elements	General characteristics. Carbon. Obtaining, properties and reactivity. Oxides and carbonates. Carbides Halogenated combinations and nitrogenous. Silicon and germanium. Obtaining, properties and reactivity. Hydrides and halides. Oxides. Silicates. Silicones
7. The Group 13 elements	General characteristics. Boron. Obtaining, properties and reactivity. Hydrides and halides. Compounds with nitrogen. Oxides, oxoacids and oxosalts.
Session 1	Study of the chemical properties of oxides. Covalent and ionic solids. Synthesis of MgO
Session 2	Study of the chemical properties of oxides. Synthesis of sulfur dioxide.
Sessions 3-4	Obtaining and chemical behavior of halogens.
Session 5	Synthesis and reactivity of group 16 compounds. Barium peroxide
Session 6	Synthesis and reactivity of group 16 compounds. Oxoacids and oxosalts of sulfur
Session 7	Synthesis and reactivity of group 15 compounds. Synthesis and study of ammonia.
Session 8	Synthesis and reactivity of group 13 compounds. Synthesis and study of boric acid.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	12	36
Seminars	12	12	24
Laboratory practical	28	0	28
Essay questions exam	1	30	31
Essay questions exam	1	30	31

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

Methodologies

	Description
Lecturing	Presentation by the teaching staff on the subject to be developed, with special emphasis on the most important or difficult to understand aspects for students. Teachers will use the Moovi platform to provide information on the subject or its development.
Seminars	One hour per week will be dedicated to discuss and resolve issues on the subject previously the students will have to work.
Laboratory practical	The experiments will be carried out over 8 sessions of 3.5 hours each. The student body you will have the practice scripts as well as the necessary support material on the platform Moovi so that you can have prior knowledge of the experiments to be performed. The students must prepare the laboratory notebook during the practicals.

Personalized assistance

Methodologies	Description
Lecturing	Personalized attention will be given to students through individual tutorials. In these, an attempt will be made to answer all the doubts that the students have about the subject taught in theory. The schedule available for these tutorials will be indicated in the presentation of the subject, and will always be as information on the Moovi platform.
Seminars	Personalized attention will be given to students through individual tutorials. In these, an attempt will be made to answer all the doubts that the students have about the subject taught in seminars. The schedule available for these tutorials will be indicated in the presentation of the subject, and will always be as information on the Moovi platform.

Laboratory practical Personalized attention will be given to students and also individual tutorials if needed. The schedule available for these tutorials will be indicated in the presentation of the subject, and will always be as information on the Moovi platform.

Assessment						
	Description	Qualification	Training and Learning Results			
Seminars	The resolution by the students of issues dealt with will be valued throughout the seminars at the time/conditions established by the professor	20	A2 A3	B1 B3	C8 C9	
Laboratory practical	Attendance at laboratory sessions is compulsory. The teaching staff will follow up on the experimental work carried out by the students in the laboratory sessions, as well as the notebook elaborated. A series of questions will be asked during the sessions that will allow evaluate the competences and skills acquired by the students.	20		B4 B1 B3 B4	C26	D2
Essay questions exam	1st Test on specific aspects of the contents explained in class, seminars and practices. This test may be eliminatory when students achieve a minimum grade of 5 points out of 10. This Test will be done on the date listed in the course schedule.	30	A2 A3	B1 B3	C8 C9	
Essay questions exam	2nd Test on specific aspects of the contents explained in class, seminars and practices. This test may be eliminatory when students achieve a minimum grade of 5 points out of 10. This Test will be carried out on the date that appears in the schedule as final exam.	30		B4 B1 B3 B4	C26 C8 C9	

Other comments on the Evaluation

The participation of the students in any of the acts of evaluation of the matter will imply the condition of presented/to and, therefore, the assignment of a qualification. Acts of evaluation are considered to be attendance at practical laboratory classes (three or more) and taking tests.

To pass the subject, students must have completed and positively evaluated on the practices of the subject and take the 2 tests of development questions. In these, it will be essential to achieve a minimum score of 5 points out of 10, in order to count the notes acquired in the follow-up of seminars, theoretical classes and in the practices carried out. Once all the scores have been taken into account, students must achieve a global grade of at least 5 out of 10 to pass the subject.

July call. Students who do not pass the subject at the end of the semester must take an assessment test during the July session. Said test will replace the results of the qualifying tests carried out throughout the semester and will have a value of up to 50%. The follow-up qualification of seminars and laboratory practices obtained throughout the semester is maintained.

The students who renounce the continuous evaluation have to chose the global evaluation of the subject. To pass the subject through the overall assessment, the student should pass the practical part of the subject. Then, the student should pass a comprehensive written test (80%) on specific aspects of the content explained in class, seminars and practices. In the written test it will be essential to achieve a minimum score of 5 points out of 10, in order to count the grade acquired in the laboratory practices, also with 5 point minimum. The global written test will be carried out on the official date of the exam for each evaluation opportunity within the official testing period marked in the academic calendar (1st opportunity (December-January) and 2nd opportunity (June-July)).

Sources of information

Basic Bibliography

RAYNER-CANHAM, G., OVERTON, T., **Descriptive Inorganic Chemistry, 6^a Ed**, 6, W.H. Freeman, 2014

HOUSECROFT, C.E. Y SHARPE, A. G., **Inorganic Chemistry, 5^a Ed**, 5, Pearson, 2018

Shriver & Atkins, **Química Inorgánica, 5^o ed.**, 5, McGraw-Hill, 2010

Complementary Bibliography

Jordan, Robert B., **Principles of Inorganic Chemistry**, 978-3-031-22928-2, 1, Springer Cham, 2024

RAYNER-CANHAM, G, **Química Inorgánica Descriptiva, 2.^a Ed**, Pearson Education, 2000

HOUSECROFT, C.E. Y SHARPE, A. G., **Química Inorgánica, 2.^a Ed (español)**, Pearson- Prentice Hall, 2006

Recommendations

Subjects that continue the syllabus

Inorganic chemistry II/V11G201V01209

Subjects that it is recommended to have taken before

Chemistry: Chemistry Lab I/V11G201V01105

Chemistry: Chemistry 1/V11G201V01104

Chemistry: Chemistry Lab II/V11G201V01110

Chemistry: Chemistry 2/V11G201V01109

IDENTIFYING DATA				
Organic chemistry I				
Subject	Organic chemistry I			
Code	V11G201V01205			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Muñoz López, Luis Iglesias Antelo, María Beatriz			
Lecturers	Iglesias Antelo, María Beatriz Muñoz López, Luis Salonen, Laura			
E-mail	bantelo@uvigo.gal lmunoz@uvigo.es			
Web				
General description	In this subject, the students reach an understanding of the fundamental principles of Organic Chemistry, regarding structure and reactivity of organic compounds. Following two lessons on general concepts, the reactivity of functional groups with multiple carbon-carbon bonds (including aromatic compounds) will be studied.			
	English Friendly subject. International students may request from the teaching staff: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
B1	Ability for autonomous learning
B2	Organization and planning capacity
B3	Ability to manage information
C17	Know the nature and behavior of functional groups in organic molecules
C25	Safely handle chemical substances, considering their physical and chemical properties, evaluating the risks associated with their use and laboratory procedures and including their environmental repercussions
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Represent the three-dimensional structure of organic molecules.	A2 B1 A5
Apply the principles of stereochemistry to the analysis of stereoisomers.	A2 B1 A5
Distinguish the most usual reactions in Organic Chemistry.	A2 B1 A5
Establish the influence of the structure and the chemical characteristics of the functional groups present in a molecule in its reactivity.	A2 B1 C17 A5
Explain the reactivity of organic compounds with multiple carbon-carbon bonds through an electrophilic addition mechanism.	A2 B1 C17 A5
Explain the reactivity of aromatic compounds through an electrophilic substitution mechanism.	A2 B1 C17 A5
Apply the rules for safety and health in laboratory work and carry out the treatment and correct elimination of the waste generated.	C25
Appropriately write and describe the experiments in the laboratory notebook, so that they can be reproduced.	B2 D3 B3

Contents	
Topic	
Lesson 1. Conformational analysis. Stereochemistry	Review of basic aspects of organic chemistry: Lewis structures, hybridization, three-dimensional structure of organic molecules, functional groups and nomenclature. Conformational analysis in cyclic compounds. Configurational stereoisomerism.
Lesson 2. Reactivity of organic compounds	Acid-base reactivity of organic compounds. Reaction mechanisms: curved arrow formalism. Reaction intermediates: carbanions. Redox reactivity of organic compounds. Formal states of oxidation.
Lesson 3. Addition reactions to carbon-carbon multiple bonds	General reactivity of functional groups with carbon-carbon multiple bonds: alkenes and alkynes. Hydrogenation of alkenes and alkynes. Protonation of alkenes: carbocations. Electrophilic addition reactions to alkenes: addition of HX, hydration reactions, addition of halogens. Electrophiles and nucleophiles. Oxidation reactions. Reactions of alkynes.
Lesson 4. Aromatic substitution reactions	Structure and general reactivity of aromatic compounds. General mechanism for the electrophilic aromatic substitution reaction. Reactions with non-carbon electrophiles. Reactions with carbon electrophiles.
Laboratory Practices	Application of the techniques acid-base extraction and thin layer chromatography to the separation of mixtures of compounds, their identification and characterization. Reactions of alkenes and benzenic derivatives.

Planning

	Class hours	Hours outside the classroom	Total hours
Flipped Learning	12	24	36
Problem solving	22	54	76
Laboratory practical	14	5	19
Problem and/or exercise solving	1	5	6
Problem and/or exercise solving	1	5	6
Problem and/or exercise solving	1	5	6
Problem and/or exercise solving	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

	Description
Flipped Learning	Some learning activities will take place out of the classroom. Afterwards, in the classroom, with the presence of the teacher, other processes of knowledge acquisition and practice will be facilitated. Prior to the class sessions, a selection of materials (audiovisual, written etc.) will be available to the students, through the virtual classroom. This material must be employed for the preparation of the class session. Additionally, the students will be expected to carry out some simple tasks applying the concepts reviewed in the previously mentioned material. Detailed information and delivery terms for the tasks will be communicated in advance. In the class session, different activities will be carried out in order to review, clarify and apply the studied concepts. Some of these activities will be handed for assessment.
Problem solving	Problem solving class sessions will be devoted to solving practical exercises applying the concepts developed in the flipped learning class sessions. Some of those exercises will be solved by the students and their performance will be graded.
Laboratory practical	Laboratory practical work will be directed to ensure that students are capable of handling chemicals safely, evaluating any specific risks associated with their use and with the use of laboratory procedures, including their environmental repercussions. Laboratory experiments will be carried out, individually, in 3.5 h class sessions. The students will find, in advance, in the virtual classroom, the material needed for the preparation of the experiments. Work with this material could include performing and delivering some tasks, prior to the class session. During the experiments, students will elaborate a laboratory notebook recording all observations pertinent to the experiment. After completion of the experiment, students will complete the required work.

Personalized assistance

Methodologies	Description
Flipped Learning	Students will be tutored by the teaching staff. Tutoring sessions can take place in person or by telematic means, by previous appointment. Contact details for the teaching staff are available in the virtual classroom on Moovi.
Problem solving	Students will be tutored by the teaching staff. Tutoring sessions can take place in person or by telematic means, by previous appointment. Contact details for the teaching staff are available in the virtual classroom on Moovi.

Laboratory practical	Students will be tutored by the teaching staff. Tutoring sessions can take place in person or by telematic means, by previous appointment. Contact details for the teaching staff are available in the virtual classroom on Moovi.
Tests	Description
Problem and/or exercise solving	Students will be tutored by the teaching staff. Tutoring sessions can take place in person or by telematic means, by previous appointment. Contact details for the teaching staff are available in the virtual classroom on Moovi.

Assessment				
	Description	Qualification	Training and Learning Results	
Flipped Learning	As part of the continuous evaluation, participation and resolution by the student of the proposed tasks in relation to the flipped learning sessions will be evaluated.	10	A2 A5	B1 C17 D3
Problem solving	As part of the continuous evaluation, participation and resolution by the student of the tasks proposed in the class sessions will be evaluated.	25	A2 A5	B1 C17 D3
Laboratory practical	Assistance to practical classes is mandatory. Laboratory work will be evaluated as APT or NON APT. The following aspects may be considered: previous and/or subsequent work, development of the experimental work and laboratory notebook. In order to pass the subject, students must obtain an APT mark in the laboratory practical work.	0		B2 C25 D3
Problem and/or exercise solving	TEST 1: Students must take a test covering contents of the first topics.	15	A2 A5	B2 C17 D3
Problem and/or exercise solving	WRITTEN TEST FOR THE EXPERIMENTAL PART: Students must take a test regarding the experimental aspects of the subject. A minimum mark of 4.0 points (out of 10.0) must be achieved.	15	A2 A5	B2 B3 C17 C25 D3
Problem and/or exercise solving	FINAL TEST: Students must take a written test covering ALL THE CONTENTS OF THE SUBJECT. A minimum mark of 4.0 points (out of 10.0) must be achieved.	25	A2 A5	B2 B3 C17 D3
Problem and/or exercise solving	FINAL ORAL TEST: Students must take an oral test covering ALL THE CONTENTS OF THE SUBJECT. A minimum mark of 4.0 points (out of 10.0) must be achieved. The format of the test will be published in advance.	15	A2 A5	B2 B3 C17 D3

Other comments on the Evaluation

In this subject, BASIC learning results will be defined that will be necessary for the students to achieve.

In order to pass the subject in January, it will be required:

- Achieve mention **APT** in the evaluation of the laboratory practical.
- Achieve a **minimum mark of 4 points (out of 10)** in the written test for the experimental part and the final test.
- In order to prove the acquisition of learning results by the students, a **final oral test** must be taken and a minimum mark of 4 points (out of 10) must be achieved.
- Achieve a minimum mark of 5.0 in the weighted addition of the marks for all the sections.

If any of the previous conditions is not fulfilled, the final mark for the subject will be the mark obtained for the final tests (written test for the experimental part, final test and final oral test) multiplied by 0.55 (55%).

The final grade for the students who pass the subject could be standardized so that the highest mark can reach a value of up to 10 points.

In case of doubt about the acquisition of learning results by the students, additional oral evaluation tests may be carried out.

STUDENTS OF 2ND AND SUBSEQUENT ENROLLMENT: Those students who were evaluated as APT during any previous course will be awarded the APT mention for the monitoring of the laboratory practical in the current academic course, not being necessary the completion of the experimental work again. However, they must take the written test for the experimental part in order to achieve the mark for the experimental part of the subject in the current academic course.

EVALUATION IN JULY: The marks obtained for the sections flipped learning, problem solving and laboratory practical will be kept. Two written tests can be retaken: a final test (40% of the final mark) **and/or** a written test for the experimental part (15% of the final mark). Additionally, an **oral test** (15% of the final mark) must be taken. The student must achieve a minimum mark of 4 points out of 10 in all those tests, so that all the evaluation elements will be taken into account in the final mark of the subject.

The final mark will be the weighted addition of the marks for all the sections, as long as all the required minima are reached. If this is not the case, the final mark for the subject will be the weighted sum of the marks obtained for the final tests (written test for the experimental part, final test and oral test).

GLOBAL EVALUATION OPTION: In order to pass the subject, students must carry out the laboratory practical work, achieving an APT mark, and a minimum mark of 5 out of 10 points in a written test for the experimental part (20% of the final mark). In addition, they must also obtain a minimum mark of 5 out of 10 points in a global exam (50% of the final mark). And must also take an oral test (30% of the final mark) and achieve a minimum mark of 5 points (out of 10).

Sources of information

Basic Bibliography

Klein, D., **Química Orgánica**, Editorial Médica Panamericana, 2013

Wade, L.G., **Química Orgánica - libro electrónico**, 9ª edición, Pearson-Educación, 2017

Wade, L.G., **Química Orgánica**, 9ª edición, Pearson-Educación, 2017

Csáky, A.G.; Martínez Grau, M.A., **Técnicas experimentales en síntesis orgánica**, 2ª edición, Síntesis, 2012

Complementary Bibliography

Carey, F., **Química Orgánica**, 9ª edición, McGraw-Hill Interamericana, 2014

Vollhardt, K.P.C.; Schore, N.E., **Química Orgánica**, 5ª edición, Edicións Omega, 2007

Clayden, J.; Greeves, N.; Warren, S., **Organic Chemistry**, 2ª edición, Oxford University Press, 2012

Yurkanis Bruice, P., **Fundamentos de Química Orgánica**, 3ª edición, Pearson, 2015

Dobado, J.A.; García, F.; Isac, J.L., **Química Orgánica. Ejercicios comentados**, Garceta, 2012

Quiñoá, E.; Riguera, R., **Cuestiones y ejercicios de Química Orgánica**, 2ª edición, McGraw-Hill Interamericana, 2004

Quiñoá, E.; Riguera, R., **Nomenclatura y representación de los compuestos orgánicos**, 2ª edición, McGraw-Hill Interamericana, 2005

Palleros, D.R., **Experimental Organic Chemistry**, John Wiley and Sons, 2000

Recommendations

Subjects that continue the syllabus

Organic chemistry II/V11G201V01210

Subjects that are recommended to be taken simultaneously

Physical chemistry I: Chemical thermodynamics/V11G201V01203

Inorganic chemistry I/V11G201V01204

Analytical Chemistry I: Principles of Analytical Chemistry/V11G201V01202

Biochemistry/V11G201V01201

Subjects that it is recommended to have taken before

Chemistry: Chemistry Lab I/V11G201V01105

Chemistry: Chemistry 1/V11G201V01104

Chemistry: Chemistry Lab II/V11G201V01110

Chemistry: Chemistry 2/V11G201V01109

IDENTIFYING DATA				
Structural Determination				
Subject	Structural Determination			
Code	V11G201V01206			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Muñoz López, Luis Vázquez López, Ezequiel Manuel			
Lecturers	Muñoz López, Luis Vázquez López, Ezequiel Manuel			
E-mail	lmunoz@uvigo.es ezequiel@uvigo.es			
Web				
General description	The subject devotes to the learning of the application of the methods but used in the structural determination of chemical substances. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code	
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
B1	Ability for autonomous learning
B3	Ability to manage information
B4	Ability for analysis and synthesis
C1	Ability to know and understand essential facts, concepts, principles and theories related to Chemistry
C2	Use correctly chemical terminology, nomenclature, conversions and units
C3	Recognize and analyze chemical, qualitative and quantitative problems, proposing strategies to solve them through the evaluation, interpretation and synthesis of data and chemical information
C6	Know the basics and tools for resolution of analytical problems and characterization of chemical substances
C15	Know the main techniques of structural research, including spectroscopy
D1	Ability to solve problems

Expected results from this subject

Expected results from this subject	Training and Learning Results				
Describe the fundamental concepts of structural determination methodologies.	A3 A5	B3	C1 C2 C6 C15		
Analyze the information that the different techniques provide about the molecular structure and distinguish the limitations they have.	A3	B1 B3 B4	C1 C6 C15		
Describe the information provided by the different X-Ray diffraction techniques.	A3	B3	C1 C6 C15		
Foretell the main features of spectra belonging to a given compound	A3 A5	B3 B4	C2 C3	D1	
Design the basic processes to obtain structural information from a chemical substance.	A3 A4	B3 B4	C2 C3	D1	
Propose a molecular structure for a given compound from their spectra (GO, MS, NMR, etc.).	A3 A4	B1 B3 B4	C2 C3	D1	

Contents	
Topic	
Subject 1. Getting general data from a chemical compound.	Combustion analysis. Empirical formula. Qualitative analysis. Optical properties.
Subject 2. Mass spectrometry.	Determination of the molecular mass. Fragmentation reactions. Isotopic patterns. Interpretation of mass spectra.
Subject 3. Diffraction methods.	Applications and limitations in structural determination.
Subject 4. Electronic and photoelectronic spectroscopy.	Determination of chromophore groups.
Subject 5. Vibrational spectroscopy.	Determination of characteristic functional groups. Principal absorptions.
Subject 6. NMR Spectroscopy.	Monodimensional ^1H and ^{13}C NMR experiments. Structural information from chemical shifts. Dynamic RMN: solution equilibria. Multiple pulse experiments. Bidimensional techniques.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	12	26	38
Problem solving	24	70	94
Problem and/or exercise solving	2	7	9
Problem and/or exercise solving	2	7	9

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

Methodologies	
	Description
Lecturing	Lectures in the large group will be used to present each technique fundamentals and basic concepts in order to obtain relevant structural information from a chemical compound.
Problem solving	Lectures in medium size groups will be used to resolve exercises and problems in order to learn how to get the relevant structural information provided by each technique.

Personalized assistance	
Methodologies	Description
Problem solving	Students will be able to consult with professors during the spring term

Assessment							
	Description	Qualification	Training and Learning Results				
Problem solving	ENTREGABLES: Students may be asked, either individually or with other students, to solve questions, exercises, problems, etc, along lectures. Their results should be given to the teaching staff for assesment.	50	A3 A4	B3 B4	C2 C3 C15	D1	
Problem and/or exercise solving	PROBA 1: There will be a 2 hours written exam in the mid term about the already presented subjects.	15	A3 A4 A5	B1 B3 B4	C1 C2 C3 C6 C15	D1	
Problem and/or exercise solving	PROBA 2: A second written exam will take place at the term end. It will deal with all the presented subjects.	35	A3 A4 A5	B1 B3 B4	C1 C2 C3 C6 C15	D1	

Other comments on the Evaluation

If doubts arise regarding the results (skills, abilities, etc) acquisition by some students, they will be asked to perform an additional oral exam before the end of the teaching term.

To pass the subject at the end of the teaching term, every student has to:

- Achieve a minimum mark of 40% in each evaluation methodology (ENTREGABLES, PROBA 1 and PROBA 2).
- Achieve a minimum mark of 50% in the averaged sum of all evaluation methodologies (ENTREGABLES, PROBA 1 and PROBA 2).
- Pass the oral exam, if necessary.

In all the previous conditions are not fulfilled, the final mark will be the averaged sum of written exams.

The final mark of passed students could be normalized in the way that the highest mark could achieve a value of 10 points.

SECOND OPPORTUNITY

Students not passing the subject at the end of the teaching term will have to perform a written exam. This exam will have a value of 50% of the final mark and will substitute all the written exams performed along the teaching term. A minimum result of 40% in this exam will be required to pass the subject. The other 50% of the final mark will result from the evaluation methodology ENTREGABLES performed during the teaching term.

GLOBAL EVALUATION

Students choosing the global evaluation modality should perform an exam about the whole subject at any of the available opportunities. To pass the subject a minimum mark of a 50% will be required.

Sources of information

Basic Bibliography

Complementary Bibliography

Williams, D.H., Fleming, I., **Spectroscopic Methods in Organic Chemistry**, 6^a, 2007

Hammond, Christopher, **The Basics of crystallography and diffraction**, 2009

Pavia, D.L., Lampman, G.M., Kriz, G.S., Vyvyan, J.R., **Introduction to Spectroscopy**, 5^a, 2014

Pretsch, Ernö; Bühlmann, P.; Badertscher, M., **Structure determination of organic compounds: tables of spectral data**, 5a, Springer, 2020

Clayden, Jonathan, **Organic Chemistry**, 2a, 2012

Hesse, M, Meier, H, Zeeh, B., **Métodos espectroscópicos en Química orgánica**, 2a, Sintesis, 2005

Klein, D., **Organic Chemistry**, 3a, Wiley, 2017

Field, L.D.; Li, H.L.; Magill, A.M., **Organic structures from spectra**, 6a, John Wiley and Sons, 2020

Recommendations

Subjects that it is recommended to have taken before

Chemistry: Chemistry 1/V11G201V01104

Inorganic chemistry I/V11G201V01204

Chemistry: Chemistry 2/V11G201V01109

Organic chemistry I/V11G201V01205

IDENTIFYING DATA				
Química analítica II: Métodos ópticos de análise				
Subject	Química analítica II: Métodos ópticos de análise			
Code	V11G201V01207			
Study programme	Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2	2c
Teaching language	Castelán Galego			
Department	Química analítica e alimentaria			
Coordinator	Pena Pereira, Francisco Javier			
Lecturers	Calle González, Inmaculada de la Pena Pereira, Francisco Javier			
E-mail	fjpena@uvigo.es			
Web				
General description	Os métodos ópticos de análise (espectroscopia analítica), constitúen unha poderosa e versátil ferramenta nos laboratorios químicos, resolvendo problemas en áreas de interese como a alimentación, o medioambiente, a industria ou biomedicina. Nesta materia aprenderanse os fundamentos, instrumentación e aplicacións dos principais métodos ópticos de análises que se basean en fenómenos de interacción entre radiación electromagnética e materia como a absorción, emisión, fluorescencia, dispersión, etc.			

Resultados de Formación e Aprendizaxe	
Code	
A1	Que os estudantes saiban aplicar os seus coñecementos ó seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo
A3	Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética
B4	Capacidade de análise e síntese
C6	Coñecer os fundamentos e ferramentas habituais na resolución de problemas analíticos e na caracterización de substancias químicas
C26	Levar a cabo correctamente procedementos habituais no laboratorio, incluíndo o uso de instrumentación química estándar para o traballo sintético e analítico
D1	Capacidade para resolver problemas

Resultados previstos na materia				
Expected results from this subject			Training and Learning Results	
Elixir a técnica analítica instrumental máis apropiada en función do analito a determinar e as características da mostra.			C6	
Definir, calcular e interpretar os diferentes parámetros de calidade dun método analítico.			B4	C6
Explicar os fundamentos dos principais métodos ópticos de análises e coñecer as súas aplicacións máis relevantes nos laboratorios.			A1	C6
Describir os procesos de interacción da radiación electromagnética coa materia, clasificar os métodos ópticos e recoñecer as diferenzas entre a espectrometría molecular e atómica.			C6	
Distinguir a instrumentación das técnicas espectroscópicas modernas e os seus diferentes compoñentes.			C6	
Seleccionar o método de calibración máis adecuado de acordo ao problema analítico exposto e computar os datos experimentais para obter a función de calibración.			C26	D1
Aplicar experimentalmente os métodos ópticos de análises para a resolución de problemas en diferentes campos de traballo.			A1 A3	C26
Levar a cabo cálculos numéricos correctos na resolución de problemas dos métodos ópticos de análises.			A1 A3	B4 C26 D1

Contidos	
Topic	
TEMA 1. Introducción aos métodos instrumentais de análise.	Clasificación dos métodos instrumentais de análise. Parámetros de calidade dun método de análise instrumental. Métodos de calibración en análise instrumental: calibración externa, adición estándar e patrón interno. Características das curvas de calibrado. Axuste por regresión e parámetros estatísticos das rectas de calibrado.

TEMA 2. Métodos ópticos de análise: xeneralidades.	Espectro electromagnético. Fenómenos de interacción entre a radiación electromagnética e a materia: absorción, emisión, fluorescencia, refracción, dispersión, difracción, polarización, etc. Clasificación dos métodos ópticos de análise: métodos espectroscópicos e non-espectroscópicos. Componentes instrumentais e configuracións representativas dos diferentes instrumentos. Sinais e ruído.
TEMA 3. Espectroscopia de absorción molecular UV-vis.	Fundamentos da absorción molecular UV-vis. Conceptos básicos. Lei de Beer. Desviacións da lei de Beer: propias á lei, químicas e instrumentais. Especies absorbentes: moléculas orgánicas con grupos cromóforos e auxocromos; elementos con electróns d e f; electróns de transferencia de carga. Tipos de instrumentos: feixe dobre, feixe simple, multicanal. Metodoloxía analítica e aplicacións: análise cuantitativa, pesos moleculares, estudo do equilibrio químico e cinética de reacción, constantes de ionización de ácidos e bases, estequiometría de complexos de coordinación, valoración fotométrica.
TEMA 4. Espectroscopia de luminiscencia.	Fundamentos das técnicas luminiscentes. Mecanismos de desactivación molecular: diagrama de Jablonski. Rendemento cuantico de luminiscencia. Fotoluminiscencia: fluorescencia e fosforescencia. Factores que inflúen na fotoluminiscencia: contorna química e estrutura molecular. Espectrofluorímetro. Quimioluminiscencia e Bioluminiscencia. Luminómetro. Metodoloxía analítica e aplicacións.
TEMA 5. Espectroscopia Infravermella e Raman.	Fundamentos da espectroscopía infravermella. Modelo do oscilador armónico. Anarmonicidade. Modos normais de vibración moleculares. Exemplos de moléculas sinxelas. Espectroscopía de dispersión Raman. Polarizabilidade. Orixe dos espectros Raman (liñas Rayleigh, Stokes e anti-Stokes). Instrumentación. Aplicacións.
TEMA 6. Espectroscopia de absorción atómica.	Fundamentos da espectroscopia atómica (absorción, emisión e fluorescencia). Espectroscopia de absorción atómica. Tipos de atomizadores (chama, célula de cuarzo, tubo de grafito). Instrumentación. Aplicacións.
Tema 7. Espectroscopia de emisión atómica e espectrometría de masas atómicas.	Fundamentos da espectroscopia de emisión atómica. Fontes de excitación. Fotometría de chama. Espectrometría de emisión en plasma acoplado inductivamente. Formación dun plasma. Espectrometría de masas con plasma acoplado inductivamente. Deseño da interfase. Instrumentación. Aplicacións.

Planificación

	Class hours	Hours outside the classroom	Total hours
Resolución de problemas	24	24	48
Prácticas de laboratorio	14	3	17
Lección maxistral	24	31	55
Exame de preguntas de desenvolvemento	2	4	6
Exame de preguntas de desenvolvemento	0	8	8
Informe de prácticas, prácticum e prácticas externas	0	4	4
Resolución de problemas e/ou exercicios	0	12	12

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

Metodoloxía docente

	Description
Resolución de problemas	A resolución de problemas permitirá reforzar a aprendizaxe do temario explicado durante as clases maxistrais. A actividade a levar a cabo nestas clases comprende a resolución de problemas numéricos, exercicios teórico-prácticos, manexo de follas de cálculo para a resolución de problemas de calibración, discusión de casos prácticos relacionados cos métodos ópticos de análises e publicados en revistas docentes, etc. O profesor proporá de forma regular, diferentes problemas/exercicios/cuestionarios que serán resoltos de forma individual polo estudante e entregados para a súa avaliación.

Prácticas de laboratorio	Nas sesións prácticas de laboratorio, o estudante aprenderá o manexo dos instrumentos característicos das espectrometrías atómicas e moleculares, adquirindo destrezas nas distintas etapas do desenvolvemento dun método instrumental tales como a preparación de patróns, optimización de parámetros instrumentais, calibración, etc. Para iso, o profesor proporcionará ao estudante con suficiente antelación os guións onde se describirán de forma breve os fundamentos teóricos, obxectivos da práctica, instrumentación, reactivos e procedemento operativo. Durante o desenvolvemento das prácticas o estudante anotará nun caderno de laboratorio todas as operacións realizadas, observacións e resultados obtidos. Poderán quedar exentos de realizar as prácticas de laboratorio aqueles estudantes que as aprobaron nos dous cursos académicos anteriores, se así o desexan. Neste caso, manterase a cualificación alcanzada no seu día en ditas prácticas.
Lección maxistral	O profesor explicará os contidos do programa a partir do material proporcionado ao estudante a través da plataforma de teledocencia Moovi. Nas clases maxistrais, presentaranse os aspectos fundamentais da materia que deberán complementarse mediante a bibliografía recomendada. Se proporá aos estudantes a realización de cuestionarios con preguntas tipo test que deberán ser resoltos individualmente.

Atención personalizada

Methodologies	Description
Lección maxistral	O profesor resolverá as dúbidas de maneira personalizada sobre calquera das actividades propostas (clases maxistrais, prácticas de laboratorio, resolución de problemas/exercicios). A tal fin, o profesor informará o horario dispoñible na presentación da materia.
Resolución de problemas	O profesor resolverá as dúbidas de maneira personalizada sobre calquera das actividades propostas (clases maxistrais, prácticas de laboratorio, resolución de problemas/exercicios). A tal fin, o profesor informará o horario dispoñible na presentación da materia.
Prácticas de laboratorio	O profesor resolverá as dúbidas de maneira personalizada sobre calquera das actividades propostas (clases maxistrais, prácticas de laboratorio, resolución de problemas/exercicios). A tal fin, o profesor informará o horario dispoñible na presentación da materia.
Tests	Description
Informe de prácticas, prácticum e prácticas externas	O profesor resolverá as dúbidas de maneira personalizada sobre calquera das actividades propostas (clases maxistrais, prácticas de laboratorio, resolución de problemas/exercicios). A tal fin, o profesor informará o horario dispoñible na presentación da materia.

Avaliación

	Description	Qualification	Training and Learning Results
Prácticas de laboratorio	Nas sesións de laboratorio levará a cabo un seguimento do traballo experimental realizado polo estudante (actitude e destrezas adquiridas). A asistencia a todas as sesións de laboratorio é OBRIGATORIA. As faltas de asistencia penalizarán a nota, e cando o número de ausencias sexa superior ao 25% das sesións de laboratorio, suporá suspender a parte práctica da asignatura.	10	A3 B4 C6 D1 C26
Exame de preguntas de desenvolvemento	1ª PROBA (temas 1-4) levada a cabo aproximadamente a metade de cuadrimestre e incluída no cronograma do curso. A proba terá dúas seccións, unha de problemas/exercicios numéricos e outra de preguntas tipo test.	30	A1 B4 C6 D1
Exame de preguntas de desenvolvemento	2ª PROBA (temas 5-7) levada a cabo na data aprobada pola Xunta de Facultade correspondente ao exame final de cuadrimestre. A proba terá dúas seccións, unha de problemas/exercicios numéricos e outra de preguntas tipo test.	30	A1 B4 C6 D1
Informe de prácticas, prácticum e prácticas externas	O estudante elaborará un informe de prácticas no que se reflectirá o traballo experimental levado a cabo nas sesións de laboratorio (Preparación de patróns, calibración de equipos, procedementos, observacións, resultados etc.). Avaliarase tanto a calidade como a correcta expresión dos resultados da análise.	10	A3 B4 C26
Resolución de problemas e/ou exercicios	O estudante resolverá problemas/exercicios similares aos incluídos nos boletíns (entregables), así coma cuestións relacionadas cos contidos teóricos dos diferentes temas do programa.	20	A1 B4 C6 D1 A3

Other comments on the Evaluation

Modalidade de avaliación continua:

Consideracións sobre a avaliación das prácticas:

-Prácticas de laboratorio: a falta de asistencia, aínda sendo xustificada, penalizará a nota. Un número de ausencias superior ao 25 % das sesións de laboratorio supoñerá suspender as prácticas. Será necesario obter unha calificación mínima de 4 puntos sobre 10 para poder sumarse ao resto de elementos de avaliación. A realización das prácticas e o informe de prácticas é imprescindible para poder superar a materia tanto na modalidade de avaliación continua como de avaliación global (non continua).

-Informe de prácticas: será necesario obter unha calificación mínima de 4 puntos sobre 10 no informe de prácticas para poder sumarse ao resto de elementos de avaliación.

Consideracións sobre a avaliación das probas (proba intermedia e de final de cuatrimestre):

-A sección de cuestións tipo test e a de problemas/exercicios numéricos terán, nas dúas probas, un peso do 50% cada unha. Para poder promediar a sección de teoría e a de problemas/exercicios deberase alcanzar un mínimo de 3 puntos sobre 10 en cada unha das dúas seccións.

-Deberase alcanzar unha puntuación mínima de 4 puntos sobre 10 na primeira proba para que esta se poda promediar coa segunda. Os estudantes que na 1ª proba non alcanzasen unha calificación de polo menos 4 puntos sobre 10 deberán levar a cabo unha proba de recuperación da primeira parte da materia cuxa calificación substituirá á obtida previamente. Esta proba de recuperación realizarase na data programada para a 2ª proba. A media das dúas probas deberá ser de polo menos 4 puntos sobre 10 para poder sumarse ao resto de elementos de avaliación. Se non se alcanza esta puntuación mínima, a calificación máxima que poderá constar en actas será de 4,5 puntos.

-Unha vez tidos en conta os criterios anteriores, a superación da materia alcánzase cunha calificación global de 5 puntos sobre 10.

Calificación na 1ª oportunidade da convocatoria (Maio-Xuño):

A participación do alumno en calquera dos elementos de avaliación coa excepción da resolución de problemas e/o exercicios (entregables) inhabilita para obter a calificación de NON PRESENTADO. A calificación na primeira edición da convocatoria estará integrada polas calificacións obtidas nas clases de resolución de problemas (entregables) (2 puntos), prácticas de laboratorio (1 punto), informe de prácticas (1 punto), 1ª proba (3 puntos) e 2ª proba (3 puntos).

Calificación na 2ª oportunidade da convocatoria (Xullo):

A calificación nesta edición estará formada polas calificacións obtidas nas prácticas de laboratorio (1 punto), informe de prácticas (1 punto) e exame final dos contidos da materia (8 puntos).

1. Prácticas de laboratorio e informe de prácticas (2 puntos).

Se conservarán as calificacións obtidas polo estudante durante o curso nas prácticas de laboratorio (1 punto) e informe de prácticas (1 punto).

2. Exame final dos contidos da materia (8 puntos).

Esta proba incluírá problemas/exercicios numéricos e preguntas tipo test e abarcará todos os temas da materia. Se terán en conta as mesmas consideracións establecidas para a primeira oportunidade, e será necesaria unha calificación mínima de 4 puntos sobre 10 neste exame para que se poda sumar á calificación obtida nas prácticas.

Na segunda oportunidade da convocatoria se conservarán, se o alumno así o desexa, as calificacións das partes da materia que teña superado (1ª PROBA ou 2ª PROBA), de xeito que, de ser o caso, o estudante repetirá únicamente a parte que non teña superado na primeira oportunidade. Teranse en conta as mesmas consideracións establecidas para a primeira oportunidade, e será necesaria unha calificación mínima de 4 puntos sobre 10 neste exame para que se poida sumar á calificación obtida nas prácticas e á calificación da parte da materia superada polo alumno na primeira oportunidade da convocatoria.

En ambos casos, a superación da materia require obter unha calificación global de 5 puntos sobre 10.

Modalidade de avaliación global (non continua):

-Os estudantes que desexen acollerse a esta modalidade deberán comunicalo por escrito ao coordinador da materia durante o primeiro mes desde o comezo do cuatrimestre. Será necesario realizar obrigatoriamente as prácticas/informe e unha proba de avaliación global para superar a materia.

-Prácticas/informe (2 puntos): aplicaranse as mesmas consideracións anteriores establecidas para a avaliación continua.

-Proba de avaliación global (8 puntos): A proba terá dúas seccións, unha de problemas/exercicios numéricos e outra de

preguntas tipo test, e abarcará todos os temas da materia, coas mesmas consideracións que as determinadas anteriormente para a avaliación continua. A superación da materia require obter unha calificación global de 5 puntos sobre 10.

-A data desta proba será coincidente coa da proba final de cuatrimestre establecida para a avaliación continua.

Bibliografía. Fontes de información

Basic Bibliography

D.A. Skoog, F.J. Holler, S.R. Crouch, **Principios de Análisis Instrumental**, 7ª edición, Cengage Learning Editores, 2018

A. Rios, M.C. Moreno, M. Simonet, **Técnicas espectroscópicas en química analítica**, Síntesis, 2012

L. Hernández, C. González, **Introducción al Análisis Instrumental**, Ariel, 2002

Complementary Bibliography

J.D. Ingle, S.R. Crouch, **Spectrochemical Analysis**, Wiley, 1988

J.N. Miller, J.C. Miller, **Estadística y Quimiometría para Química Analítica**, Prentice Hall, 2002

J.M. Fernández Solís, J. Pérez Iglesias, H.M. Seco Lago, **Estadística sencilla para estudiantes de ciencias**, Síntesis, 2012

J. Guiteras, R. Rubio, G. Fonrodona, **Curso experimental en Química Analítica**, Síntesis, 2003

J.M. Andrade y 5 autores más, **Problems of Instrumental Analysis: a hands-on guide**, World Scientific Publishing Europe, 2017

Recomendacións

Subjects that continue the syllabus

Química analítica IV: Métodos cromatográficos e afíns/V11G201V01306

Química analítica III: Métodos eletroanalíticos e separacións/V11G201V01302

Calidade nos laboratorios analíticos/V11G201V01407

Química analítica ambiental e agroalimentaria/V11G201V01410

Ampliación de química analítica/V11G201V01406

Subjects that it is recommended to have taken before

Química: Laboratorio de química I/V11G201V01105

Química: Química I/V11G201V01104

Química: Laboratorio de química II/V11G201V01110

Física: Física I/V11G201V01102

Química: Química II/V11G201V01109

Química analítica I: Principios de química analítica/V11G201V01202

Matemáticas: Matemáticas II/V11G201V01108

Física: Física II/V11G201V01107

Matemáticas: Matemáticas I/V11G201V01103

IDENTIFYING DATA**Physical Chemistry II: Surfaces and Colloids**

Subject	Physical Chemistry II: Surfaces and Colloids			
Code	V11G201V01208			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Bravo Díaz, Carlos Daniel Hervés Beloso, Juan Pablo			
Lecturers	Bravo Díaz, Carlos Daniel Correa Duarte, Miguel Ángel Currás Barreiro, Leyre Hervés Beloso, Juan Pablo Hervés Pardavila, Adrián Sanmartín Rodríguez, Paula Sousa Castillo, Ana			
E-mail	jherves@uvigo.es cbravo@uvigo.es			
Web	http://moovi.uvigo.gal/login/index.php			
General description	In the present subject we intend to develop the fundamentals of Chemical Thermodynamics which have been introduced in previous subjects in order to apply them to systems of particular chemical interest, such as macromolecules and colloids, as well as to the adsorption processes. For accomplishing these purposes, Transport Phenomena are studied first, using some basic elements of Kinetic Theory which will be analyzed more deeply in the subject 'Química Física V: Cinética Química' of the third year. It is then possible to study the origin of ionic conductivity and discuss its chemical applications extensively. By using the thermodynamic treatment of the interface, the stability of colloidal systems can be analyzed and the adsorption processes studied. The experimental methods for the study of the structure and composition of interfaces are presented and used as far as possible in lab experiments. Such methods include those based on surface tension measurements and also those related to adsorption on solid surfaces. The experimental methods needed for the study of macromolecules and colloids are also studied. : English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
B1	Ability for autonomous learning
B2	Organization and planning capacity
B4	Ability for analysis and synthesis
C16	Know the relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids, crystals and other materials
C27	Demonstrate the ability to observe, monitor and measure chemical processes, by systematically and reliably recording them and presenting reports of the work done
C28	Interpret data derived from laboratory observations and measurements in terms of their meaning and relate them to the appropriate theory
D1	Ability to solve problems

Expected results from this subject

Expected results from this subject	Training and Learning Results			
To know the general mechanisms of transport processes, its equations and applications.	A1	B1 B2 B4	C16 C27 C28	D1

To understand the origin of ionic conductivity and its chemical applications.	A1	B1 B2 B4	C16 C27 C28	D1
To know the structure of the interfaces and the magnitudes that characterise it.	A1	B1 B2 B4	C16	
To explain the principles which govern the adsorption phenomena and to know various adsorption isotherms.	A1	B1 B2 B4	C16 C27 C28	D1
To explain the nature and structure of polymers and macromolecules.	A1 A3	B1 B2 B4	C16	
To explain the causes of the stability of colloidal systems and their control.	A1 A3	B1 B2 B4	C16 C27 C28	D1
To describe the fundamentals of the experimental techniques used in the determination of the structure of macromolecules and colloidal systems	A1 A3	B1 B2 B4	C16 C27 C28	D1

Contents

Topic

TRANSPORT PHENOMENA.	1. Fundamental results of the kinetic theory of gases. 2. Non-electric transport phenomena: Diffusion. Thermal conductivity. Viscosity. 3. Electric transport phenomena. ionic conductivity. Ionic mobility. Applications of conductivity measurements.
SURFACE PHENOMENA and SURFACE TENSION	1. Interfaces. 2. Thermodynamic treatment: surface tension. curved interfaces. Kelvin equation 3. Capillarity and contact angle. 4. Interfaces with more than one component: Gibbs Law. 5. Monolayers. Detergency.
ADSORPTION ON SOLIDS	1. Description of the structure of solid surfaces. 2. Adsorption: general aspects. 3. Physisorption and Chemisorption. 4. Adsorption isotherms. 5. Electrified interface. Double layer models.
COLLOIDS	1. Classification of colloidal systems. 2. Synthesis of colloids. 3. Colloidal stability. 4. DLVO theory. 5. Association colloids: micelles, vesicles and microemulsions
POLYMERS AND MACROMOLECULES	1. Structure of macromolecules. 2. Structural models. Conformations. 3. Distribution of molecular masses. 4. Characterization of macromolecules. 5. Polymerization. Degree of polymerization.
LABORATORY LESSONS	Laboratory practices related to the contents of the theory classes: - Transport phenomena: ionic conductivity. - Surface phenomena: Surface tension Measurements. - Adsorption on solid surfaces. - Synthesis and characterization of macromolecules and colloids.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	42	66
Problem solving	12	22	34
Laboratory practical	28	20	48
Objective questions exam	1	0	1
Objective questions exam	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

Description

Lecturing	Discussion of the fundamental aspects of each topic and description of those to be addressed in the seminars. Discussion of the specific issues raised by students. The student will be provided with the study material necessary to follow the lessons through the Moovi platform.
Problem solving	Resolution of numerical problems and theoretical questions as well as test-type exercises. Numerical and theoretical problems will be solved by the teacher with the participation of the students. The results will be analyzed and interpreted. On a voluntary basis, the student may solve some of these exercises in the seminar, with the assistance of the teacher and the participation of the rest of the students.
Laboratory practical	Every student is expected to perform a well balanced set of experiments which exemplifies and develops the fundamental topics. In principle, we expect the experiments to be carried out by couples of students for agility, but they may also be done individually, depending on the circumstances. Scripts describing every experiment, references to bibliographic material and instructions for the use of the devices if needed, as well as others related to laboratory safety, will be made available. The student must draw up the figures and make the necessary calculations to obtain the final results, as well as analyze and discuss them.

Personalized assistance

Methodologies	Description
Lecturing	The student may raise specific questions in the lectures and more extensive ones in the teacher's tutoring schedule
Problem solving	The solution to the proposed exercises will be discussed with students in connection with the development of the theoretical foundations. The additional questions students may raise will be answered during the teacher's tutoring schedule.
Laboratory practical	The problems or doubts the students might have regarding the theoretical foundation of the experiments, their development and the key aspects of the calculations needed to obtain the result will be discussed during the practical sessions. Additional issues will be addressed in tutoring hours.
Tests	Description
Objective questions exam	Any doubts regarding the exams, in particular those related to their scope and configuration, shall be clarified. In the case of the short test, the solutions to the exercises will be briefly presented and discussed in the following seminar. During tutoring hours, the answers provided by the student will be discussed with him/her at his/her request; the time deadlines will be respected in the case of the exam (long-duration test).
Objective questions exam	

Assessment

	Description	Qualification	Training and Learning Results			
Problem solving	The resolution by the student of the proposed exercises and their presentation will be valued. Test-type questionnaires will also be carried out. In both cases voluntarily. The weight in the score is between the limits 0-10%	10	A1	B1 B2 B4	C16	D1
Laboratory practical	Laboratory lessons are compulsory. Its experimental development is valued as well as the presentation of a practice report. This must contain tables, graphs and the necessary calculations to obtain the results. This report may be replaced by an oral presentation of some of the lab lessons accompanied by questions from the teaching staff who teach the practical exercises. The weight in the score is between the limits 0-15%)	15	A1 A3	B1 B2 B4	C16 C27 C28	D1
Objective questions exam	First short exam. It will take place in the middle of the semester approximately. It will consist of solving questions and problems. If its mark reaches or surpasses 5 on the 10-point scale the corresponding topics can be considered as passed. Its weight, depending on the other sections of the evaluation, will be 35%.	37.5	A1		C16 C28	D1
Objective questions exam	Second short exam. It will take place at the end of the semester. It will consist of solving questions and problems. Its weight, depending on the other sections of the evaluation, will be 35%.	37.5	A1		C16 C28	D1

Other comments on the Evaluation

To pass the subject it is necessary to pass the laboratory practices.

The qualification of each exam (and the average of them) must be at least 4.0 out of 10 so that an average can be made with the other sections.

Presenting any exercise, performing any practice or test makes it impossible for the qualification to be 'non qualified'.

Sources of information

Basic Bibliography

Atkins, P.W.; de Paula, J., **Atkin's Physical Chemistry**, 10th ed., Oxford University Press, 2014

Levine, I. N, **Physical Chemistry**, 6th ed., McGraw-Hill, 2009

Complementary Bibliography

Bertrán-Rusca, J; Núñez-Delgado, J, **Química Física (Vol II)**, 1º edición, Ariel Ciencia, 2002

Adamson, A. W.; Gast, A. P, **Physical Chemistry of Surfaces**, 6th ed, Physical Chemistry of Surfaces, 1997

Everett, D. H. F.R.S, **Basic Principles of Colloid Science**, RSC Paperbacks, 1988

Recommendations

Subjects that it is recommended to have taken before

Physical chemistry I: Chemical thermodynamics/V11G201V01203

Chemistry: Chemistry 2/V11G201V01109

Other comments

Some contents will be developed and complemented in subjects taught in the third and fourth year. For instance "Química Física V: Cinética Química" (3rd year), "Química de Materiales" (4th year) and, the optional subjects "Nanoquímica" and "Materia Condensada" of the 4th year.

IDENTIFYING DATA				
Inorganic chemistry II				
Subject	Inorganic chemistry II			
Code	V11G201V01209			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Talavera Nevado, María			
Lecturers	Pérez Lourido, Paulo Antonio Talavera Nevado, María Valencia Matarranz, Laura María			
E-mail	matalaveran@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	It is a subject of six credits that is taught in the second semester of the second year and belongs to the module of compulsory subjects of the Degree in Chemistry. The objective of the subject is the study of the metallic elements of the main groups (s and p blocks) and a brief introduction to the study of transition (d block) and internal transition metals (f block).			

Training and Learning Results	
Code	
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
B1	Ability for autonomous learning
B3	Ability to manage information
B4	Ability for analysis and synthesis
C8	Know the characteristic properties of the elements and their compounds, including the relations between groups and their variations in the periodic table
C9	Know the structural aspects of chemical elements and their compounds, including stereochemistry
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work
D2	Capacity for teamwork

Expected results from this subject				
Expected results from this subject	Training and Learning Results			
Be able to foretell the properties of the metals depending on its position in the Periodic Table	A2 A3	B1 B3 B4	C8	
Be able to choose the general metal suitable for obtaining of the main group metals and their more relevant compounds	A2 A3	B1 B3 B4	C8 C9	
Be able to describe the structure and the more relevant reactivity of the main group metals and their compounds	A2 A3	B1 B3 B4	C8 C9	
Be able to deduce the physical properties of an element or compound from the type of bond and/or intermolecular forces	A2 A3	B1 B3 B4	C8 C9	
Show capacity to relate the physical and chemical properties of any substances of interest with his applications	A2 A3	B1 B3 B4	C8 C9	
Be able to carry out in the laboratory to preparation of some elements and his compounds as well as the study of any of the their physical and chemical properties	A2 A3	B1 B3 B4	C8 C9 C26	D2

Contents
Topic

Subject 1. The metals and the metallic behaviour	Crystalline structure of the metals Link metallic Distribution of the metals in the Periodic Table Properties of the metals Alloys
Subject 2. Metallurgy	Obtaining, concentration and reduction of the ore Diagrams of *Ellingham Methods of refining and purification of metals
Subject 3. Elements of the group 1. Alkaline	Abundance, obtaining and uses physical Properties Reactivity (chemical properties) Compound more important
Subject 4. Elements of the group 2. Alkaline- *térreos	Abundance, obtaining and uses physical Properties Reactivity (chemical properties) Compound more important
Subject 5. Metallic elements of the group 13: To the, *Ga, *In and *Tl	Abundance, obtaining and uses physical Properties Reactivity (chemical properties) Compound more important
Subject 6. Metallic elements of the group 14: *Sn, *Pb	Abundance, obtaining and uses physical Properties Reactivity (chemical properties) Compound more important
Subject 7. Metallic elements of the group 15: Ace, *Sb and *Bi	Abundance, obtaining and uses physical Properties Reactivity (chemical properties) Compound more important
Subject 8. Introduction to the Chemistry of the Metals of Transition	Main characteristics of the Metals of Transition Abundance and obtaining physical Properties chemical Properties
Subject 9. Elements of the group 12: *Zn, *Cd and *Hg	Abundance, obtaining and uses physical Properties Reactivity (chemical properties) Compound more important
Subject 10. Chemical *organometálica of the main groups	*Organolíticos *Organomagnesianos Derived of aluminium Other complexes *organometálicos important
Subject 11. Introduction to Chemistry of the Metals of Internal Transition: Lanthanides and Actinides.	Abundance, obtaining and uses physical Properties Reactivity (chemical properties) Compound more important Compound *organometálicos *Bioinorgánica
Laboratory. They will make 4 practical sessions of 3,5 hours each one of them.	Session 1. Obtaining of iron by aluminothermy Session 2. Study of the reactivity of the calcium and some of his compounds in water Session 3. Comparative study of the reactivity of metals of the main groups and of transition Session 4. Identification of salts

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	30	54
Problem solving	12	24	36
Laboratory practical	14	8	22
Essay questions exam	2	18	20
Essay questions exam	0	18	18

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

Methodologies

Description

Lecturing	Exhibition by the lecturer of the contents on the matter stressing the most notable appearances and in those that result of more difficult understanding for the students. The classes will develop of interactive form with the students, commenting the available on-line material in Moovi and internet as well as the easiest bibliography for the preparation, in depth, of each subject. They will resolve the doubts that go having the students.
Problem solving	Activity in which they formulate problems and/or exercises related with the matter. The student/has to develop it the ideal or correct solutions by means of reasoning, logical and critical thought giving place to an interpretation of the correct results. It is used to employ how complement of the theory lesson.
Laboratory practical	Realisation under the supervision of the professors but of autonomous way, of practices of laboratory in sessions of 3,5 hours each one. The students will have, through the virtual classroom, of the necessary material for the previous preparation of the experiments. The work with said material will be able to include the realisation and delivery of tasks. During I unroll it of the practices, each student will elaborate a fascicle of laboratory, where will annotate all the relative information to the experiment made (reactions, observations, results, etc.). After the realisation of the practices, the students will have to complete the work indicated in each case. Students who performed and approved the practical laboratory during 2025/2026 course, do not need to repeat it while keeping the grade obtained.

Personalized assistance

Methodologies	Description
Lecturing	Throughout the teaching period, students will be able to consult their doubts both in face-to-face sessions and during tutorial hours, in the latter case, by appointment. The teaching team will inform of their availability with the tutorial schedules published on the Faculty's website. Additionally, the telematic communication channels with the students will be used (email, virtual classroom tools or the Moovi tele-teaching platform).
Laboratory practical	The teaching staff will attend to the students' queries related to the development of laboratory teaching, both in the practice sessions and before and after their delivery. The hours of attention to the students of the teaching staff of the subject will be available in the virtual classroom and through other channels established by the University.
Problem solving	The resolution of the proposed exercises will be discussed with the students and the results obtained will be analyzed in connection with the development of theoretical aspects. Additional questions that students may raise during the teacher's tutorial schedule will be answered.
Tests	Description
Essay questions exam	Throughout the teaching period, students will be able to consult their doubts both in face-to-face sessions and during tutorial hours, in the latter case, by appointment. The teaching team will inform of their availability with the tutorial schedules published on the Faculty's website. Additionally, the telematic communication channels with the students will be used (email, virtual classroom tools or the Moovi tele-teaching platform). During the exam, the student can ask the teacher for any clarifications he deems appropriate for the correct understanding of the questions asked.
Essay questions exam	Throughout the teaching period, students will be able to consult their doubts both in face-to-face sessions and during tutorial hours, in the latter case, by appointment. The teaching team will inform of their availability with the tutorial schedules published on the Faculty's website. Additionally, the telematic communication channels with the students will be used (email, virtual classroom tools or the Moovi tele-teaching platform). During the exam, the student can ask the teacher for any clarifications he deems appropriate for the correct understanding of the questions asked.

Assessment

Description		Qualification	Training and Learning Results			
Problem solving	Each student will resolve exercises of approach, questions and/or problems of the contents so much in hours of seminar like lessons or out of the classroom.	15	A2 A3	B3 B4	C8 C9	D2

Laboratory practical	In the sessions of laboratory will carry out a follow-up of the experimental work made by the students (attitude and skills purchased). It is important to indicate that it is COMPULSORY the assistance to all the sessions of laboratory. The fault of assistance, even being justified, will penalise the note (in case of absences justified recommends if possible, recover the practice in another group). If the number of absences is upper to 25% of the sessions of laboratory, will suppose to suspend the practices, and with this the matter. If it does not achieve an equal or upper qualification to 5 in this section also will suppose to suspend the matter.	15	A2 B3 C8 A3 B4 C26
	The evaluation of the practices of laboratory will be able to take into account the delivery and answer of the previous questions, the preparation of the fascicle of laboratory, the behaviour and the skills achieved by the students in each one of the practical sessions. Besides it will be able to him ask to the students the realisation of questions related with the practices made or a proof written, that will have to deliver in this moment and that will serve for his evaluation.		
	The people that approved the practical lessons in the previous course (2025-2026) do not need to repeat them. They will maintain the grade.		
	The punctuation of this section only will consider yes in the proofs written reaches an equal or upper qualification to 5 points on 10.		
Essay questions exam	In the official date fixed in the calendar of examinations of the Faculty of Chemistry will make a first proof written intermediate on the matter given.	35	A2 B1 C8 A3 B3 C9 B4
	It is necessary to achieve an equal or upper note to 4 on 10 to be considered.		
Essay questions exam	In the official date fixed in the calendar of examinations of the Faculty will make a second proof written on the second part of the matter given.	35	A2 B1 C8 A3 B3 C9 B4
	It is necessary to achieve an equal or upper note to 4 on 10 to be considered.		

Other comments on the Evaluation

In any modality of evaluation, in case of doubt about the acquisition of results of learning by part of the students, will be able to make additional oral proofs of evaluation.

The students will have to make a proof of inorganic formulation in the distinct proofs written and obtain a qualification of Apt to approve the subject.

Continuous evaluation:

In case of not achieving the minimum qualification demanded in some proof to surpass the matter, the final qualification will be the qualification of said proof

understands that a/one student presented to the evaluation of the matter and, therefore, will consign him a qualification, in the following supposed:

1. If it presents the some examination of questions of development.
2. It participates in proofs or activities of continuous evaluation further of the terms established by the centre for the application of the modality of global evaluation.

Is precise a minimum note of 5 on 10 to surpass the matter.

Global evaluation: The students to the that have conceded him by the deanship the global evaluation will have an examination of questions of development (85%) that will make in the official date of the examination for each opportunity of evaluation inside the period of official proofs marked in the academic calendar of each course, to what will add the note obtained in the practices (15%).

Is precise a minimum note of 5 on 10 in the global examination and the practices to surpass the matter.

Sources of information

Basic Bibliography

Catherine E. Housecroft, Alan G. Sharpe ; traducción Pilar Gil Ruiz, **Química inorgánica**, 2ª, Pearson, 2006

Catherine E. Housecroft, Alan G. Sharpe ; traducción Pilar Gil Ruiz, **Química inorgánica**.

https://www.ingebook.com/ib/NPcd/IB_Escritorio_Visualizar?cod_primaria=1000193&libro=2154, 2ª, Pearson, 2006

Complementary Bibliography

Rochow E.G., **Química inorgánica descriptiva**.

<https://www.digitaliapublishing.com/a/103289/quimica-inorganica-descriptiva>, 1ª, Reverté, 1981 (2010)

James E. Huheey, Ellen A. Keiter, Richard L. Keiter, **Química inorgánica: principios de estructura y reactividad**, 4ª, Oxford University Press, 1997

Cotton F.A. , Wilkinson G., **Química inorgánica avanzada**, 4ª, LIMUSA WILEY, 2006

Rayner-Canham G., **Química inorgánica descriptiva**, 2ª, Pearson Education, 2000

House, James E., **Inorganic Chemistry**, 3ª, Academic Press, 2020

Hosmane, Narayan S., **Advanced Inorganic Chemistry. Application in every day life**, 1ª, Academic Press, 2017

Crichton, Robert, **Biological inorganic chemistry**, 3ª, Academic Press, 2019

Recommendations

Subjects that continue the syllabus

Inorganic Chemistry IV: Transition Metals and Solid State/V11G201V01309

Inorganic Chemistry III: Coordination Chemistry/V11G201V01304

Subjects that are recommended to be taken simultaneously

Structural Determination/V11G201V01206

Subjects that it is recommended to have taken before

Chemistry: Chemistry Lab I/V11G201V01105

Chemistry: Chemistry 1/V11G201V01104

Chemistry: Chemistry Lab II/V11G201V01110

Inorganic chemistry I/V11G201V01204

IDENTIFYING DATA				
Organic chemistry II				
Subject	Organic chemistry II			
Code	V11G201V01210			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish Galician English			
Department				
Coordinator	Freire Iribarne, Félix Iglesias Antelo, María Beatriz			
Lecturers	Fernández Rodríguez, Diego Freire Iribarne, Félix Iglesias Antelo, María Beatriz Rodríguez Riego, Rafael Teijeira Bautista, Marta			
E-mail	bantelo@uvigo.gal felixmanuel.freire@uvigo.es			
Web				
General description	The main objective of this subject is to go in depth in the knowledge of the properties and reactivity of the functional groups. After a detailed study of the reactions of nucleophile substitution and elimination, the reactions of addition to carbonyl group, the carboxylic acid derivatives and the reactivity in alpha to carbonyl group will be tackled. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code			
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study		
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy		
B5	Ability to adapt to new situations and to make decisions		
C17	Know the nature and behavior of functional groups in organic molecules		
C18	Know the properties of aliphatic, aromatic, heterocyclic and organometallic compounds		
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work		
C28	Interpret data derived from laboratory observations and measurements in terms of their meaning and relate them to the appropriate theory		
D1	Ability to solve problems		
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English		

Expected results from this subject

Expected results from this subject	Training and Learning Results		
To distinguish, according to the reaction conditions and substrates used, the mechanisms of nucleophilic substitutions SN1 and SN2.	A1	C17	D1
	A5	C18	D3
To apply nucleophilic substitution reactions on sp ³ carbons to obtain organic compounds with single bonds.	A1	C17	D1
	A5	C18	D3
To distinguish, according to the reaction conditions and substrates used, the E1 and E2 mechanisms of elimination reactions.	A1	C17	D1
	A5	C18	D3
To explain the reactivity of carbonyl compounds through nucleophilic addition.	A5	C17	D1
		C18	D3
To explain the reactivity of carboxylic acid derivatives by means of an addition-elimination mechanism.	A5	C17	D1
		C18	D3
To apply the reactivity of enols and enolates.	A1	C17	D1
	A5	C18	D3
To apply the reactivity of beta-dicarbonyl compounds and alfa,beta-unsaturated carbonyl compounds in organic synthesis.	A1	C17	D1
	A5	C18	D3

To carry out properly the usual experimental procedures in simple organic preparations.

A1 B5 C17 D1
A5 C18 D3
C26
C28

Contents

Topic	
LESSON 1. Reactions of nucleophilic substitution on sp ³ carbons	Bimolecular and unimolecular nucleophilic substitution reactions (SN2 and SN1): kinetic, mechanisms and stereochemistry. Competition between SN2 and SN1. Transformation of functional groups through SN2 and SN1 reactions.
LESSON 2. Reactions of elimination	Bimolecular elimination reaction (E2). Unimolecular elimination reaction (E1). Competition between substitution and elimination. Application of elimination reactions in organic synthesis.
LESSON 3. Reactions of nucleophilic addition to the carbonyl group	Structure and general reactivity of the carbonyl group (aldehydes and ketones). General mechanism of the nucleophilic addition. Addition of oxygenated and sulfur compounds, nitrogenated compounds, hydride, organometallic compounds, cyanide, and acetylides. The Wittig reaction.
LESSON 4. Reactions of nucleophilic substitution on the carbonyl group	Structure and general reactivity of carboxylic acids and derivatives. Preparation and reactivity of acid halides, acid anhydrides, esters, and amides. Structure and reactivity of nitriles.
LESSON 5. Reactivity in alpha position of the carbonyl group	Enols and enolates: general reactivity. Keto-enol tautomerism. Alpha-alkylation of enolates. Alpha-halogenation of enols and enolates. Reactions of enolate anions with carbonyl compounds (aldolic condensation).
LESSON 6. Reactivity of bifunctional carbonyl compounds	Reactions of beta-dicarbonyl compounds. Reactions of alpha,beta-unsaturated carbonyl compounds. Michael reaction. Robinson annulation.
LABORATORY	In these sessions, experiments related to the theoretical content of the lessons will be carried out.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	23	30	53
Problem solving	12	24	36
Laboratory practical	27	7	34
Problem and/or exercise solving	1	2	3
Problem and/or exercise solving	1	4	5
Problem and/or exercise solving	1	4	5
Problem and/or exercise solving	1	8	9
Problem and/or exercise solving	1	4	5

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

Methodologies

	Description
Lecturing	The teaching staff will expose, in a structured way, the general aspects of the subject, paying special attention to those of greatest relevance to the program and the most difficult for students to assimilate. The teaching staff will provide, through the virtual classroom, the necessary material for the personal work of the students.
Problem solving	In this activity, a series of exercises and problems previously elaborated and proposed by the teacher will be resolved. The teacher will solve the doubts and will comment on the specific aspects.
Laboratory practical	A series of experiments in the laboratory will be carried out in face-to-face sessions 3,5 h long. The students will have all the necessary material for the previous preparation of the experiments through the virtual classroom. During the laboratory sessions, the students will elaborate a laboratory notebook in which they will annotate all observations related to the experiments. After the development of the practices, the students will have to complete the work indicated in each case.

Personalized assistance

Methodologies	Description
Lecturing	Students will be tutored by the teaching staff. Tutoring sessions can take place in person or by telematic means, by previous appointment (felixmanuel.freire@uvigo.gal).

Laboratory practical	Students will be tutored by the teaching staff. Tutoring sessions can take place in person or by telematic means, by previous appointment.
Problem solving	Students will be tutored by the teaching staff. Tutoring sessions can take place in person or by telematic means, by previous appointment (felixmanuel.freire@uvigo.gal, rafael.rodriguez.riego@uvigo.gal).
Tests	Description
Problem and/or exercise solving	Students will be tutored by the teaching staff. Tutoring sessions can take place in person or by telematic means, by previous appointment.

Assessment						
	Description	Qualification	Training and Learning Results			
Laboratory practical	Assistance to laboratory classes is compulsory. Laboratory work will be evaluated as APT or NON APT. The following aspects will be evaluated: previous or subsequent work, experimental work and lab notebook. In order for the students to pass the subject, a qualification of APT must be reached.	0	B5	C17	D1	C18 C26 C28
Problem and/or exercise solving	Previous laboratory test: Before the beginning of the laboratory sessions, the students will take a test in which they must show mastery of laboratory basic questions (determination of molecular formulas, yield calculation, organic solvents characteristics).	5	B5	C17	D1	C26 C28
Problem and/or exercise solving	Test 1: Halfway through the semester, students will take a test covering the contents of the first lessons (1-3).	20	A1	B5	C17	D1 A5 C18 D3
Problem and/or exercise solving	Test 2: At the end of the semester, students will take a test covering the contents of the last lessons.	15	A1	B5	C17	D1 A5 C18 D3
Problem and/or exercise solving	Final test: A test covering ALL THE CONTENTS OF THE SUBJECT. A minimum mark of 4.0 points out of 10.0 must be achieved in order to pass the subject.	40	A1	B5	C17	D1 A5 C18 D3
Problem and/or exercise solving	Final laboratory test: after finishing the laboratory sessions, students will take a test regarding the experimental part of the subject. A minimum mark of 5.0 points out of 10.0 must be achieved in order to pass the subject.	20	B5	C17	D1	C18 C26 C28

Other comments on the Evaluation

Basic learning outcomes for this subject:

- Chemical language (functional groups; organic formulation and nomenclature; reaction and resonance arrows; curved arrows; resonance forms).
- Stereochemistry (representing 3D-structures; chair conformations; chiral centres; absolute and alkene configuration assignment).
- Basic reactivity (identifying acids, bases, nucleophiles and electrophiles; formal oxidation states; carbocations; cations and anions stability).
- Laboratory (determination of a reaction yield).

In case of doubt about the acquisition of the learning results by the students, additional oral assessment tests may be taken.

To pass the subject in June you will need:

- Achieve the mention of APT in the evaluation of laboratory practices.
- Achieve a minimum score of 4 points out of 10 in the final test.
- Get a minimum score of 5 points out of 10 in the final laboratory test.
- Achieve a minimum score of 5 in the weighted sum of all sections.

If any of the above conditions is not met, the mark that will appear in the report will be the mark of the test in which the minimum was not reached. Or, in the case of not reaching the minimum in none of the final tests, the weighted sum of the two final tests.

The final grade of the student who passes the subject may be normalized so that the highest grade can reach a value of up to 10 points.

2nd AND SUBSEQUENT REGISTRATION STUDENTS: Students who have been evaluated with APT in the laboratory work

in a previous year will be awarded APT in the laboratory work for the current academic year. It is not needed to redo the experiments. However, they must carry out the previous laboratory test (5%) and the final laboratory test (20%) to obtain the corresponding qualification for the experimental part of the subject in the current academic year.

For students who choose continuous assessment, the teacher may use the comprehensive assessment option if it benefits the student.

EVALUATION IN JULY: The grade obtained by the students during the course in the laboratory practical will be maintained. It will be possible to take a test of all the theoretical content of the subject that will mean 75% of the final grade and/or a written test of the experimental part that will mean 25% of the final grade.

It will be necessary to achieve a minimum of 5 points out of 10 in these tests to pass the subject.

The final mark will be the weighted sum of both tests, provided that the required minimums are reached. Otherwise, the score that will appear in the report will be the mark of the test in which the minimum was not reached. Or, in the case of not reaching the minimum in none of the final tests, the weighted sum of the two final tests.

GLOBAL EVALUATION OPTION: To pass the subject, the student must carry out the laboratory practices, achieve APT grade in the work developed in the laboratory and a grade equal to or greater than 5 points out of 10 in the written test of the experimental part (25% of the final mark). In addition, it is necessary to achieve at least 5 points out of 10 in a test in which all the contents of the subject will be evaluated (75% of the final grade).

Sources of information

Basic Bibliography

KLEIN, D., **Química Orgánica**, 1ª edición en español, Médica Panamericana, 2013

VOLLHARDT, K.P.C.; SCHORE, N.E., **Química Orgánica**, 5ª en español, Ediciones Omega, 2007

WADE, L.G., **Química Orgánica**, 9ª en español, Pearsons-Educación, 2017

M A Martínez Grau, **TECNICAS EXPERIMENTALES EN SINTESIS ORGANICA**, 2ª Edición, Síntesis, 1988

Complementary Bibliography

PALLEROS, D.R., **Experimental Organic Chemistry**, John Wiley and Sons, 2000

QUIÑOÁ, E.; RIGUERA, R., **Cuestiones y ejercicios de Química Orgánica**, 2ª edición, McGraw-Hill Interamericana, 2004

QUIÑOÁ, E.; RIGUERA, R., **Nomenclatura y representación de los compuestos orgánicos**, 2ª edición, McGraw-Hill Interamericana, 2005

DOBADO, J.A.; GARCÍA-CALVO, F.; GARCÍA, J.I., **Química Orgánica: ejercicios comentados**, Garceta, 2012

CAREY, F., **Química Orgánica**, 9ª en español, McGraw-Hill Interamericana, 2014

CLAYDEN, J.; GREEVES, N.; WARREN, S., **Organic Chemistry**, 2ª edición, Oxford University Press, 2012

Recommendations

Subjects that continue the syllabus

Organic Chemistry IV: Design of Organic Synthesis/V11G201V01310

Organic Chemistry III: Concerted, Radical and Photochemical Reactions/V11G201V01305

Subjects that are recommended to be taken simultaneously

Structural Determination/V11G201V01206

Subjects that it is recommended to have taken before

Organic chemistry I/V11G201V01205

IDENTIFYING DATA				
Chemical engineering				
Subject	Chemical engineering			
Code	V11G201V01301			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	#EnglishFriendly #PortuguêsAmigável Spanish Galician			
Department				
Coordinator	Gómez Costas, Elena			
Lecturers	Gómez Costas, Elena González de Prado, Begoña			
E-mail	elenagc@uvigo.es			
Web				
General description	This subject, given in the 3er course of the Degree in Chemistry, offers an introduction to the Chemical Engineering, in which they relate the knowledges purchased in the degree of chemistry with his application in the processes of the chemical industry. The main aim of the matter is that the student purchase the basic knowledges in balances of matter and energy and apply his knowledges to the design of unitary operations of separation like the distillation or the liquid extraction-liquid. Besides, this matter serves of base to comprise the contents of other subjects like Environmental Chemistry, Alimentary Chemistry and Industrial Chemistry. Matter of the program English Friendly and Português Amigável: With the end of integration of the international students, the professor offers the possibility to the student of: a) have of materials and bibliographic references for the follow-up of the matter in English, b) receive tutorías in English, c) make the proofs and evaluations in English.			

Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
B4	Ability for analysis and synthesis
C3	Recognize and analyze chemical, qualitative and quantitative problems, proposing strategies to solve them through the evaluation, interpretation and synthesis of data and chemical information
C23	Know the principles and procedures of chemical engineering
D1	Ability to solve problems

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Know and identify the diverse operations of separation and his fields of application.	A1	B4	C3 C23	D1
Elaborate and interpret diagrams of liquid balance-steam, liquid- liquid and liquid-gas	A1	B4	C3 C23	D1
Design the different operations of separation based in liquid balance-steam, liquid-liquid and liquid-gas.			C23	D1
Design chemical reactors ideals.	A1		C3 C23	D1

Contents

Topic	
Subject 1. Introducción to Chemical Engineering	Origin, concept and evolution of Chemical Engineering. Scheme of a chemical process. General concepts: batch, continuous and semi-continuous operation; steady and unsteady state; co-current and counter-current operation. Classification of unit operations. Systems of units.

Subject 2. Material and Energy Balances	General balance equation. Material balances in systems without chemical reaction in steady state (recycle, purge and bypass) and in unsteady state. Material balances in systems with chemical reaction in steady and unsteady state. General energy balance equation. Energy balances in systems without chemical reaction in closed and open systems. Energy balances in systems with chemical reaction. Steady state
Subject 3. Distillation	Vapor-liquid equilibrium. Phase diagrams for binary mixtures. Simple distillation: flash distillation and differential distillation. Rectification.
Subject 4. Liquid liquid extraction	Liquid-liquid equilibrium of binary and ternary systems: binodal curve and tie-lines. Liquid-liquid extraction in direct contact. Liquid-liquid extraction in counter-current
Subject 5. Chemical Reactors	Reaction rate. Ideal reactors: batch reactor, continuous stirred tank reactor (CSTR) and plug flow reactor (PFR).
Subject 6. Heat Transfer	Heat transfer mechanisms. Heat conduction through flat, cylindrical and spherical walls. Heat exchangers.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	12	24	36
Problem solving	14	28	42
Collaborative Learning	6	0	6
Autonomous problem solving	2	18	20
Objective questions exam	2	22	24
Problem and/or exercise solving	2	20	22

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

Methodologies

	Description
Lecturing	Weekly one-hour face-to-face sessions dedicated to the presentation and in-depth exploration of the key concepts of each thematic block. To maximize the effectiveness of these classes, students are required to conduct a prior review of the various materials hosted on the Moovi platform, where explanatory videos, PowerPoint presentations, and/or detailed written summaries of the contents are available. This prior preparation is essential to facilitate the understanding of the subject and allow for a smooth transition toward problem-solving activities
Problem solving	Practical sessions aimed at applying the technical concepts explained in the lectures. For each thematic block, students will have at least one specific problem set available on Moovi. In the classroom, the professor will solve the most representative exercises in a guided manner
Collaborative Learning	Face-to-face sessions conducted in small groups in which students collaboratively solve problems proposed by the professor. During these classes, discussion and teamwork are encouraged in order to apply the knowledge acquired in both the lectures and the problem-solving sessions. These activities are carried out entirely in the classroom, and upon completion, each group must submit its solutions for assessment.
Autonomous problem solving	Individual completion and submission of quizzes, problem sets, and/or activities for each topic through the Moovi platform, where students will be provided with specific learning materials that must be completed and submitted individually. This system enables continuous monitoring and assessment of each student's progress and facilitates the evaluation of their level of understanding of the course content. In addition, Topics 1 and 6 will be delivered through guided autonomous learning using the flipped classroom methodology.

Personalized assistance

Methodologies	Description
Problem solving	During these face-to-face sessions, the professor will provide direct guidance to the groups. For monitoring learning progress, students may schedule individual tutorials (in person or online) via email at any time during the semester. Likewise, the professor will propose in-person group tutorials, whenever possible, at previously agreed times in order to coordinate progress and address collective technical questions.

Collaborative Learning	The professor will provide guidance and address questions related to the course content and problem sets through individual or group tutorials. These tutorials may be conducted either in person or online, using the Moovi platform, email, or virtual sessions through the instructor's online classroom. Students may request and schedule individual tutorials at any time during the semester by arranging an appointment via email. In addition, to enhance the learning process, group tutorials will be organized whenever possible, preferably in person, at times agreed upon with the students in order to maximize participation.
Autonomous problem solving	The professor will address Moovi activities and quizzes through individual or group tutorials. Tutorials may be conducted either in person or online, using the Moovi platform, email, or virtual sessions via the instructor's online classroom. Students may request and schedule an individual tutorial at any time during the semester by arranging an appointment via email. In addition, in order to optimize learning, in-person group tutorials will be proposed whenever possible, at previously agreed times with the students, in order to ensure the highest possible level of participation.

Assessment					
	Description	Qualification	Training and Learning Results		
Collaborative Learning	Evaluation of the resolution of the exercises made of form grupal entirely in the classroom.	10	B4	C3	D1
Autonomous problem solving	Qualification based in the realisation and individual delivery of questionnaires and tasks in Moovi in the terms indicated. It includes the follow-up of the autonomous learning guided (flipped classroom) of the subjects 1 and 6.	10	B4	C3	D1
Objective questions exam	Global examination of the theoretical contents-practical of all the matter, made in the official date fixed by the centre.	40	A1	B4	C3
Problem and/or exercise solving	Realisation of two proofs written short of practical character during the cuatrimestre. The first will evaluate the contents of the subjects 1 and 2, and the second the subjects 3 and 4. These proofs allow a follow-up of the learning without deleting matter for the final examination.	40	A1	B4	C3

Other comments on the Evaluation

Two short written tests will be carried out throughout the semester. These tests do not remove any subject matter and account for 40% of the final grade. In order to pass the course, it is essential to obtain a minimum score of 4 out of 10 in the combined mark (average) of these two problem-solving and/or exercise-based tests. In addition, in-class activities and independent assignments focused on collaborative learning and problem solving will be proposed, which together will account for 20% of the final grade.

On the official date set by the Faculty, a final examination will be held covering all course content, which will account for 40% of the final grade. A minimum score of 4 out of 10 in this exam is required for the continuous assessment grades to be taken into account. If this minimum mark is not achieved, the final grade for the course will correspond exclusively to the mark obtained in this examination.

Student participation in any of the assessment tests or the submission of at least 20% of the assignments set by the instructor implies the status of "presented" and will result in a recorded grade in the official academic record.

Second examination period: a comprehensive exam covering all course content will be held, accounting for 80% of the final grade. The marks obtained from in-class collaborative learning activities and independently completed student work during the course will be retained.

Students who opt out of continuous assessment will take a single final examination on the official exam dates for both sittings, which will account for 100% of the final grade.

Sources of information

Basic Bibliography

G. Calleja, F. García, A. de Lucas, D. Prats, J.M. Rodríguez, **Introducción a la Ingeniería Química**, Síntesis, 1999
D.M. Himmelblau,, **Principios Básicos y Cálculos en Ingeniería Química**, Prentice-Hall, 2002
C.J. GEANKOPLIS, **Procesos de transporte y principios de procesos de separación**, CECSA, 2006
W.L. McCabe, J.C. Smith, P. Harriot, **Operaciones Unitarias en Ingeniería Química**, McGraw-Hill, 2002

Complementary Bibliography

C.J. King, **Procesos de Separación**, Reverté, 1986
H.S. Fogler, **Elementos de Ingeniería de la Reacción Química**, Prentice-Hall, 2001
R.M. Felder, R.W. Rousseau, **Principios elementales de los procesos químicos**, Limusa,

Recommendations

IDENTIFYING DATA				
Analytical Chemistry III: Electroanalytical Methods and Separations				
Subject	Analytical Chemistry III: Electroanalytical Methods and Separations			
Code	V11G201V01302			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	#EnglishFriendly Spanish Galician English			
Department				
Coordinator	González Romero, Elisa			
Lecturers	Costas Rodríguez, Marta González Romero, Elisa			
E-mail	eromero@uvigo.es			
Web				
General description	Give knowledge of the analysis of compound (organic and inorganic, ions, atoms and molecules) of environmental interest, clinical, biomedical, in the food and pharmaceutical industries, in laboratories quality control, etc, by means of the main Electrometric Techniques of analysis and Classical Separation methods. Inside the process/analytical procedure, will take into account the conditions for the direct measurement and those other situations in which it would be necessary the previous separation of the analyte and/or interferences of the matrix (treatment of sample). It will give a wide and current vision of the versatility of these techniques like tool to resolve problems in the areas of application mentioned, already was carried out the analysis in the chemical laboratories (involves transport and storage of the sample) or directly in the place of sample collection (analysis in situ or decentralised), because of its advantages of miniaturisation and, therefore, of portability, its easy handle and its rapidity of answer (methods of screening). With all this, pretends that the student can acquire the sufficient skill, in the first place, in the handle of the sources of bibliographic documentation and, second, in the set up and maintenance of teams, so that it can apply the analytical methodology in the resolution of real problems. Matter of the program English Friendly: the international students will be able to follow the classes without difficulty then, so much the visual material (presentations in PowerPoint) like the bibliography recommended, presents in English, in addition to having to his disposal another material of support for the follow-up of the matter in English and to be able to request to the professors any another material or additional bibliographic references in this language. They will attend the interventions in class, the tutorial and the realisation of the proofs and evaluations also in English. Matter Offered for the Elderly Program; to the students of this program that select this matter, will facilitate them material of support in Spanish (books of text, monographs, articles, etc) so that they can follow fluently the contents, in addition to having of the bibliography recommended.			

Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
B5	Ability to adapt to new situations and to make decisions
C6	Know the basics and tools for resolution of analytical problems and characterization of chemical substances
C13	Know the principles and applications of electrochemistry
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work
D1	Ability to solve problems

Expected results from this subject

Expected results from this subject	Training and Learning Results		
Identify and distinguish properly the different steps of the analytical process	A3		D1
Know and apply the main systems of sampling, storage and treatment of samples for electroanalytical purposes	A1	C13	D1

Describe and explain the fundamentals and the analytical applications of separation techniques (no chromatographic ones) in the treatment of sample and the electroanalysis in the determination	A3		C13	D1
Purchase critical trial to evaluate and select the ideal technique, so much electroanalytical as of separation, to resolve a real analytical problem, taking into account to the analyte, to the type of sample and the analytical quality that demands to the results.	A1	B5	C13 C26	D1
Differentiate, choose and correctly handle the instrumentation involved in electroanalysis and the material used in non-chromatographic separations	A1	B5	C13 C26	D1
Acquire skills to plan and develop an analysis method, as well as to calibrate, measure and interpret the results obtained when solving, experimentally, the analytical problem that is proposed and successfully evaluate / defend any situation, simulated or real, that arises at the laboratory.	A3	B5	C26	D1
Acquire skills to discuss and defend the choice of an analysis method in different situations and its validation.	A3	B5	C13 C26	D1
Correctly carry out calculations in the preparation of solutions, in the calibration and in the evaluation of the results and recognize errors.	A1 A3	B5	C6 C26	D1
Collect information to prepare, argue and present reports.	A1	B5		D1
Handle chemicals correctly, assess risks and manage the waste produced in the lab.	A3	B5		D1

Contents

Topic	
UNIT 1.- Electroanalysis in the measurement step. Fundamentals of electrometric methods.	Redox and electrochemical chemical reactions. Interface electrode / dissolution. Transportation phenomena. Electrolysis and model of stationary diffusion. Classification of electrometric techniques. Instrumentation: basic components in potentiometric systems, conductimetric and potentiostatic / galvanostatic.
UNIT 2.- Electrodes and cells.	Working, reference and auxiliary electrodes. Working Electrodes: ISE, ISFET, solids (metallic and carbon), liquids (Hg), screen-printed electrodes (SPE) and modified. Supporting electrolytes and solvents. Cell configuration in electroanalysis and equivalent circuit. Calibration, the role of blank in electroanalysis and calculation of analytical parameters. Direct measurement and measurement after sample treatment: separation and derivatization in electroanalysis. Validation.
UNIT 3.- Conductimetry and potentiometry.	Conductometric analysis. Potentiometric analysis. Conductometric and potentiometric titrations. Analytical applications
UNIT 4.- Electroanalysis in dynamic systems I.	Coulombimetry, chronocoulombimetry and coulometric titrations. Analytical applications. Chronoamperometry and amperometry. Linear sweep voltammetry (LSV) and cyclic (CV). Processes of electrode for organic and inorganic compounds and criteria. Analytical applications.
UNIT 5.- Electroanalysis in dynamic systems II.	Pulse techniques: normal pulse voltammetry (NPV), differential pulse (DPV), square wave (SWV). Alternate current techniques (AC). Stripping techniques. Hybrid techniques and couplings. Analytical applications. Reflections and comparative study with others analytical techniques.
UNIT 6.- Fundamentals and aims of the separations in analytical chemistry.	Treatment of sample by digestion. Preparation of the sample: purification and pre-concentration. Studies of recovery.
UNIT 7.- Non-chromatographic Separations.	Precipitation, Leaching, Volatilisation and Distillation (lyophilisation, Kjeldhal, Willard-Winter), Electrodeposition and stripping.
UNIT 8.- Extraction	Liquid-liquid extraction, S-L extraction (Soxhlet, Assisted Extraction by Ultrasonic, microwave and accelerated-ASE), microextraction and solid phase extraction (SPE).
LABORATORY EXPERIMENTS	Experiments related to the contents in electroanalysis and non-chromatographic separations, applying the analytical process and including the evaluation and data processing, as well as the delivery of reports.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	18	42
Seminars	12	4	16
Laboratory practical	26	14	40
Workshops	0	6	6
Objective questions exam	1	8	9
Essay questions exam	2	12	14
Report of practices, practicum and external practices	0	12	12

Methodologies	
	Description
Lecturing	The master classes (55 min) aim to give a global and real vision of electroanalysis, both from organic and inorganic compounds, by direct measurement or prior separation of the analyte. Each one of the topics will be documented with scientific articles, the contents of which will serve to establish and expand the knowledge acquired in the theoretical classes, and with representative examples of the fundamental concepts that are collected in each topic. The teaching-learning methodology will be centered on the student, so the classes will be aimed at motivating / encouraging a high participation on the part of these in the classroom. Therefore, the classes will be developed in a very interactive with the students, using the didactic material for their development online, as well as the most appropriate bibliography. The use of ICTs (MooVi and My Moodle) will be the resource that allows the student to communicate with the teacher (in addition to e-mail and the tutorials) and their peers, at the same time being the source of information of immediate access for them. In the tele-teaching platform, they will be able to find the basic information and documentation on the subject being taught, the schedule of activities, the exercises proposals, practice guide, workshop planning and qualifications.
Seminars	After the lectures, the seminars will be dedicated to solving problems / exercises, in which it is intended to strengthen the level of understanding of the students in the topic under study. These problems / exercises, in principle, are worked on in class in small groups, then there is a general debate on them and later the student will have to solve them individually. The seminars aim to reinforce knowledge acquired in the theoretical classes. There will also be a discussion of practical cases and work scientists related to the contents of the subject.
Laboratory practical	The practical laboratory classes play a fundamental role in teaching the subject. On the one hand, they are essential for understanding the theories and concepts taught in the lessons; and on the other, they allow the student to be trained in the handling of analytical methodology, as well as norms and rules of scientific work, both at the level of group and individual work, including report writing. Ultimately, these are procedural objectives. The use of ICTs (MooVi and My Moodle) will be the resource that allows the student to communicate with the teacher and their colleagues, at the same time being the source of information of immediate access for them. In the tele-teaching platform, you will be able to find basic information and documentation on the subject that is taught, the agenda of activities, the proposed exercises, the practice guide, the workshop planning and qualifications.
Workshops	They would be part of the seminars and laboratory practices in which students must solve by themselves, under the teacher's supervision but with greater autonomy, assumptions real practicals of electrochemical processes, detection and determination of compounds of interest (pollutants, drugs, biomolecules, etc.) and design analytical strategies. Both in the seminars and workshops will monitor the personal work that is being carried out by the student at all times. Discussions will be held that will serve to solve problems real, as well as to expose complementary concepts, addressed or not in other subjects, but necessary in the approach to this problem. This task will be subject to the evolution of the student in the learning process.

Personalized assistance

Methodologies	Description
Lecturing	The tutoring program is configured as a study support element, where the student will have personalized academic assistance that results in a better use of the training and knowledge provided by the subject. In addition to face-to-face tutorials and / or via email, student work, individually or in groups, will also be tutored at through the MooVi Platform or through the remote campus.
Seminars	The tutoring program is configured as a study support element, where the student will have personalized academic assistance that results in a better use of the training and knowledge provided by the subject. In addition to face-to-face tutorials and / or via email, student work, individually or in groups, will also be tutored at through the MooVi Platform or through the remote campus.
Laboratory practical	The tutoring program is configured as a study support element, where the student will have personalized academic assistance that results in a better use of the training and knowledge provided by the subject. In addition to face-to-face tutorials and / or via email, student work, individually or in groups, will also be tutored at through the MooVi Platform or through the remote campus.
Workshops	The tutoring program is configured as a study support element, where the student will have personalized academic assistance that results in a better use of the training and knowledge provided by the subject. In addition to face-to-face tutorials and / or via email, student work, individually or in groups, will also be tutored at through the MooVi Platform or through the remote campus.

Tests	Description				
Report of practices, practicum and external practices	The tutoring program is configured as a study support element, where the student will have personalized academic assistance that results in a better use of the training and knowledge provided by the subject. In addition to face-to-face tutorials and / or via email, student work, individually or in groups, will also be tutored at through the MooVi Platform or through the remote campus.				
Assessment					
	Description	Qualification	Training and Learning Results		
Seminars	PRACTICAL CASES: application of techniques in the RESOLUTION OF environmental, clinical, food industry PROBLEMS, etc. There will be a personalized follow-up of the student and evaluable by the teacher, considering the degree of participation by the students in the practical cases that arise in the seminar classes for the resolution of analytical problems in different fields of application. The ability to resolve questions and issues that arise related to the topic will be taken into account, both in the way of presenting them (ability to synthesize, explain and transmit the information) and in defending them vehemently.	10	A1 A3	B5 C6 C13 C26	D1
Laboratory practical	EXPERIMENTAL IN THE LABORATORY The teachers involved will carry out personalized monitoring of the experimental work carried out by the student in the laboratory sessions, their progress, autonomy, attitude, aptitude and skills developed, as well as their ability to work in a group. It is important to indicate that it is MANDATORY AND ESSENTIAL to attend ALL laboratory sessions and pass the activity to qualify for approval in the matter. Logically, the laboratory practices will be suspended for students who do not complete or fail this activity. A minimum grade of 4/10 must be achieved to qualify for the pass of the subject.	15	A1 A3	B5 C6 C13 C26	D1
Workshops	Resolution of PRACTICAL ASSUMPTIONS (design of experiments, laboratory introduction) A personalized monitoring of the student will be carried out and the way of defending/presenting the information will be evaluated, endorsed by the reliable bibliographic search (ability to search, value, classify and select information), as well as the ability to structure, synthesize, criticize and interrelate the contents for the resolution of the practical case or case raised.	5	A1 A3	B5 C6 C13 C26	D1
Objective questions exam	There will be a short test of objective questions on the topics covered in seminars/workshops that may include theoretical-practical questions/problems or multiple choice. This test serves, at the same time, for the student to assess and evaluate their study methodology. In order to compensate with the rest of the evaluation, a total final grade of 4/10 must be achieved (and a minimum grade of 4/10 in each part of the test). The day and time, as well as the classroom, will be public and the information will be included in the academic program of the center, previously approved by the Faculty Board.	10	A1 A3	B5 C6 C13 C26	D1
Essay questions exam	It corresponds to the official test (ordinary and/or extraordinary calls) and MANDATORY for all enrolled students. It is made up of three parts: theoretical (5%), theoretical-practical (15%) and problems (15%) that integrates the development of an analytical procedure and/or resolution of a practical case. In order to compensate with the rest of the evaluation, a total final grade of 4/10 must be achieved (and a minimum grade of 4/10 in each part of the test). The day and time, as well as the classroom, will be public and the information will be included in the academic program of the center, previously approved by the Faculty Board. OBSERVATION: If there are several teachers involved in the subject (in theory/seminars), the grade that the student must obtain in the part taught and evaluable by each teacher will have to be greater than or equal to 3.5/10, being the necessary requirement for the overall weighting of the exam to take place. Not reaching this qualification, the final result is fail.	40	A1 A3	B5 C6 C13 C26	D1

Report of practices, practicum and external practices	Upon the teacher's indication, the work team will prepare the practical reports (limited number of pages), which will reflect the work done in the laboratory by the team. Two models will be followed: scientific and technical. The fact of adjusting to the norms, the title proposal, layout, discussion of results, ability to synthesize the conclusions, etc. will be valued.	10	A1 B5 C6 D1 A3 C13 C26
	The scientific articles/technical reports handled in the practices will serve as a model. Taking as a model does not mean PLAGIARISING, which will be penalized with a ZERO in the qualification of the reports. These reports, whether scientific or technical, must be delivered within the established period and will be corrected by the professor. A minimum grade of 4/10 must be achieved to qualify for the pass of the subject.		
Laboratory practice	A laboratory test will be practiced, at an individual level, which will allow the evaluation of the competencies and skills acquired by the student during the laboratory sessions. Said test will be carried out at the end of the laboratory sessions and is mandatory, and a minimum grade of 4/10 must be achieved to opt for the subject's approval.	10	A1 B5 C6 D1 A3 C13 C26

Other comments on the Evaluation

Please, pay attention: translated content from main language (castellano) using the translation tool of DocNet App.

For better reading, please, go to main language and copy the text to google translator or another.

1.-The ***EVALUACIÓN CONTINUOUS*** has taking into account the ***calificación*** of the distinct activities/test that they describe in this section (see ***Ítems de evaluación*** up). It is **indispensable to reach a *calificación* of 5/10 in each one of split them/activities/test that *evalúan to SURPASS the matter.** Además, be necessary to reach a ***calificación* mínima of 4/10 in each one of these activities/test proposed to OPT To THE APPROVED of the matter.** In case of not achieving the note ***mínima*** demanded in any of the activities/test, supposes the ***calificación* of SUSPENSE** in the matter; the ***calificación* that appear in the record be the note *ponderada *máxima* high reached**, reflecting **ace** the ***calificación* *máxima*** faithful and real of the activities/test made by the student (Regulation on ***evaluación***, the ***calificación*** and the quality of the teaching and of the process of learning of the student, approved in the ***claudio*** of 18 April 2023, ***Título V.** Of the ***calificación*** of the student, ***Art. 31.2.***).

The ASSISTANCE To THE *PRÁCTICAS* And To THE SEMINARS/WORKSHOPS, **ace** like the development and the ***realización*** of the activities/test associated (see ***Ítems de evaluación***), is **COMPULSORY** for ALL THE STUDENTS ENROLLED, receive to the ***evaluación*** continuous or global. **The *prácticas*, the reports and the seminars/workshops are not recoverable** in the second neither successive announcements. The **ABSENCE in the *prácticas* and/or seminars/workshops, ace** like the does not deliver of the reports in group, are not recoverable in the second neither successive announcements, preventing ***también*** surpass the ***evaluación*** global (in the case of the students that had opted by this way of ***evaluación***).

THE DELIVERY OF THE REPORTS OF *PRÁCTICAS*, inside the term established by the ***profesorado***, is **COMPULSORY**. All the reports happen by programs ***anti-plagiarism*** and only allow a ***máximo*** of 10% of similarity. The ***detección*** of plagiarism with an upper similarity to 10% ***tendrá*** like consequence the **SUSPENSE in the activity, with a *calificación* of ZERO** and without ***opción*** to recover (Regulation on ***evaluación***, the ***calificación*** and the quality of the teaching and of the process of learning of the student, approved in the ***claudio*** of 18 April 2023, ***Título VII.** Of the use of half ***ilícitos***, ***Art. 40.***).

The *calificación* obtained in the distinct activities/test of *evaluación* compulsory, whenever it reach the *mínimo* of 4/10, *mantendrá* for the announcement of July, by what in this announcement the student present only to the parts that have not surpassed in the first announcement.

2.- ***EVALUACIÓN GLOBAL:** to the ***calificación*** definite of this proof move the qualifications obtained in the activities of ***carácter*** compulsory and developed in the ***prácticas*** of laboratory and in the seminars/workshops. **The student that wish to receive to the *evaluación* global, have to deliver to the coordinator of the matter, IN THE TERM OF TWO WEEKS from the start of the teaching, a writing signed in which it certify that opts by said *evaluación* global, what him prevent go back to the *evaluación* continuous.**

3.-Regarding the ***realización*** of the proofs or any official examination of the subject, is **COMPULSORY to carry achieve to be able to access to the classroom: *DNI/*NIF or *carnet to drive, SIMPLE CALCULATOR (no programmable or *electrónica*) and 2 BOWL *GRAFOS BLUE.** No allow the use of an extraneous calculator. Therefore, no allow the access to the classroom with the following UNAUTHORISED material: correctors (***tipex***), ***lapiceros***, ***TELÉFONO***

MÁVILE, INTELLIGENT CLOCK Or ANY ANOTHER DEVICE *ELECTRÓNICO, coats, hunters, *parcas, sweatshirts marsupials, scarves and similar, etc.

The no allowed material and detected in the interior of the classroom during the *realización of the proofs be confiscated by the *profesorado and no *tendrán right to *devolución. *Además, the *incumplimiento of these norms, established by the *profesorado and known by the students with quite *antelación to the proofs and/or exámenes when being published in the *GUÍA To EDUCATIONAL OF THE MATTER, consider fraudulent behaviour and *tendrán consequences of *orden discipline (Regulation on *evaluación, the *calificación and the quality of the teaching and of the process of learning of the student, approved in the *claudio of 18 April 2023, *Título VII. Of the use of half *ilícitos, *Art. 41.)

The use of means or material *ilícitos involve the *finalización of the proof and the immediate abandonment of the classroom, appearing a SUSPENSE in Records (certifying the fault in the file) and losing the rights to make ANY ACTIVITY, PROOF or EXAMINATION OF THE SUBJECT during the rest of the course. *También Notify the fault committed to the managers of the Centre and of the *Dpto. So that they notify, to his time, to the upper authorities so that they take the timely measures (Regulation on *evaluación, the *calificación and the quality of the teaching and of the process of learning of the student, approved in the *claudio of 18 April 2023, *Título VII. Of the use of half *ilícitos, *Art. 42.).

4.-All the activities that develop in the classroom or in the laboratories, the material of support (presentations), etc. *están subject to the rights of the copyright and of image. The educational of the matter do not allow to be recorded, neither by *vídeos neither by audios or any another format like the *pantallazos, during the development of the face-to-face classes or in the *teleáticas. What communicates for the timely effects by the possible consequences of *orden disciplinary that can produce .

NOTE: it recommends the reading of the document Regulation on *evaluación, the *calificación and the quality of the teaching and of the process of learning of the student, approved in the *claudio of 18 April 2023, that be available in *MooVi to the start of the course.

***EVALUACIÓN OF THE STUDENTS OF THE PROGRAM OF GREATER**

- 1.- Assistance to the activities programmed 40%
- 2.- Follow-up of the activities made 30%
- 3.- The *análisis home (sensors and devices *portátiles) 30%

Sources of information

Basic Bibliography

Hernández, L y González, C, **Introducción al análisis instrumental**, Ariel, 2002
Skoog, DA; Holler, FJ y Crouch, SR, **Principios de análisis instrumental**, 7, Cengage Learning Editores, 2018
Wang, J, **Analytical Electrochemistry**, 3, Wiley, 2006
Cela, R; Lorenzo, RA y Casais, MC, **Técnicas de separación en química analítica**, Síntesis, 2002

Complementary Bibliography

Monk, PMS, **Fundamentals of Electroanalytical Chemistry**, Wiley, 2001
Riley, T y Watson, A, **Polarography and other Voltammetric Methods**, Wiley, 1987
Kissinger, PT y Heineman, WR, **Laboratory Techniques in Electroanalytical Chemistry**, Marcel Dekker, INC, 1984
Valcárcel, M y Silva, M, **Teoría y práctica de la extracción líquido-líquido**, Alhambra, 1984
Miller, JM, **Separation Methods in Chemical Analysis**, Wiley, 1974

Recommendations

Subjects that continue the syllabus

Analytical Chemistry IV: Chromatographic and Affine Methods/V11G201V01306

Subjects that are recommended to be taken simultaneously

Chemical engineering/V11G201V01301
Inorganic Chemistry III: Coordination Chemistry/V11G201V01304
Organic Chemistry III: Concerted, Radical and Photochemical Reactions/V11G201V01305

Subjects that it is recommended to have taken before

Chemistry: Chemistry Lab I/V11G201V01105
Chemistry: Chemistry 1/V11G201V01104
Analytical Chemistry II: Optical Methods of Analysis/V11G201V01207
Chemistry: Chemistry Lab II/V11G201V01110
Physical chemistry I: Chemical thermodynamics/V11G201V01203

Physical Chemistry II: Surfaces and Colloids/V11G201V01208
Inorganic chemistry II/V11G201V01209
Chemistry: Chemistry 2/V11G201V01109
Analytical Chemistry I: Principles of Analytical Chemistry/V11G201V01202
Organic chemistry I/V11G201V01205
Biochemistry/V11G201V01201
Physics: Physics 2/V11G201V01107

Other comments

It is strongly recommended that students who enroll in this course have passed the subjects assigned to the area of analytical chemistry from previous courses.

IDENTIFYING DATA				
Physical Chemistry III: Quantum Chemistry				
Subject	Physical Chemistry III: Quantum Chemistry			
Code	V11G201V01303			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Mosquera Castro, Ricardo Antonio Hermida Ramón, José Manuel			
Lecturers	Hermida Ramón, José Manuel Mosquera Castro, Ricardo Antonio			
E-mail	mosquera@uvigo.es jose_hermida@uvigo.es			
Web				
General description	The foundations of the quantum chemistry are presented and applied to simple models to describe: nuclear movements in molecules and the electronic structure of the atoms. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
B1	Ability for autonomous learning
B2	Organization and planning capacity
B4	Ability for analysis and synthesis
C1	Ability to know and understand essential facts, concepts, principles and theories related to Chemistry
C4	Use computer tools properly to obtain information, process data, perform computational calculations and calculate matter properties
C14	To know the principles of quantum mechanics and its application in the description of the structure and properties of atoms and molecules
D1	Ability to solve problems

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Write and apply the fundamental operators of the quantum mechanics using the basic concepts of the theory of operators to calculate functions and own values, half values and most likely values in the model systems (particle in the box, harmonic oscillator, rigid rotor, electrostatic model of the atom *monoelectronic).		B2 B4	C1 C14	D1
Describe the eigenfunctions and eigenvalues of the model systems.		B1 B2 B4	C1 C14	
Use the variational and perturbational methods to treat more complex systems (atoms *polielectronic, oscillator *anharmonic, etc.)	A1 A5	B1 B2 B4	C1 C4 C14	D1
Formulate approximate solutions for the Schrödinger's equation of atoms *polielectronic and describe its electronic structure using angular momentum coupling models.		B1 B2 B4	C1 C14	D1
Describe the spectrums of atoms *monoelectronic and *polielectronic.	A1 A5	B1 B2 B4	C1 C4 C14	D1
Apply the symmetry group theory in the context of the chemistry	A1 A5	B2	C1	D1

Contents

Topic

1. Foundations of the quantum mechanics.	1.1. Origin of the quantum mechanics (experimental facts). Formalisms of the quantum mechanics. Non relativistic quantum mechanics. Atomic units. 1.2. Wavefunction. Constrains of the wavefunction. Wavefunctions for a single particle and a set of particles. Slater Determinants. Interpretation of the wavefunction. Normalization. Molecular and atomic wavefunctions. Separation of movements. 1.3. Operators. Hermiticity. Values for a magnitude. Eigenvalues. Orthogonality. Conmutation. Angular momentum operators. Ladder operators. Symmetry operators. Point groups. Symmetry classification of the wavefunctions (symmetry species). Character tables. 1.4. Half value. Most probable values. Uncertainty. Hypervirial and virial theorems. 1.5. Time-dependent Schrödinger equation. Stationary States (Non-time dependent Schrödinger equation).
2. Molecular translation	2.1. Free particle in 1-dimensional space and 3-dimensional spaces. 2.2. Particle in a monodimensional box of infinite potential walls. 2.3. Particle in a 3-dimensional box. Level degeneration. 2.4. Infinite thick barriers. Reflection and transmission coefficients. 2.5. Finite thick barriers. Tunnelling.
3. Approximate treatments to resolve the equation of Schrödinger.	3.1. Variational Method. Eckart's Theorem. 3.2. Variational functions (linear combinations). Secular determinant. 3.3. Time-independent perturbational theory in non degenerated levels. 3.4. Time-independent perturbational theory in degenerate levels. 3.5. Semiclassical treatment for radiation-matter interaction: Time-dependent perturbational theory. Consequences in the non-elastic interaction between radiation and matter. Dipole transition. Stimulated absorption and emission coefficients. Coefficient of spontaneous emission. Lifetime of the excited states. 3.6. Distribution of a sample of particles between its levels of energy (statistics of Maxwell-Boltzmann). Absorption and emission intensity of radiation.
4. Molecular rotation.	4.1. Diatomic molecules: rigid Rotor. 4.2. Polyatomic molecules: spherical, symmetric and asymmetric tops. Rigid polyatomic rotors. 4.3. Centrifugal distortion in diatomic molecules.
5. Molecular vibration.	5.1. Harmonic oscillator (diatomic molecules). 5.2. Systems with connected harmonic oscillators (polyatomic molecules). 5.3. Effect of the molecular symmetry. 5.4. Limitations of the harmonic model. Anharmonic oscillator (diatomic molecules).
6. Electronic structure: one electron atoms.	6.1. Electrostatic model. Time-independent Schrödinger equation. 6.2. Results of the electrostatic model. Orbitals. 6.3. Electronic spin. Spin-orbit coupling. Fine structure. 6.4. Atomic nucleus. Hyperfine structure. 6.5. Interpretation of electronic spectra of 1-electron atoms. Zeeman effect.
7. Electronic structure: many electron atoms.	7.1. Electrostatic model. Impossibility to solve Schrödinger equation exactly. 7.2. Description of the Hartree-Fock method. Limitations. 7.3. Angular momentum coupling. 7.4. Interpretation of electronic spectra of polyelectronic atoms.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	48	72
Problem solving	12	30	42
Laboratory practical	14	14	28
Essay questions exam	2	3	5
Essay questions exam	0	3	3

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

Methodologies

Description

Lecturing	The professor will expose the concepts, methods and main knowledge of each topic. He/She will orient the autonomous work of the student marking objectives and proposing questions and/or exercises. In the classroom the student has to pay attention to the exposition, take his/her notes and formulate the questions that he/she considers. In the autonomous work the student has to complete the elements of the topic that remained as autonomous work, resolve the questions that have been proposed, assimilate this information and, if necessary, elaborate new questions to formulate to the professor in next sessions or in tutorials.
Problem solving	The professor will resolve the exercises that he considers fundamental in each topic. Problems for independent resolution will be proposed to students. The participation of the students will be motivated, thus, in some sessions the students will solve the problems. Students have to assist to these classes with participatory spirit, trying to understand the resolution of the exercises and connect it with the knowledges obtained in theory. Modeling of problems and its mechanical resolution should be avoided. In the independent work the student has to solve the problems proposed and even search for other related problems.
Laboratory practical	The professors will propose exercises, larger than those usually proposed in problem solving lectures. Most of the problems will be solved using computers. The students will obtain the results of the proposed exercises. In the independent work they will have to analyze the obtained results. It is always important that they relate the work made with that knowledge acquired in the lectures.

Personalized assistance

Methodologies	Description
Lecturing	The student can request tutorials to consult the doubts that arise in his/her independent work.
Problem solving	The student is allowed to request tutorials to consult the doubts that arise in his/her independent work.
Laboratory practical	The student could request tutorials to consult the doubts that arise in his/her independent work.
Tests	Description
Essay questions exam	The student could request tutorials to consult the doubts that arise in his/her independent work and to review the results of his exams.
Essay questions exam	

Assessment

	Description	Qualification	Training and Learning Results			
Problem solving	The examinations will contain numerical problems. As a whole they will represent 50% of the total points of the examinations	40	A1 A5	B2 C4 C14	C1 D1	
Laboratory practical	The qualification of the practices will be obtained from: i) systematic observation of the work made; ii) answers to the questions of the professors during the practice sessions, and iii) written exams. Obtain at least 4 over 10 in the practical laboratory class is an indispensable requirement to pass the subject. In case of not reaching the 4 over 10 in this part of the subject, the global qualification will not exceed 4.0 over 10 points.	20	A1 A5	B1 B2 B4	C1 C4 C14	D1
Essay questions exam	During the course we will have the following exams: a) A partial test that will include the units 1, 2 and 3. This test will contain: numerical problems, theoretical questions and a personal interview (within 10 days after the written exam). There, the student will answer (including a written proof) questions asked by the professors. To pass the exam is a compulsory requirement to obtain at least 4 points over 10 in this interview.	40	A1 A5	B1 B2 B4	C1 C14	D1
Essay questions exam	b) One final exam, with two chances, in the dates that fix the Faculty: December/January the first and June/July the second. This will include at the first opportunity the units 4, 5, 6 and 7, except for those students that have chosen the global evaluation. In the second opportunity (except exceptional cases) this exam will comprise the entire course material. In both opportunities, this proof will contain: numerical problems, theoretical questions and a personal interview (within 10 days after the written exam). There the student will answer questions asked by the professors. To pass the exam is a compulsory requirement to obtain at least 4 points over 10 in this interview.	40	A1 A5	B1 B2 B4	C1 C4 C14	D1

Other comments on the Evaluation

Rule 1: To pass the course you need to have made lab sessions satisfactorily. This requires : a) assist to all the lab sessions or provide documentation that, at the professors' discretion, certifies a justified reason for missing no more than 1 session; and b) reach at least 4 over 10 points. If you do not fulfil both requirements the course mark would not be higher than 4.0.

Rule 2: Each exam (partial or final) includes: theoretical questions, numerical problems, and a short interview. To pass the exam requires the following minimum conditions (all of them in 0 to 10 scale): a) 5.0 in global; b) 4.0 points in theoretical questions; c) 3.0 in numerical problems; and d) 4.0 in the interview. Not verifying any of b), c) or d) conditions implies you could not exceed 4.0.

Rule 3. The students who, fulfilling "rules 1 and 2", and reach at least 4.5 points in the midterm exam will be able to take the first chance of the final examination answering only the exercises and questions related to units 4, 5, 6 and 7. This option has to be indicated to the professor at the beginning of the final exam. When taken this option, the global exams score will be the average of the two exams.

Rule 4. If the the previous rules are fulfill, the global score of the course will be the highest of: a) that obtained in the exam (or group of exams) using rule 3; and b) the following weighted average 20% lab, 80% examinations.

Rule 5. All students have to assist to the lab sessions, even if they passed them in previous courses.

Rule 6. It is not contemplated to keep successfully passed parts of the course between different academic courses.

Rule 7. Professors could require that, in a personal interview, the student clarifies any doubt that affect to any of his/her exam/s. This procedure applies for examples of difficult reading, suspicious of copy, or any other troubles that could be solved in this way.

Rule 8. Any kind of copy will lead to the expelling from the exam and to obtain zero points, both in the exam and in the course.

Rule 9. Active participation in class and answers during the interviews may result in additional 0.5 points.

Sources of information

Basic Bibliography

Bertrán, J.; Branchadell, V.; Moreno, M; Sodupe, M., **Química cuántica**, 1, Síntesis, 2000

Complementary Bibliography

Levine, I. N., **Química cuántica**, 5, Prentice-Hall, 2001

Atkins, P.; Friedman, R., **Molecular quantum mechanics**, 5, Oxford University Press, 2010

Pilar, F. L., **Elementary quantum chemistry**, 2, McGraw-Hill, 1990

McQuarrie, D. A., **Quantum chemistry**, 1, Viva Books, 2003

Recommendations

Subjects that continue the syllabus

Physical Chemistry IV: Molecular Structure and Spectroscopy/V11G201V01307

Subjects that it is recommended to have taken before

Chemistry: Chemistry 1/V11G201V01104

Physics: Physics I/V11G201V01102

Mathematics: Mathematics 2/V11G201V01108

Physics: Physics 2/V11G201V01107

Mathematics: Mathematics 1/V11G201V01103

IDENTIFYING DATA				
Inorganic Chemistry III: Coordination Chemistry				
Subject	Inorganic Chemistry III: Coordination Chemistry			
Code	V11G201V01304			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Rodríguez Arguelles, María Carmen			
Lecturers	Pérez Lourido, Paulo Antonio Rodríguez Arguelles, María Carmen			
E-mail	mcarmen@uvigo.es			
Web				
General description	This subject addresses the most relevant aspects of Coordination Chemistry: This type of compound will be studied from the structural, synthetic point of view and also its most outstanding properties. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code	
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
B1	Ability for autonomous learning
B3	Ability to manage information
C2	Use correctly chemical terminology, nomenclature, conversions and units
C7	Distinguish the main types of chemical reactions and their characteristics
C15	Know the main techniques of structural research, including spectroscopy
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work
D2	Capacity for teamwork
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Understand the nomenclature and bonding types in coordination compounds.	A2 A3	B1 B3	C2 C7 C15	D2 D3
Understand the different types of reactions in which coordination compounds participate.	A3	B1 B3	C2 C7 C15	D2 D3
Understand and interpret the different characterization techniques used for coordination compounds.	A3	B1 B3	C2 C15	D2 D3
Understand the presence and applications of coordination compounds in different fields.	A3 A5	B1 B3	C2	D2 D3
Laboratory practices			C26	D2

Contents

Topic	
Introduction	Types of ligands. Nomenclature. Coordination number and coordination geometries. Isomerism.
Bonding in Coordination Compounds	Crystal Field Theory. Molecular Orbital Theory.
Stability of Coordination Compounds	Formation constants. Factors affecting the stability of coordination compounds in solution.

Preparation of coordination compounds.	Preparation of coordination compounds. Study of the different types of synthetic processes.
Characterization of Coordination Compounds	Elemental and thermal analysis. Magnetic properties. Conductivity. Absorption and emission spectroscopies.
Applications of Coordination Compounds	n biological systems. In medicine. Other applications.
Laboratory Experiments	(*)Síntese de compostos de coordinação de metais de transição. Caracterización estructural mediante diferentes técnicas

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	12	36
Seminars	24	22	46
Problem solving	0	10	10
Laboratory practical	14	0	14
Objective questions exam	1	15	16
Essay questions exam	1	27	28

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

Methodologies

	Description
Lecturing	The fundamental aspects of the subject will be presented.
Seminars	Students will solve exercises related to the course content.
Problem solving	Students will work independently to solve questions and exercises available on MOOVI.
Laboratory practical	The laboratory practices will consist of 4 sessions of 3.5 hours attendance. The students will carry out different experiences in the laboratory and must make the corresponding laboratory book. Some of the experiences may require the previous study individually or by group. Attendance at all laboratory sessions is obligatory.

Personalized assistance

Methodologies	Description
Seminars	Doubts can be addressed during tutorials requested via email.
Laboratory practical	Students may consult the instructors in charge during tutorial hours or by appointment any questions related to the laboratory practical work
Lecturing	Questions may be addressed during tutorials requested via email.
Problem solving	Questions and issues related to the exercises will be addressed during tutorials requested via email.

Assessment

	Description	Qualification	Training and Learning Results
Seminars	The students will solve in-class questions related to the subject matter.	15	A3 B3 C2 C15
Problem solving	Students will complete it autonomously in Moovi	10	B1 C2 B3
Laboratory practical	The evaluation in the laboratory practices will have 10% regarding the laboratory notebook (it can be through a written test) and 5% to the behavior and skills by direct observation of the teacher. Students may also be asked to solve simple questions that they must deliver at that time and that will serve for their evaluation. Absences, even if justified, will negatively impact the grade. If the number of absences exceeds 25% of the laboratory sessions, the student will fail the practical sessions and, consequently, the course. A grade of 5 or higher in this section will also result in failing the course. Students who completed and passed the practical sessions in the previous academic year (2025-2026) are exempt from repeating them, if they so wish. They will retain their grade.	15	A3 C26 D2
Objective questions exam	A one-hour test will be conducted on the date specified in the schedule.	25	A3 C2
Essay questions exam	A two-hour written exam will be held at the time established by the Faculty of Chemistry.	35	A2 B1 C2 A3 B3

Other comments on the Evaluation

Continuous Assessment

- **Mandatory Laboratory Attendance:** Attendance at practical laboratory sessions is compulsory.
- **Minimum Grade Requirement:** Students must achieve a minimum score of 3 out of 10 in each assessment component for the grade to be considered in the final evaluation.
- **Non-Compliance Consequence:** Failure to meet any of these conditions results in the forfeiture of the right to continuous assessment.
- **Final Assessment for Non-Passing Students:** Students who do not pass the course by the end of the semester must sit for a written exam during the final assessment period in July. This exam accounts for 60% of the final grade and replaces the results of the two written tests.

Global Assessment

- **Reasons for Global Assessment:**
 1. Non-compliance with continuous assessment conditions.
 2. Student request within the timeframe established by the Faculty of Chemistry.
- **Content of Global Assessment:** The global assessment will encompass all course material, including laboratory practices. It will be conducted on the same date as the continuous assessment exam but will differ in content and duration.
- **Passing Criteria:** A minimum score of 5 out of 10 is required to pass the global assessment.

Sources of information

Basic Bibliography

Jordan, RB., **Principles of inorganic chemistry: basics and applications**, Springer, 2024

Tanase T, **Coordination Chemistry : Molecular Science of Organic-Inorganic Complexes**, 978-1-83767-064-2, 1, Royal Society of Chemistry, 2024

Weber B., **Coordination chemistry : basics and current trends.**, 978-3-662-66440-7, 1, Springer, 2023

Weller M., Rourke, J., Armstrong, F., Lancaster, S., Overton, T., **Inorganic Chemistry**, 978-0-19-886691-6, 8, Oxford University Press, 2025

Complementary Bibliography

House, J.E., **Inorganic Chemistry**, 978044314102, 4, Elsevier, 2025

Odom, A.L. Beaulac R, Johnson AR, Smith MR, McCusker JK, Nataro C.; **Inorganic chemistry : an integrated approach**, 1, Oxford University Press, 2025

Pfenning BW, **Principles of Inorganic Chemistry**, 9781119650324, 2, John Wiley & Sons, Inc, 2022

Recommendations

Subjects that continue the syllabus

Inorganic Chemistry IV: Transition Metals and Solid State/V11G201V01309

Subjects that it is recommended to have taken before

Inorganic chemistry I/V11G201V01204

Inorganic chemistry II/V11G201V01209

IDENTIFYING DATA				
Organic Chemistry III: Concerted, Radical and Photochemical Reactions				
Subject	Organic Chemistry III: Concerted, Radical and Photochemical Reactions			
Code	V11G201V01305			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	#EnglishFriendly #FrançaisAmical Spanish Galician			
Department				
Coordinator	Nieto Faza, Olalla			
Lecturers	Besada Pereira, Pedro Nieto Faza, Olalla Salonen , Laura			
E-mail	faza@uvigo.es			
Web				
General description	This class will study radical, pericyclic and photochemical processes, using a mechanistic approximation with emphasis on selectivity. The teaching methodology is centered around problem-solving, and includes laboratory and molecular modeling practical work. Subject in the English Friendly program: International students can ask the instructors for a) learning materials and bibliography in English, b) personal attention in English at office hours and c) assignments and exams in English.			

Training and Learning Results

Code	
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
B3	Ability to manage information
B4	Ability for analysis and synthesis
C18	Know the properties of aliphatic, aromatic, heterocyclic and organometallic compounds
C19	Know the main synthetic routes in organic chemistry, including the interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds
C27	Demonstrate the ability to observe, monitor and measure chemical processes, by systematically and reliably recording them and presenting reports of the work done
C28	Interpret data derived from laboratory observations and measurements in terms of their meaning and relate them to the appropriate theory
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Know and apply the factors affecting the stability of organic radicals.	A3 A4	B3 B4	C18 C19	D3
Identify and understand the mechanisms of radical reactions and use this knowledge to propose strategies to either avoid or exploit them.	A3 A4	B3 B4	C18 C19	D3
Use the Woodward-Hoffmann rules to differentiate between allowed and forbidden reaction paths in pericyclic processes.	A3 A4	B3 B4	C18 C19	D3
Recognize the most common pericyclic mechanisms (electrocyclizations, cycloadditions, and sigmatropic and ene reactions) and use them in synthetic sequences.	A3 A4	B3 B4	C18 C19	D3
Predict the regio and stereoselectivity of pericyclic reactions.	A3 A4	B3 B4	C18 C19	D3
Understand the mechanisms of photochemical activation of organic molecules.	A3 A4	B3 B4	C18 C19	D3
Understand and apply the mechanisms of photochemical reactions: double bond isomerizations, photodissociations, photoreductions and pericyclic reactions.	A3 A4	B3 B4	C18 C19	D3

Perform pericyclic, radical and photochemical reactions and elaborate, separate and purify their products using common techniques.	A3 A4	B3 B4	C18 C19 C27 C28	D3
Use spectroscopic tools to establish the structure of organic compounds.	A3 A4	B3 B4	C18 C27 C28	D3
Use molecular modeling tools to study the properties of organic compounds and reaction mechanisms.	A3 A4	B3 B4	C18 C19 C27 C28	D3

Contents

Topic

1. Reaction mechanisms	1.1. Reaction mechanism. Reaction profiles and transition state theory. 1.2. Reaction driving force. Frontier orbital theory. 1.3. Types of selectivity in organic transformations. 1.4. Mechanism classifications.
2. Radical reactions	2.1. Homolytic vs. heterolytic bond breaking. 2.2. Radical stability. 2.3. Chain reactions, alkane halogenation. 2.4. Radical polymerizations. 2.5. Radical reductions and reductive couplings. 2.6. Radical reactions in nature.
3. Pericyclic reactions	3.1. Woodward-Hoffmann rules. Orbital symmetry conservation and transition state aromaticity. Thermal and photochemical allowed and forbidden reactions. 3.2. Electrocyclizations. 3.3. Cycloadditions. Frontier orbital theory. 3.4. Sigmatropic and ene reactions.
4. Photochemical reactions	4.1. UV/vis spectra of organic molecules. Properties of excited states. 4.2. Photophysical processes: unimolecular deactivation, internal conversion, intersystem crossing, emission (fluorescence, phosphorescence). 4.3. Double bond isomerizations. 4.4. Photodissociations. 4.5. Photoreductions. 4.6. Pericyclic reactions. 4.7. Photochemical reactions in nature.
5. Laboratory work	Practical work on experiments related to the previous sections of the course. Synthesis, purification and characterization of organic compounds.
6. Molecular modeling	Use of computational chemistry tools to study the properties of organic molecules and reaction mechanisms associated to the previous sections of the course.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	0	2	2
Flipped Learning	12	20	32
Problem solving	24	52	76
Laboratory practical	28	10	38
Problem and/or exercise solving	1	0	1
Problem and/or exercise solving	1	0	1
Problem and/or exercise solving	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

	Description
Introductory activities	Presentation of the course and instructors. Review of the syllabus and the structure of the course in the remote learning platform.
Flipped Learning	The interaction of the students with the materials available in the remote learning platform is expected, as is working on the activities proposed to prepare for class. Classroom time will be used to consolidate, review, clarify and apply the studied concepts.
Problem solving	Practical exercises and problems will be solved to apply the concepts developed in the theory and flipped classroom sessions.

Laboratory practical	The students will perform in the laboratory basic techniques related to the synthesis, separation, purification and structural characterization of organic compounds. The work includes evaluation of risk, experiment planning and analysis of results. Molecular modeling techniques will be used to study the properties of organic compounds and selected reaction mechanisms. To be allowed in the laboratory, the student is required to perform a set of preliminary preparation tasks on the remote learning platform. The work will be carried out individually in 3.5 h sessions, and will be documented in a laboratory notebook. After the practical sessions, a paper will be prepared according to the instructions of the professors.
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Personalized assistance

Methodologies	Description
Flipped Learning	Continuous evaluation provides both instructors and students with feedback about the evolution of student learning and students' strengths and weaknesses. Although instructors can set tutorial appointments for students they deem at risk, it is expected that the students will take responsibility for their own learning and ask for help when needed. Students can request personalized support from the instructors at any time along the course, in order to solve any problem related to the subject, to review difficult concepts or to ask for help with the assignments. Tutorial sessions can be held through office hours in person or online, using the virtual campus. Personalized attention will also be provided through e-mail or the forums in the remote learning platform.
Problem solving	Problem-solving sessions in small groups facilitates personalized support to the student as soon as difficulties arise. As in the previous section, personalized attention will be provided in office hours, as well as through e-mail or forums in the remote learning platform.
Laboratory practical	In the laboratory sessions, most individual problems will be solved in class. As in the previous section, personalized attention will be provided in office hours, as well as through e-mail or forums in the remote learning platform.

Assessment

	Description	Qualification	Training and Learning Results
Flipped Learning	Students must participate in class activities and interact with the contents planned in the online learning platform. The results of the tests and other online activities integrated in every lesson in the platform will be evaluated.	15	A3 B3 C18 D3 A4 B4 C19
Laboratory practical	The competencies associated to the safe handling of chemicals, the assessment of risks in the laboratory and the planning and execution of experiments (both computational and in the laboratory) and the analysis of results, will be evaluated. For this, we will use the systematic observation of the student's work, the preliminary work, previous to the laboratory sessions, and the quality of the laboratory notebook and the assigned report. Attendance to laboratory sessions and a grade higher than five in them is needed to pass this course.	10	A3 B3 C18 D3 A4 B4 C19 C27 C28
Problem and/or exercise solving	There will be three exams, involving problems and exercises: 1. A test about the first sections of the subject (2 hours), associated to a 25% of the final grade. 2. A test about all the contents covered in the class (2 hours), associated to a 40% of the final grade. A minimum grade of 4.0 out of 10 is required for a global passing grade. 3. A written exam (0.5 hours) related to the experimental part of the subject, associated to a 10% of the final grade. A 4.0 grade (out of 10) in this test is required for a global passing grade.	25	A3 B3 C18 D3 A4 B4 C19 C27 C28
Problem and/or exercise solving	(*)Unha proba final sobre todo o temario (2 horas) que suporá o 40% da cualificación final. Esixirase unha nota mínima de 4.0 puntos sobre 10 nesta proba para superar a materia.	40	A3 B3 C18 D3 A4 B4 C19 C27 C28
Problem and/or exercise solving	(*)Unha proba escrita (0.5 horas) relacionada coa parte experimental da materia, que suporá un 10% da cualificación final. Esixirase unha nota mínima de 4.0 puntos sobre 10 nesta proba para superar a materia.	10	

Other comments on the Evaluation

Students need to demonstrate complete mastery of a set of essential learning outcomes in order to pass the course.

In case there is doubt about the mastery of the course's learning outcomes by any student, further or complementary oral tests can be scheduled for a sound evaluation.

Student participation in any of the graded activities will result in the assignment of a grade in this course (the student will be considered "presentado"). Attendance to laboratory sessions, participation in exams and the handing out of assignments are considered graded activities in this context.

Students who have attended the course in previous academic years: Those evaluated with a PASS grade in the experimental part of the course, upon request, will be awarded a PASS grade in this part of the course this year. As a result, their attendance to the laboratory sessions will not be required. However, the written test associated to the experimental part is required to get the grade associated to the experimental contents of the course this year (20%).

In the 2ª Edición de la Convocatoria Ordinaria, the grades obtained by the student in the problem solving, flipped learning and laboratory practical parts will be kept. An exam covering all the theoretical contents of the subject will be proposed, with a qualification that will represent a 65% of the final grade. A written test covering the experimental work will also be administered, with a contribution of 10% to the final grade. A minimum grade of 4.0 out of 10 in each of these two tests is needed for a passing grade and the consideration of the other grading elements.

The students desiring to opt-out of the continuous evaluation mode, need to attend the laboratory sessions and obtain a PASS in them, as well as obtaining a grade equal or higher than 5 out of 10 in the written test associated to the experimental part of the class (20% of the grade). On top of that, a grade equal or higher to 5 out of 10 is needed in a written exam covering all the contents of the course (80% of the grade).

Sources of information

Basic Bibliography

Eric V. Anslyn, Dennis A. Dougherty, **Modern physical organic chemistry**, University Science Books, 2006

Felix A. Carroll, **Perspectives on structure and mechanism in organic chemistry**, John Wiley, 2010

John Perkins, **Radical chemistry : the fundamentals**, Oxford University Press, 2000

Ian Fleming, **Pericyclic reactions**, Oxford University Press, 1999

Carol E. Wayne, Richard P. Wayne, **Photochemistry**, Oxford University Press, 1996

Steven M. Bachrach, **Computational organic chemistry**, John Wiley & Sons,, 2007

James W. Zubrick, **The Organic Chem Lab Survival Manual: a student's guide to techniques**, John Wiley & Sons, 2009

Jerry R. Mohrig ... [et al.], **Laboratory techniques in organic chemistry : supporting inquiry-driven experiments**, W.H. Freeman, 2014

Complementary Bibliography

Nicholas J. Turro, V. Ramamurthy, J.C. Scaiano, **Modern molecular photochemistry of organic molecules**, University Science Books, 2010

Ernö Pretsch, Philippe Buhlmann, Martin Badertscher, **Structure determination of organic compounds : tables of spectral data**, Springer,, 2009

Chemistry Libre Texts, **ChemistryLibre Texts**, [lookshelves/Organic_Chemistry](https://www.masterorganicchemistry.com/),

James Ashenhurst, **MasterOrganicChemistry**, <https://www.masterorganicchemistry.com/>,

Recommendations

Subjects that continue the syllabus

Organic Chemistry IV: Design of Organic Synthesis/V11G201V01310

Subjects that are recommended to be taken simultaneously

Physical Chemistry III: Quantum Chemistry/V11G201V01303

Subjects that it is recommended to have taken before

Organic chemistry II/V11G201V01210

Organic chemistry I/V11G201V01205

Structural Determination/V11G201V01206

Other comments

In this class, the student is expected to learn how to deftly manipulate a relevant number of new concepts in a short period of time. As a result, daily work and study is a must. The same applies to class attendance and active participation in all the proposed activities, including interaction with the materials available in the online platform or the reading of the designated documents before every in person session.

It is strongly advised to have passed Organic Chemistry I and II and Structural Determination or equivalent, since the concepts learnt in these classes will be required in this one.

The use of molecular models is heavily recommended, as one of the main difficulties of this course is the visualization of the three-dimensional structure of molecules.

A laboratory coat and notebook is needed for the laboratory sessions.

IDENTIFYING DATA				
Química analítica IV: Métodos cromatográficos e afíns				
Subject	Química analítica IV: Métodos cromatográficos e afíns			
Code	V11G201V01306			
Study programme	Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3	2c
Teaching language	#PortuguêsAmigável Castelán			
Department	Química analítica e alimentaria			
Coordinator	Leao Martins, Jose Manuel			
Lecturers	Costas Rodríguez, Marta Leao Martins, Jose Manuel			
E-mail	leao@uvigo.es			
Web				
General description	Coñecementos básicos sobre as técnicas de separación e a súa aplicación na análise química. Aplicacións xerais. Materia do programa Portugués amigável. Os/ as estudantes internacionais poderán solicitar ao profesorado: a) materiais e referencias bibliográficas para o seguimento da materia na(s) lingua(s) estranxeira(s), b) atender as titorías na(s) lingua(s) estranxeira(s), c) probas e avaliacións en lingua estranxeira.			

Resultados de Formación e Aprendizaxe	
Code	
A1	Que os estudantes saiban aplicar os seus coñecementos ó seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo
A4	Que os estudantes poidan transmitir información, ideas, problemas e solución a un público tanto especializado coma non especializado
B5	Capacidade de adaptarse a novas situacións e adoptar decisións
C6	Coñecer os fundamentos e ferramentas habituais na resolución de problemas analíticos e na caracterización de substancias químicas
C26	Levar a cabo correctamente procedementos habituais no laboratorio, incluíndo o uso de instrumentación química estándar para o traballo sintético e analítico
D1	Capacidade para resolver problemas

Resultados previstos na materia				
Expected results from this subject	Training and Learning Results			
Describir os principios e fundamentos xerais das técnicas de separación.	A1 A4	B5		D1
Describir os fundamentos e principios da cromatografía de gases, identificar e saber seleccionar detectores en función das aplicacións analíticas.	A1 A4	B5	C6	D1
Describir os fundamentos e principios da cromatografía de líquidos, identificar e saber seleccionar detectores en función das aplicacións analíticas.	A1 A4	B5	C6	D1
Describir os fundamentos e principios da electroforesis capilar, identificar e saber seleccionar detectores en función das aplicacións analíticas.	A1 A4	B5	C6	D1
Describir os fundamentos e principios das técnicas cromatográficas acopladas a espectrometría de masas e as súas aplicacións na análise química.	A1 A4	B5	C6	D1
Aplicacións prácticas (seminarios) e de laboratorio das diferentes técnicas de separación no ámbito da análise ambiental, alimentos ou outras aplicacións.	A1 A4	B5	C6 C26	D1

Contidos
Topic

Preparación de mostra, introducción aos métodos de separación cromatográfico.	Introdución aos métodos de separación cromatográficos. Fundamentos xerais da cromatografía (principios, clasificación segundo o tipo de fases móbiles e estacionarias). Interaccións fisicoquímicas segundo a fase móbil e a fase estacionaria. Teoría cromatográfica e parámetros cromatográficos. Aspectos cuantitativos na análise cromatográfica. Preparación da mostra para cromatografía. A extracción líquido-líquido, en fase sólida e a microextracción. Concepto de analito, matriz e interferencia. Avaliación do efecto matriz e avaliación da eficacia en termos de recuperación.
Cromatografía de gases (GC)	Cromatografía de gases (GC): Principios e fundamentos; tipo de fases móbiles e estacionarias. Os principais compoñentes instrumentais dos sistemas cromatográficos. Os detectores máis comúns. Aplicacións no ámbito ambiental, alimentario, toxicolóxico, etc.
Cromatografía de líquidos (LC)	Cromatografía de líquidos (HPLC): Principios e fundamentos. Tipos de cromatografía (fase normal, fase inversa, intercambio iónico e exclusión por tamaño). Preparación das fases móbiles (efecto do pH, forza iónica e fracción de disolvente orgánico). Principais compoñentes instrumentais dos sistemas cromatográficos. Detectores habituais nos sistemas cromatográficos. Aplicacións nos ámbitos ambiental, alimentario, toxicolóxico, etc.
Electroforese capilar (CE)	Introdución e principios da separación electroforética. Sistemas de separación e compoñentes instrumentais. Concepto de mobilidade electroforética e electroosmótica. Detectores máis empregados nos equipos de electroforese capilar. Aplicacións analíticas.
Espectrometría de masas (MS)	Introdución á espectrometría de masas no ámbito analítico. Fundamentos da técnica e compoñentes instrumentais. Teoría da ionización e da fragmentación. Tipos de analizadores e as súas aplicacións analíticas. Espectrometría de masas en tándem e de alta resolución. Aplicacións analíticas.
Técnicas cromatográficas avanzadas.	Técnicas cromatográficas avanzadas: Cromatografía de líquidos ultrarrápida (UHPLC), nanocromatografía (nLC), técnicas cromatográficas híbridas (GC-MS/MS, LC-MS/MS).
(*)Análisis de los datos cromatográficos	(*)Representación gráfica de una separación cromatográfica, aspectos cualitativos y cuantitativos (tiempo de retención, área y altura de pico). Cálculo de los parámetros cromatográficos. Validación de un método cromatográfico.

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	24	21	45
Seminario	12	20	32
Prácticas de laboratorio	14	19	33
Obradoiro	0	22	22
Resolución de problemas e/ou exercicios	0	6	6
Exame de preguntas de desenvolvemento	2	10	12

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

Metodoloxía docente

	Description
Lección maxistral	As clases maxistrais, cunha duración de 50 minutos, teñen como obxectivo ofrecer unha visión global e introdutoria das técnicas de separación e da súa aplicación na análise. Os contidos abordados nestas sesións teóricas poderán complementarse con artigos científicos, vídeos, laboratorios virtuais e ferramentas de simulación, que servirán para ampliar e consolidar os coñecementos tratados na aula. A plataforma Moovi (UVIGO) empregárase como ferramenta de apoio e como medio de comunicación entre o alumnado e o profesorado.
Seminario	O obxectivo que se pretende alcanzar con esta actividade pedagóxica é asentir os coñecementos e ampliar as competencias adquiridas nas clases maxistrais. Tanto nos seminarios e talleres como nas actividades de laboratorio farase un seguimento do traballo individual e/ou colectivo que estean a realizar os estudantes. Os estudantes disporán dos medios facilitados para dita atención personalizada (tutorías presenciais ou virtuais, plataforma Moovi, Sistema Campus remoto da UVigo, correo electrónico ou outro canal de comunicación). Para iso, requírense medios informáticos (ordenadores, tablets, etc.) que permitan executar as tarefas propostas na sesión de seminarios.

Prácticas de laboratorio	As sesións de laboratorio están orientadas á aprendizaxe de diferentes técnicas cromatográficas que permitan identificar e cuantificar analitos en diversas matrices (contaminantes ambientais, alimentos, compostos de interese farmacéutico ou outras aplicacións). A través dos experimentos de laboratorio, preténdese vincular os conceptos tratados nas clases maxistras e nos seminarios coa actividade práctica desenvolvida no laboratorio. O estudantado, de forma autónoma ou en grupo, deberá planificar e executar a actividade experimental. A realización dos experimentos estará condicionada polas infraestruturas dispoñibles na Facultade de Química da Universidade de Vigo (dotación de equipamento e material do que dispón o laboratorio de prácticas). A execución das prácticas laboratoriais, ou das simulacións realizadas mediante programas axeitados, deberá ir sempre acompañada dunha boa organización e dunha análise rigorosa dos datos experimentais. Requírese o uso de medios informáticos (ordenadores, software de cálculo e redacción, táboas dixitais, etc.) que permitan o tratamento e discusión dos datos, así como a redacción dos informes correspondentes aos experimentos realizados.
Obradoiro	Estas actividades forman parte dunha proposta non presencial que complementa as clases maxistras, os seminarios e as sesións de laboratorio. O estudantado deberá desenvolver, de maneira autónoma e de forma individual ou en grupo, un traballo de investigación ou unha monografía escrita sobre temas directamente relacionados cos contidos da materia.

Atención personalizada

Methodologies	Description
Lección maxistral	Titorías individuais presenciais ou virtuais. Seguimento do progreso académico do alumnado. Resolución de dúbidas específicas sobre contidos do temario ou actividades relacionadas co desenvolvemento da materia. Orientación sobre métodos de estudo e xestión do tempo.
Seminario	Titorías grupais. Revisión conxunta de proxectos ou traballos en grupo. Aclaración de conceptos comúns detectados na clase. Orientación sobre actividades prácticas ou seminarios.
Prácticas de laboratorio	Titorías individuais ou grupais, presenciais ou virtuais, con asesoramento e apoio no desenvolvemento do traballo práctico ou de laboratorio. No caso das titorías virtuais, deberase empregar a plataforma Moovi ou o Campus Remoto da UVigo, así como o correo electrónico dirixido ao docente encargado desa actividade.
Tests	Description
Resolución de problemas e/ou exercicios	Formarían parte dunha actividade complementaria ás clases maxistras, seminarios e de laboratorio. O estudantado deberá resolver por si mesmo, de forma autónoma, individualmente e/ou en grupo, exercicios prácticos relacionados cos contidos da materia. Este traballo contará co seguimento individual ou colectivo por parte do docente. Sempre que o estudantado precise atención personalizada, deberá solicitar titoría presencial previamente por correo electrónico ao docente ou ben recorrer ás plataformas da UVigo para actividade docente non presencial, como o Campus Remoto ou Moovi.
Exame de preguntas de desenvolvemento	Calquera tipo de proba escrita ou oral prevista no calendario da materia será realizada segundo as normas establecidas no centro universitario. O estudantado, nos períodos previos á realización das ditas probas, poderá dispoñer de atención personalizada por parte do profesorado implicado na materia a través da actividade de titorías presenciais e/ou virtuais. Nestas probas empregase unha estratexia de avaliación baseada en preguntas, exercicios ou análise de casos prácticos. O modelo de cuestións variará en función do tipo de proba (tipo test, respostas curtas, opción múltiple, exercicio numérico, etc.).

Avaliación

	Description	Qualification	Training and Learning Results			
Seminario	Realizarase un seguimento da actividade de seminarios mediante a realización de traballos que se lle encarguen ao estudantado ao longo da materia e/ou na data de realización das probas de avaliación/exame. Tamén se realizará un control de asistencia ás sesións de seminario, así como, se é o caso, a realización de entregables e/ou dunha proba escrita integrada na actividade de avaliación (proba curta e/ou exame). A cualificación mínima que se deberá acadar neste apartado de avaliación da actividade de seminario será de 4 puntos sobre unha cualificación global de 10. No caso de superar o número máximo de faltas de asistencia permitido ao longo do curso, esta actividade considerase non superada.	25	A1	C6	D1	

Prácticas de laboratorio	Realizarase un seguimento do traballo individual e/ou colectivo desenvolvido no laboratorio, podendo requirirse a presentación dun informe ou a resolución das cuestións expostas no laboratorio. Nesta avaliación, o profesorado encargado da actividade de laboratorio poderá recorrer, se o considera oportuno, a unha proba escrita sobre as prácticas desenvolvidas. A asistencia e realización das prácticas de laboratorio son obrigatorias e imprescindibles para superar a materia. A cualificación mínima que se deberá acadar neste apartado será de 5 puntos sobre unha cualificación global de 10.	15	A1	C6	D1	C26
Resolución de problemas e/ou exercicios	Realizarase unha proba curta, en modalidade escrita, dunha hora de duración, con data establecida no cronograma definido pola facultade. Trátase dunha proba de carácter non eliminatorio e permite ao alumnado facer o seguimento do seu estudo na materia. Os seus contidos estarán relacionados coa materia impartida nas sesións de teoría, seminario e laboratorio.	20	A1	C6	D1	
Exame de preguntas de desenvolvemento	O exame (proba longa) estará constituído por contidos impartidos nas clases maxistras e por actividades desenvolvidas nos seminarios, talleres e laboratorio. O contido é responsabilidade do profesorado implicado na materia. Terá unha duración de tres horas. É requisito acadar unha cualificación mínima de 4 puntos sobre 10 na parte correspondente ás clases maxistras, así como na parte relacionada coas sesións de seminario. No caso de existir un exame escrito correspondente á compoñente de laboratorio, a cualificación mínima que se deberá acadar será de 5 puntos sobre 10.	40	A1	B5	C6	D1 A4 C26

Other comments on the Evaluation

Dado que as actividades de formación e avaliación CONTINUA programadas dentro das prácticas de laboratorio e seminarios están deseñadas para formar ao estudiantado en habilidades e competencias directamente relacionadas co exercicio da profesión no ámbito da análise química, a asistencia e participación en ambas as actividades avaliadas son OBRIGATORIAS. A ausencia ou non realización inustificada destas actividades impedirá superar a materia; neste caso, no acta outorgarase unha cualificación de 3,0 puntos sobre 10.

Por tanto, considerando o carácter teórico-práctico da materia e os resultados de aprendizaxe que se perseguen con ambas as metodoloxías, o estudiantado que opte pola modalidade de avaliación GLOBAL final tamén deberá realizar OBRIGATORIAMENTE estas actividades. En caso de non facelo, asignaráselle igualmente unha cualificación de 3,0 puntos sobre 10.

O estudiantado que tivese realizado e asistido no curso anterior ás actividades de seminario e laboratorio non terá obriga de asistencia nestes apartados. No caso de cursos anteriores, SERÁ OBRIGATORIA a asistencia ás sesións de seminario, PERO NON ás prácticas de laboratorio.

Neste último caso, para estudantes repetidores do curso académico anterior que superasen as prácticas, manterase a cualificación obtida nese curso. Para cursos anteriores con prácticas superadas, outorgarase unha cualificación de 5,0 sobre 10 puntos.

O alumnado repetidor que desexa mellorar a cualificación deberá cursar novamente as prácticas de laboratorio.

Exame ordinario/extraordinario:

O exame, tamén denominado proba longa, estrutúrase en tres partes: teórica (**T**), correspondente á clase maxistral; teórico-práctica ou suposto práctico (**TP**); e problemas (**P**), correspondente á actividade de seminario. A duración máxima da proba será de tres horas.

A cualificación de laboratorio (**L**) ponderarase na cualificación final segundo se indica a continuación, de acordo cos descritores da guía docente de avaliación.

É OBRIGATORIO que o estudiantado acade unha cualificación mínima de 4 puntos (nunha escala de 0 a 10) en cada unha das partes avaliadas (T, TP e P), e de 5 puntos na avaliación de laboratorio (L).

Se se cumpren os requisitos mínimos, a cualificación FINAL GLOBAL calcularase mediante a seguinte ponderación:

$$\text{NOTA FINAL (A)} = 0,40 \times T + 0,25 \times TP + 0,20 \times P + 0,15 \times L$$

En caso de non cumprirse estes requisitos, a cualificación final da materia no acta corresponderá ao valor MÍNIMO obtido nunha das partes avaliadas.

ATENCIÓN: o alumnado que desexa optar pola modalidade de AVALIACIÓN GLOBAL FINAL (no continua) deberá comunicalo

e entregar un documento escrito e asinado ao profesorado responsable da materia durante as dúas primeiras semanas desde o inicio da docencia da materia correspondente.

Na presentación da materia, así como na páxina da Facultade de Química, están dispoñibles as datas das actividades de avaliación.

Moi importante: para poder SUPERAR a materia (é dicir, para poder sumar as cualificacións obtidas en cada actividade avaliable), é OBRIGATORIO acadar unha nota mínima de 4,0 (sobre 10) en cada unha das actividades avaliables mencionadas anteriormente (probos curtos, proba final, prácticas de laboratorio e seminarios).

O alumnado que NON cumpra este requisito na primeira oportunidade será cualificado no acta coa nota máis alta acadada nas partes non superadas e deberá repetir na segunda oportunidade (convocatoria de xullo) a proba correspondente á parte ou partes nas que non acadase o 4,0. Loxicamente, o alumnado que se atope nesta situación conservará a cualificación das partes superadas ($\geq 4,0$) na primeira oportunidade.

IMPORTANTE: o estudantado que non execute as actividades de avaliación de acordo cos criterios do código ético e de responsabilidade, entre outros, por exemplo mediante a copia en distintas probas de avaliación, quedará automaticamente suspenso na materia para o curso académico correspondente. Perderá automaticamente todo o proceso de avaliación e no acta outorgaráselle unha cualificación final de 1,0 punto.

IMPORTANTE: a xustificación das faltas durante o curso deberá ir acompañada do correspondente xustificante oficial. Consideraranse causas xustificadas as relacionadas coa saúde, o falecemento de familiares, a práctica de deporte profesional ou federado, así como todas aquelas recollidas no Estatuto da UVigo.

Uso da Intelixencia Artificial nesta materia

Nesta materia, permítese o uso de sistemas de IA por parte do estudantado nas seguintes tarefas/actividades: procura e síntese de fontes, apoio á redacción, xeración de exemplos de exercicios e apoio á programación.

Prohíbese o seu uso na elaboración íntegra de informes e no tratamento de resultados experimentais. Así mesmo, queda expresamente prohibido o seu uso en probas ou exames escritos e orais.

Queda expresamente prohibido o uso da IA para: a substitución total ou substancial da autoría propia do estudante, a presentación como propio de contido xerado por IA sen declaralo, a suplantación de identidade, a fabricación ou manipulación de datos, e calquera outro uso que constitúa fraude académico.

Cando o uso da IA estea permitido, o estudantado deberá declarar: a ferramenta e versión empregada, os prompts ou indicacións relevantes utilizadas, as partes da actividade nas que se empregou, e a revisión humana/crítica realizada sobre o resultado. As citas deberán indicar ferramenta, data e finalidade da consulta.

O uso da IA contrario ao establecido nesta guía docente poderá ser considerado fraude académico, conforme á normativa disciplinaria aplicable, podendo con levar a inadmisión do traballo, a solicitude de probas adicionais ou a apertura do procedemento correspondente.

Se o profesorado desta materia emprega sistemas de IA como apoio na corrección ou retroalimentación das actividades avaliables, a cualificación final basearase en todo caso nunha revisión humana efectiva e non meramente formal, mantendo o criterio profesional como elemento determinante da avaliación.

Bibliografía. Fontes de información

Basic Bibliography

Luis María Polo Díez, **Fundamentos de la cromatografía**, 1ª Ed., Dextra Editorial S.L, 2015

A. Braithwaite and J.F. Smith,, **Chromatographic Methods**,, 1ª Ed, Springer, Dordrecht, 1999

Phillipe Schmitt Kopplin, **Capillary Electrophoresis: Methods and Protocols**, 2ª Ed, Humana Press, 2016

Complementary Bibliography

Chhabil Dass,, **Fundamentals of Contemporary Mass Spectrometry**,, 1ª Ed., Wiley-Interscience,, 2010

Rouessac Francis; Rouessac Annick, **Chemical Analysis: Modern Instrumentation Methods and Techniques**, ISBN 10: 1119701333 ISBN 13: 9781119701330, 1ª Ed., Wiley-Interscience,, 2024

Recomendacións

Subjects that are recommended to be taken simultaneously

Química analítica III: Métodos eletroanalíticos e separacións/V11G201V01302

Subjects that it is recommended to have taken before

Química analítica II: Métodos ópticos de análise/V11G201V01207

Química analítica I: Principios de química analítica/V11G201V01202

Other comments

O estudiantado ten á súa disposición ligazóns a páxinas web de sociedades científicas e editoriais especializadas relacionadas coa Química Analítica, en particular coas técnicas de separación. A consulta destes recursos constitúe unha ferramenta de grande utilidade como apoio ao estudo, así como para a elaboración de traballos de seminario e de laboratorio.

<https://www.aoac.org/>

<https://aoaceurope.com/>

<https://secyta.es/>

<https://seqa.es/>

<https://www.euchems.eu/>

<https://www.sciencedirect.com/journal/journal-of-chromatography-a>

<https://www.sciencedirect.com/journal/journal-of-chromatography-b>

Recoméndase o uso de plataformas como YouTube, JoVE, entre outras, para facilitar a visualización e mellorar a comprensión dos contidos que se abordarán nesta materia.

IDENTIFYING DATA**Physical Chemistry IV: Molecular Structure and Spectroscopy**

Subject	Physical Chemistry IV: Molecular Structure and Spectroscopy			
Code	V11G201V01307			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Flores Rodríguez, Jesús Ramón			
Lecturers	Flores Rodríguez, Jesús Ramón Graña Rodríguez, Ana María			
E-mail	flores@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	In the present subject Quantum Mechanics is applied to the study of molecules and the fundamentals of molecular spectroscopy. First, the Born-Oppenheimer approximation is introduced and the concept of potential energy surface presented, so a relatively detailed study of the rotation and vibration-rotation spectroscopies can later be done. The molecular orbital (MO) and valence bond (VB) methods for the analysis of the electronic structure of molecules are presented, so that of simple molecules can be studied and some basic aspects discussed. The concepts needed for studying the electron and photoelectron spectroscopies are, therefore, given. The most important computational methods for the study of the electronic structure, which form the basis of Computational Chemistry, are also presented in a simple way. The analysis of the spectroscopic methods includes the fundamentals of the magnetic resonance techniques, which is done from a theoretical perspective, as well as those of some other methods, including those based on the use of the laser. The theoretical developments studied in this subject rely on the fundamentals of Quantum Mechanics and the models for translation, vibration and rotation as presented in Química Física III: Química Cuántica. The introduction to Group Theory provided in that subject is completed in the present one by the first theme. Some elements of Statistical Mechanics are used to analyze the intensity and width/shape of the spectral lines for instance. Also, the Fermi-Dirac and the Bose-Einstein distribution laws are presented. By its theoretical and experimental contents, it provides some support to Química Física V: Cinética Química.			

Training and Learning Results

Code				
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study			
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy			
B1	Ability for autonomous learning			
B2	Organization and planning capacity			
B4	Ability for analysis and synthesis			
C2	Use correctly chemical terminology, nomenclature, conversions and units			
C4	Use computer tools properly to obtain information, process data, perform computational calculations and calculate matter properties			
C14	To know the principles of quantum mechanics and its application in the description of the structure and properties of atoms and molecules			
C15	Know the main techniques of structural research, including spectroscopy			
D1	Ability to solve problems			

Expected results from this subject

Expected results from this subject	Training and Learning Results			
To apply the group theory in the context of the chemistry	A1 A5		C4	D1
To formulate the molecular Hamiltonian taking into account the Born-Oppenheimer approximation and to know about potential energy surfaces	A1 A5	B4	C2 C4 C14	D1
To describe the MO and VB methods and to apply the MO method to simple molecules.	A1 A5	B1 B2 B4	C2 C4 C14	D1

To describe some important computational methods and apply them to molecular electronic structure calculations.	A1 A5	B1 B2 B4	C2 C4 C14	D1
To apply the basic concepts of molecular spectroscopy.	A1 A5	B1 B2 B4	C2 C4 C14 C15	D1
To interpret distinct types of molecular spectra (microwave, infrared and visible-ultraviolet) in order to obtain structural information.	A1 A5	B1 B2 B4	C2 C4 C14 C15	D1
To describe the foundations of resonance spectroscopies	A1 A5	B1 B2 B4	C2 C4 C14 C15	D1

Contents

Topic	
Subject I. The Group Theory in Chemistry.	1. Matrix representations. 2. Character tables. Degeneracy. 3. Basis functions. 4. Direct product representations. 5. Vanishing integrals. 6. Symmetry adapted linear combinations and projection operators. 7. Group Theory and Quantum Chemistry.
Subject II. Molecular electronic structure I.	1. The molecular hamiltonian: the Born-Oppenheimer approximation. 2. Potential energy surfaces. 3. The hydrogen molecule ion H_2^+: the MO method. 4. The hydrogen molecule H_2: the VB method 5. Comparison of the MO and VB methods. 6. The Hellmann-Feynman theorem and the virial theorem applied to molecules 7. On the validity of the Born-Oppenheimer approximation.
Subject III. Molecular electronic structure II.	1. Electronic configurations and electronic terms in diatomic molecules. 2. The effect of the spin-orbit interaction. 3. Electron density and bond polarity. 4. The MO and VB methods applied to diatomic molecules. 5. Polyatomic molecules: classification of the electronic states. 6. Application of the MO method to simple polyatomic molecules. 7. Electron population analysis. 8. Localized MOs. 9. Molecules with conjugate bonds: the sigma-pi separation. The free electron MO method. 10. The Hückel MO method. 11. Electron delocalization and aromatic stability. 12. Population of the energy levels: Fermi-Dirac and Bose-Einstein distributions. 13. Electronic bands. 14. Application of the VB method to polyatomic molecules: types of hybridization. 15. Resonance and its meaning in Physical Chemistry.
Subject IV. Electronic structure and Computational Chemistry.	1. The Hartree-Fock SCF method applied to molecules. 2. Basis functions in molecular calculations. 3. The Roothaan-Hall and Pople-Nesbet equations. 4. Limitations of the Hartree-Fock SCF method. 5. Post-Hartree-Fock methods. 6. Density Functional Theory (DFT). 7. Relativity in molecular calculations. 8. Semi-empirical methods.
Subject V. Interaction of the electromagnetic radiation with matter and molecular spectroscopy.	1. Interaction of the electromagnetic radiation with matter. 2. Diffusion. 3. Absorption: transition moments and selection rules. 4. The Lambert-Beer law. 5. Broadening of the spectral lines. 6. Raman effect. 7. Laser and laser types. 8. Fourier transform. 9. General aspects of the experimental techniques

Subject VI. Molecular rotation and rotational spectroscopies.	1. The polyatomic rigid rotor: results of the classical and quantum treatments. 2. Rotational spectra. 2.1. Selection rules, populations and line intensities 2.2. Stark effect. 2.3. Hyperfine structure and nuclear quadrupole moment. 2.4. Molecules with non-zero electronic angular momentum. 2.5. Type-I doubling. 3. Microwave spectroscopy (MW) and its applications. 4. Rotational Raman spectra. 5. Obtaining the molecular geometry from the rotational constants. 6. Nuclear spin and rotational states.
Subject VII. Molecular vibration and vibrational spectroscopies.	1. Vibration in diatomics. 2. Anharmonicity, vibration-rotation interaction and centrifugal distortion. 3. Vibration and vibration-rotation spectra in diatomic molecules. 4. Line intensity and nuclear spin. 5. Vibration in polyatomic molecules. 6. Vibration-rotation spectra in polyatomic molecules. 7. Analysis based on the symmetry: IR and Raman activities. 8. Anharmonicity and potential energy surfaces. 9. Normal modes with more than a minimum. 10. Vibration in solids.
Subject VIII. Electronic spectra.	1. Electronic spectra. 2. Diatomic molecules. 2.1 Selection rules. 2.2 Franck-Condon principle and fine structure. 2.3 Dissociation and predissociation. 3. Electronic spectra in polyatomic molecules. 4. Fluorescence and phosphorescence. 5. Non-radiative transitions. 6. Photoelectron spectroscopies 7. Optically active molecules. Circular dichroism. 8. Laser techniques.
Subject IX. Resonance spectroscopies	1. Introduction. 2. Foundations of the RMN and RSE spectroscopies : Chemical shift. 3. Interpretation of the shielding constants. 4. Interpretation of the fine structure. 5. RMN and nuclear exchange processes. 6. RMN for the solid state. 7. Foundations of the pulse techniques and spin relaxation. 8. RSE spectroscopy: hyperfine structure. 9. Quadrupole resonance spectroscopy. 10. Mössbauer spectroscopy.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	23	57.6	80.6
Problem solving	12	26.4	38.4
Laboratory practical	14	14	28
Objective questions exam	2	0	2
Objective questions exam	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

	Description
Lecturing	Study Sessions. Discussion of the basic aspects of each topic and description of those to be addressed in the seminars. Discussion of the specific issues raised by students. The student will be provided with ample study material to follow the lessons through the Moovi (Moodle) platform. Consequently, an active attitude on the part of the student is essential, so that the lectures become also true study sessions.
Problem solving	Numerical problem solving and theoretical questions, as well as test-type or guided exercises. Some basic numerical and theoretical exercises will be solved by the teacher in the seminars with the participation of the students. The results will be analyzed and interpreted. On a voluntary basis, the student may present the solution to some selected exercises in the seminar, with the assistance of the teacher and the participation of the other students. They may, voluntarily as well, present a written resolution to an exercise and debate it with the teacher in tutoring time.

Laboratory practical	Every student is expected to perform a well-balanced set of experiments which exemplifies and develops the basic topics. The experimental part will be carried out by couples of students for agility; the rest will be done individually. Scripts describing every experiment, references to bibliography and instructions for the use of computers, programs and instrumentation, as well as others related to laboratory safety, will be made available as needed. The student must produce the figures and make the necessary calculations to obtain the final results, as well as analyze and discuss them with the teacher. At the end of each practice, students will fill up a Form asking about the data obtained in the experimental part, about the results of the computations and calculations and, eventually, reporting also any unexpected trouble they had. Independently of that form, each student must present before the deadline corresponding to his/her lab group, a Detailed Report for each experiment, which must be original, where the theoretical and experiment foundations as well as the final results are discussed.
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Personalized assistance

Methodologies	Description
Lecturing	The student may raise specific questions in the lectures and wider ones in the teacher's tutoring time.
Problem solving	The solution to the exercises will be discussed with the students in connection with the development of the theoretical aspects. Also the solution to the tests. Students will be helped in the classroom with the guided exercises. The additional questions they may raise will be answered during the teacher's tutoring time.
Laboratory practical	The practical problems or doubts the students may raise regarding the theoretical foundation of the experiments, their development or the key aspects of the calculations needed to obtain the result will be discussed during the practical sessions. Additional issues may be addressed in tutoring hours.
Tests	Description
Objective questions exam	Any doubts regarding the exams, in particular those related to their scope and configuration, will be clarified. In the case of the short exams, the solutions to the exercises will be briefly presented and discussed in a seminar after the short exam. During tutoring hours, the answers provided by the student will be discussed with him/her at his/her request.

Assessment

	Description	Qualification	Training and Learning Results
Problem solving	The resolution of one or more exercises by the student and their presentation in the seminar will be rated. Short tests taken in the seminar will be rated too, as well as the final part of the guided exercises. In all cases on a non-compulsory basis. The weight in the global grade lies between 0-10%.	10	A1 B1 C2 D1 A5 B2 C4 B4 C14 C15
Laboratory practical	Lab Practices are compulsory. They will be rated by assessment of their development (10%) as well as that of the corresponding Detailed Reports (10%), one per practice. Those reports must be elaborated individually, be original, must include tables, figures and graphics and the calculations needed to obtain the final results, as well as a detailed discussion in relation to all relevant theoretical and experimental aspects of the subject. Students must upload them to the Moovi platform before the established deadline.	20	A1 B1 C2 D1 A5 B2 C4 B4 C14 C15
Objective questions exam	For the written exams the subject is divided into two parts (I and II), which have a relative weight of 50% in the mark. The written exams consist in the resolution of questions and problems. First short exam ("Primera prueba corta", Part I). It will take place by about half of the lecturing period. If its mark is equal or greater than 5 points over 10, part I will be considered as passed by the student. If it is lower than 5 but equal or greater than 3.75, it may represent 50% of the mark of part I, the other 50% coming from part I of the Final Exam, if that leads to improvement; otherwise the latter mark prevails. Its weight on the global mark depends on the results of other items and lies in the range: 0-40%.	35	A1 B1 C2 D1 A5 B2 C14 B4 C15

Objective questions exam	Second short exam (Part II). It will take place near the end of the lecturing period. Independently of the mark, the students must take part II in the Final Exam (see below). Its mark is only valid for calculating an average with the corresponding mark of Part II of the Final Exam, not independently of the latter. It may represent 25% of the mark of part II if that leads to an improvement, otherwise the mark obtained for part II in the Final Exam will prevail. Its weight on the global mark, depending on that other sections is: 0-10%. Final Exam. Compulsory. It will take place shortly after the lecturing period (May/June). Those students who have not passed the first short exam (mark ≥ 5) will have to take all the exercises. Those who pass it can still try to solve the exercises of part I to improve the corresponding mark. Its weight on the global mark depends on that of other sections and lies within 26.5%-80%. The combined mark of the exams (not including the tests nor the other exercises of the first item) has to be at least 3.75 on the 10-point scale for the subject to be passed. The lab practices and the final exam are compulsory. See also the second and third points of the next section (Other Comments on the Evaluation) on the Final Mark and the importance of attending the Exam. The assessment rules of the Second Call (June) to those students who have not passed the subject, are given in the first point of the next section.	35	A1 B1 C2 D1 A5 B2 C14 B4 C15
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Other comments on the Evaluation

- In the *Second-Opportunity Evaluation*, the corresponding Final Exam is also compulsory, if not taken, the mark will be the same as in the first opportunity. In any case, the Final Mark can never be lower than that of the first-opportunity evaluation. Lab practices represent 20% of the mark. The marks corresponding to "Problem Solving", second short exam and also that of the first short exam if ≥ 3.75 , will be kept and used to calculate the average by the weights given in the last section, but only if their use gives a higher grade. Otherwise the mark of the Final Exam, including all exercises, will prevail, being 80% of the Final Mark.
- Final Mark
 - The average mark corresponding the written tests, that is to the exams (third and fourth items of the last section) has to be ≥ 3.75 on a 10-point scale for the other items (Problem Solving and Lab) to be considered in the global average, otherwise the Final Mark will be simply that of the written tests, and calculated according to the rules presented in the former section; therefore attending the Exam is extremely important. The Final Mark must be ≥ 5 on the 10 point scale to have the subject passed. Again, Lab Practices and the Final Exam are compulsory.
 - Taking four or more tests/guided exercises or presenting one exercise (Problem Solving), or attending one Lab session or any of the short exams, makes it impossible to get "No Presentado" as a grade.

Sources of information

Basic Bibliography

Atkins, P.W.; de Paula, J.; Keeler, J., **Atkins Physical Chemistry**, 11th, Oxford University Press, 2018

Levine, I. N., **Physical Chemistry**, 6th, McGraw Hill, 2009

Complementary Bibliography

Berry, S.W.; Rice, S.A.; Ross, J., **Physical Chemistry**, 2nd, Oxford University Press, 2000

Engel, Th.; Reid, Ph., **Physical Chemistry**, 3d, Pearson, 2014

Levine, I. N., **Quantum Chemistry**, 7th, Pearson, 2014

Hollas, J.M., **Modern Spectroscopy**, 4th, Wiley, 2004

Levine, I.N., **Molecular Spectroscopy**, 1st, John Wiley & Sons, 1975

Banwell, C. N., **Fundamentals of Molecular Spectroscopy**, 4th, McGraw-Hill, 1994

Requena, A. ; Zúñiga, J., **Espectroscopía**, 1a, Pearson, 2004

Gil Criado, M.; Núñez Barriocanal, J.L., **Espectroscopía Molecular**, 1a, Garceta, 2018

Bernath, P.J., **Spectra of Atoms and Molecules**, 4th, Oxford University Press, 2020

Atkins, P. W. ; Friedman, R., **Molecular Quantum Mechanics**, 4th, Oxford University Press, 2005

Atkins, P. W., **Quanta : a handbook of concepts**, 2nd, Oxford University Press, 1991

McQuarry, D.A., **Quantum Chemistry**, 2nd, University Science Books, 2008

Pilar, F.L., **Elementary Quantum Chemistry**, 2nd, Dover, 2001

Gasser, R.P.H. Richards, W.G., **An introduction to statistical thermodynamics**, 1st, World Scientific, 1995

Recommendations

Subjects that are recommended to be taken simultaneously

Physical Chemistry V: Chemical Kinetics/V11G201V01308

Subjects that it is recommended to have taken before

Physical chemistry I: Chemical thermodynamics/V11G201V01203

Physical Chemistry II: Surfaces and Colloids/V11G201V01208

Physical Chemistry III: Quantum Chemistry/V11G201V01303

IDENTIFYING DATA				
Physical Chemistry V: Chemical Kinetics				
Subject	Physical Chemistry V: Chemical Kinetics			
Code	V11G201V01308			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	Galician			
Department				
Coordinator	Fernández Nóvoa, Alejandro			
Lecturers	Fernández Nóvoa, Alejandro Losada Barreiro, Sonia			
E-mail	afnovoa@uvigo.es			
Web				
General description	The object of this discipline is to present the basis of "Chemical Kinetics", i. e., the basis for understanding the temporal evolution of the chemical processes. Both, from the macroscopic point of view (Macroscopic Kinetics and experimental methods) and from the microscopic one (reaction mechanisms and theoretical interpretation of reaction rates).			

Training and Learning Results				
Code				
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study			
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues			
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy			
B1	Ability for autonomous learning			
B4	Ability for analysis and synthesis			
C12	Know the kinetics of chemical change, including catalysis and reaction mechanisms			
C27	Demonstrate the ability to observe, monitor and measure chemical processes, by systematically and reliably recording them and presenting reports of the work done			
C28	Interpret data derived from laboratory observations and measurements in terms of their meaning and relate them to the appropriate theory			
D1	Ability to solve problems			

Expected results from this subject				
Expected results from this subject	Training and Learning Results			
Apply Maxwell-Boltzmann statistics to the case of ideal gases and derive thermodynamic properties from microscopic properties.	A1 A5	B1 B4	C28	D1
Explain the hypothesis, the consequences and the fundamental results of the Kinetic Molecular Theory of gases.	A1 A5	B1 B4	C28	D1
Describe all the basic concepts in Chemical Kinetics and be able to make a formal kinetical treatment.	A1 A3 A5	B1 B4	C12 C27 C28	D1
Be able to carry out to analysis of kinetical data, including the ones of complex reactions and relate them with the mechanisms of reaction.	A1 A3 A5	B1 B4	C12 C27 C28	D1
Describe the fundamentals of the experimental techniques available for the kinetic study of chemical reactions.	A1 A5	B1 B4	C12 C27 C28	D1
Describe and apply the Collisions Theory of and the Transition State Theory (in their thermodynamic approach and mecano-statistical approach).	A1 A5	B1 B4	C12 C28	D1
Describe the types of catalysis and explain the mechanism of the catalized reactions.	A1 A5	B1 B4	C12 C28	D1

Contents	
Topic	

Statistical thermodynamics.	Introduction to the Statistical Thermodynamics. Configurations. Molecular Partition Function. Canonical ensemble. Thermodynamic functions. Equilibrium constants.
Macroscopic Kinetics (I).	Importance of the kinetical aspect of chemical processes. Reaction rate and rate equations. Methods for the analysis of kinetical data.
Macroscopic Kinetics (II).	Kinetical analysis of complex reactions. Temperature influence in the reaction rate. Reaction mechanisms.
Experimental methods in Chemical Kinetics.	Transformation of the rate equations. Conventional techniques. Experimental techniques for study of fast reactions.
Theoretical Interpretation of the Chemical Change.	Kinetic-Molecular theory of Gases. Collision theory for bimolecular reactions. Transition State Theory.
Catalysis.	General characteristics of catalysis. Homogeneous Catalysis. Heterogeneous Catalysis. Enzymatic Catalysis.
Introduction to Electrochemical Kinetics.	Electrode-solution interface. Stages of a electrochemical process. Galvanic cells. Overpotential. Butler-Volmer and Tafel equations..
Laboratory Experiments.	Employing several instrumental techniques: - Determination of rate constants and reaction orders. - Study of influence of diverse factors (temperature, ionic strength, ...) in the reaction rate.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	33	57
Seminars	12	33	45
Laboratory practical	14	10	24
Report of practices, practicum and external practices	0	10	10
Essay questions exam	2	6	8
Essay questions exam	0	6	6

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

Methodologies

	Description
Lecturing	They will consist of an exposition by the teacher of the fundamental aspects of each topic, based on the material available on the MOOVI platform. Numerical problems will also be formulated to help understand and settle concepts.
Seminars	The seminar classes will be devoted mainly to solving problems and, when necessary, to delve into the aspects of the topics that present the greatest difficulties for the students.
Laboratory practical	Carrying out, under the supervision of the teaching staff but independently, of laboratory practices in sessions of 3.5 hours. With enough time in advance, the students will have the scripts for the practices to be carried out on the MOOVI platform, along with all the additional material necessary. The script will present the essential elements to carry out the practice at an experimental level, as well as the basic points of its theoretical foundation and data treatment. At the end of the practices, and within the term set by the teaching staff, it will be necessary to deliver/expose the report of one of them, prepared following the guidelines given by the teaching staff.

Personalized assistance

Methodologies	Description
Seminars	In the teacher's tutoring schedule, those doubts of the students that may arise throughout the course in the seminar classes will be resolved individually and more personally.
Lecturing	In the teacher's tutoring schedule, those doubts of the students that may arise throughout the course in the theory classes will be resolved individually and more personally.
Laboratory practical	In the teacher's tutoring schedule, those doubts of the students that may arise during the course in the laboratory classes will be resolved individually and on a more personal basis.
Tests	Description
Essay questions exam	In the teacher's tutoring schedule, those doubts of the students that may arise throughout the course during the preparation of the first written exam will be resolved individually and more personally.
Essay questions exam	In the teacher's tutoring schedule, those doubts of the students that may arise throughout the course during the preparation of the second written exam will be resolved individually and more personally.

Report of practices, practicum and external practices	In the teacher's tutoring schedule, those doubts of the students that may arise during the preparation of the corresponding practical reports will be resolved individually and on a more personal basis.
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Assessment					
	Description	Qualification	Training and Learning Results		
Laboratory practical	It marks here together with the effort and the attitude, the skills and the competitions developed by the students during the realisation of the distinct practical. Attendance at the practical sessions is mandatory and, therefore, it is not possible to pass the subject if it is not completed.	15	A1 A3	B1 C27 C28	D1
Report of practices, practicum and external practices	The report of a practice proposed by the teaching staff will be made, which must be presented/expose taking care of the formal aspects related to the organization, the correct use of the units, the correct preparation of the graphics and the presentation of the results. The critical analysis of these and drawing conclusions will also be valued.	5	A3	B4 C12 C28	
Essay questions exam	There will be a written exam halfway through the semester on the date approved by the Faculty Board. This test will cover the contents of subjects I, II and III.	40	A5	B4 C12 C28	D1
Essay questions exam	A written exam will be carried out at the end of the semester on the date approved by the Faculty Board (the date will coincide with that of the Global Test for students of the Global Assessment modality). This test will cover the contents of subjects IV, V, VI and VII.	40	A5	B4 C12 C28	D1

Other comments on the Evaluation

Continuous assessment:

- To pass the subject, it is an essential requirement that the average of the marks in the written exams be equal to or greater than 4.0 out of 10.0 points. In the case of not reaching said score, the qualification that will be reflected will be only be the average of the qualifications of the tests, not counting any of the other sections.

- To pass the subject, it is an essential requirement to carry out the laboratory practices and obtain in them a minimum global qualification of 5.0 out of 10 points (75% laboratory work, 25% report). In the case of not reaching said score, the grade that will be reflected may not exceed 4.0 points.

- Attendance to the practical sessions is mandatory and, therefore, it is not possible to pass the subject if it has not been done.

- To pass the subject, it is an essential requirement to obtain a grade equal to or greater than 5.0 points out of 10 in its overall grade (15% laboratory practices, 5% practice reports and 80% written tests).

The active participation in the classes (lectures and seminars) may result in additional points up to a maximum of 0,5 points out of 10.

Overall evaluation:

Students who, within the term set by the Faculty, opt for the Global Assessment modality, will take a global written exam on the date set by the Xunta de Facultade. This overall written test will account for 80% of the grade for the subject.

In this global evaluation, the Laboratory Practices will constitute 15% of the qualification of the subject and 5% the corresponding reports.

- To pass the subject, it is an essential requirement to obtain a grade equal to or greater than 4.0 out of 10.0 in the overall written exam. In case of not reaching said score, the qualification that will be reflected only be the qualification of the global test, not counting any of the other sections.

- To pass the subject, it is an essential requirement to carry out the laboratory practices and obtain an overall minimum grade of 5.0 out of 10 points (75% laboratory work, 25% report). In the case of not reaching said score, the grade that will be reflected may not exceed 4.0 points.

- To pass the subject, it is an essential requirement to obtain a grade equal to or greater than 5.0 points out of 10 in its overall grade (80% overall test, 15% laboratory practices and 5% practice reports).

Examined/Not Examined Status:

The participation of the students in one of the two written tests or the attendance to two or more laboratory sessions will imply the condition of "taked exam" and, therefore, the assignment of a qualification.

Second Opportunity:

In the case of the "*Continuous Assessment*" as in the case of "*Global Evaluation*" for the evaluation in the second opportunity, the qualifications of the laboratory practices and of the corresponding report will be maintained.

Sources of information**Basic Bibliography**

Atkins, P. W.; De Paula, J., "**Química Física**", 9789500612487, 8ª Ed., Editorial Médica Panamericana, 2008

Engel, T.; Reid, P., "**Química Física**", 9788478290772, 1ª Ed., Ed. Pearson, Addison Wesley, 2006

Levine, I. N., "**Principios de Fisicoquímica**", 9786071509888, 6ª Ed., Ed. Mc Graw-Hill Education, 2014

LOGAN, S. R., "**Fundamentos de Cinética Química**", 8478290303, 1ª Ed., Ed. Addison Wesley Iberoamericana, 2000

Complementary Bibliography

Laidler, K. J., "**Chemical Kinetics**", 0060438622, 3ª Ed., Ed. Harper & Row Publishers, 1987

Levine, I. N., "**Problemas de Fisicoquímica**", 9788448198336, 1ª Ed., Ed. McGraw-Hill Interamericana, 2005

Metz, C.R., "**Fisicoquímica. Problemas y Soluciones**", 9586000702, 2ª Ed., Ed. McGraw-Hill Interamericana, 1991

Recommendations**Subjects that it is recommended to have taken before**

Physical chemistry I: Chemical thermodynamics/V11G201V01203

Physical Chemistry II: Surfaces and Colloids/V11G201V01208

Mathematics: Mathematics 2/V11G201V01108

Physical Chemistry III: Quantum Chemistry/V11G201V01303

Physics: Physics 2/V11G201V01107

IDENTIFYING DATA				
Inorganic Chemistry IV: Transition Metals and Solid State				
Subject	Inorganic Chemistry IV: Transition Metals and Solid State			
Code	V11G201V01309			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language				
Department				
Coordinator	García Fontán, María Soledad			
Lecturers	Carballo Rial, Rosa García Fontán, María Soledad Martínez Estévez, Mónica			
E-mail	sgarcia@uvigo.es			
Web				
General description	The first part of the subject focuses on the structural study and the structure/properties relationship of inorganic solids. In the second part of the subject, the most relevant aspects of the Chemistry of Transition Metals and their derivatives, such as coordination compounds, are addressed. Experiments on the synthesis and characterization of coordination compounds and inorganic solids will be carried out in the laboratory.			

Training and Learning Results

Code	
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
B1	Ability for autonomous learning
B3	Ability to manage information
B4	Ability for analysis and synthesis
C8	Know the characteristic properties of the elements and their compounds, including the relations between groups and their variations in the periodic table
C9	Know the structural aspects of chemical elements and their compounds, including stereochemistry
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work
D2	Capacity for teamwork

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Recognize and predict the main structural types of solids and their implications for physical and chemical properties.	A2	B1	C8	
	A3	B3		
		B4		
List and recognize the types of defects in crystals and their effect on the properties of the solid.	A2		C9	
Identify non-stoichiometric compounds.	A2		C9	
Recognize the effect of the addition of impurities on the color and optical properties of some inorganic solids.	A3	B3	C9	
Identify the main methods of preparation of inorganic solids.	A3		C8	
Describe how transition metals can be obtained from their natural resources and differentiate the behavior between the elements of the first, second and third transition series.	A2	B3	C8	
	A3	B4	C9	
Predict the reactivity of metal halides and oxides and coordination compounds based on the bond and oxidation state of the metal.	A2	B3	C8	
	A3	B4	C9	
Rationalize the thermodynamic stability of coordination compounds depending on the oxidation state of the metal and the type of ligand.	A2	B3	C8	
	A3	B4	C9	
Carry out in the laboratory the preparation, characterization and study of some physical and chemical properties of the main structural types of solids as well as other derivatives of transition metals.	A2	B3	C8	D2
	A3	B4	C9	
			C26	

Contents	
Topic	
1. Introduction and fundamentals.	Technological importance of solids. Classification of solids. Inorganic solids[] formulation incorporating structural information. Polymorphism, pseudomorphism, polytypism
2. Structural rationalization.	Polyhedral representations. Pauling[]s rules. Connectivity rule.
3. Structure of solids.	Main structural types and their implication in the generation of useful properties of solids
4. Perfect and imperfect crystals and their properties.	Types of defects. Point defects. Consequences of the presence of defects on the properties of solids. Conductivity. Optical properties
5. Solid preparation methods.	Ceramic method. Soft chemistry. High pressure synthesis. Formation of solids from gases and liquids
6. Chemistry of metals in groups 3 and 4.	Obtaining and uses. Most frequent oxidation states. Representative compounds.
7. Chemistry of group 5 metals.	Obtaining and uses. Most frequent oxidation states. Representative compounds.
8. Chemistry of group 6 metals.	Obtaining and uses. Most frequent oxidation states. Representative compounds.
9. Chemistry of group 7 metals.	Obtaining and uses. Most frequent oxidation states. Representative compounds.
10. Chemistry of group 8 metals.	Obtaining and uses. Most frequent oxidation states. Representative compounds.
11. Chemistry of group 9 metals.	Obtaining and uses. Most frequent oxidation states. Representative compounds.
12. Chemistry of group 10 metals.	Obtaining and uses. Most frequent oxidation states. Representative compounds.
13. Chemistry of group 11 metals.	Obtaining and uses. Most frequent oxidation states. Representative compounds.
Chemistry Practices of Compounds transition metais (4 sessions).	Preparation and characterization of transition metal complexes
Inorganic Solids Practices (4 sessions).	Preparation and characterization of inorganic solids

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	24	31	55
Laboratory practical	28	14	42
Seminars	12	12	24
Objective questions exam	2	9	11
Objective questions exam	0	18	18

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

Methodologies	
	Description
Lecturing	Theoretical lectures will be focused on the presentation of the fundamental aspects of the subjects
Laboratory practical	They will be carried out applying the theoretical knowledge acquired. The sessions will be take place in 8 sessions of 3.5 hours and the students will have to reflect and interpret what they have observed in the corresponding laboratory notebook.
Seminars	The seminar classes will be dedicated to the resolution of practical cases related to the subject as well as to the resolution of doubts or questions that arise in the development of each subject. Seminars will also be held to deal with aspects not taught in previous subjects but necessary for the course to run smoothly

Personalized assistance	
Methodologies	Description
Lecturing	Students will be able to consult all kinds of doubts related to the subject during the tutorial hours.
Laboratory practical	Students will be able to consult all kinds of doubts related to the subject during the tutorial hours.
Seminars	Students will be able to consult all kinds of doubts related to the subject during the tutorial hours.

Assessment

Description		Qualification	Training and Learning Results
Laboratory practical	The assistance to the practical classes is compulsory. The evaluation will consist of 10% of resolution of simple questions and 5% based in the behaviour and skills by direct observation of the professor. The grade will be only considered if in the final exam the student achieves an equal or upper qualification to 3 points on 10.	15	A2 B3 C8 D2 A3 B4 C9 C26
Seminars	Students will be asked the resolution of simple questions that they will have to deliver at that point and will serve for his evaluation. The grade will be only considered if in the final exam the student achieves an equal or upper qualification to 3 points on 10.	15	B1 C8 B3 C9 B4
Objective questions exam	There will be two short exams in the term which will evaluate the knowledge related with the subject. The grade will be only considered if in the final exam the student achieves an equal or upper qualification to 3 points on 10. The date and hour of the exams are public and is included in the academic programming approved by the Faculty corresponding organism.	30	B3 C8 B4 C9
Objective questions exam	There will be a final exam for a global evaluation of the subject. The grade of the exam will be only considered if the formulation test gets an "Competent". The date and hour of the exams are public and is included in the academic programming approved by the Faculty corresponding organism.	40	B3 C8 B4 C9

Other comments on the Evaluation

*In case of doubt about the *adquisici  n of results of learning by part of the students, *podr  n make additional oral proofs of *evaluaci  n in *calquier moment before the closing of the records.*

Conditions to opt to the *evaluaci  n continuous

- The student has to *obligatoriamente assist the all the classes you  rich and seminars. - The student has to *obligatoriamente assist the all the classes *pr  cticas of laboratory.- The professor/has to have it in time and form of a *m  nimo 80% of the *entregables proposed in the distinct face-to-face activities (exercises in classes you  rich and seminars or exercises of work *aut  nomo) at the end of the course.- It is *tambi  n compulsory that him/the student present to all the proofs written scheduled. The *incumplimiento of any one of of these conditions involves the stray of right to *evaluaci  n continuous.***Desarollo To opt to the *evaluaci  n continuous:-** The competitions *espec  ficas of the matter related with the competitions of the *titulaci  n (*CE8, *CE9 and *CE26) evaluate  n of form *expl  appointment in exercises in the classroom and proofs written. The competitions *b  sicas, general and transversal be  n evaluated of form *impl  appointment in the *calificaci  n of the exercises.-*Sera Necessary obtain in tests it to it of *formulaci  n an "Apt "" to surpass the matter.- Be   necessary a *puntuaci  n upper or the same to 30% of the total value in each one of the proofs written (short and final) and in the total sum of the qualifications of the *entregables ace   as of 50% of the *pr  cticas of laboratory so that in the *calificaci  n final take into account the rest of the elements of *evaluaci  n (*entregables and short proofs).-Surpass the oral proof in the case to be necessary. In the case of not achieving any of the *m  nimos, in the *acte appear   the result *ponderado of the proofs and exercises described in which *consigui   the criterion.

2*   Announcement - The students that do not surpass the matter at the end of the *cuatrimestre have to  n do a proof written in the *per  odo of closing of *evaluaci  n definite in the month of July. Said proof *tendr   a value of 40% of the note and substitute   the results of the proof of the end of *cuatrimestre. The *calificaci  n of the *entregables (of the face-to-face activities) and short proofs are not recoverable.- The *calificaci  n final of the/ the students, to be upper to 7 points on 10, *podr   be normalised so that the *calificaci  n *m  s high *podra be until 10 points.

In the case of not fulfilling the requirements for *evaluaci  n continuous or choose the *evaluaci  n global, the/the student *podr   present to a *evaluaci  n global at the end of the *cuatrimestre where have to   resolve questions related with all the competitions *espec  ficas of the matter (included the *CE26). In each question or *cuesti  n, identify   the competition that *est   evaluating. This proof be   different in *extensi  n to the made by those that opt by *evaluaci  n continuous. In whose case:- Be   necessary to obtain a *m  nimo of 3 points on 10 of average in the *evaluaci  n of the competitions *CE8 and *CE9 and of 5 in the competition *CE26 to surpass the matter.-*Sera Necessary obtain in tests it to it of *formulaci  n an "Apt "" to surpass the matter.- Be   necessary to obtain a *calificaci  n global equal or upper to 5 on 10 in this *pruebapara surpass the matter and in *ning  n case *tendr   in account the previous qualifications obtained during the *cuatrimestre.-Surpass the oral proof in the case to be necessary.- The *calificaci  n no see   affected by the *normalizaci  n applied to be upper to 7 points. The *calificaci  n final *obtendr   taking into account: 80% of the note obtained in the competitions *CE8 *yCE9. 20% of the note obtained in the competition *CE26.- The student has to *obligatoriamente assist the all the classes you  rich and seminars. - The student has to *obligatoriamente assist the all the classes *pr  cticas of laboratory.

Sources of information

Basic Bibliography

A. R. West, **Solid State Chemistry and its applications**, 2, Wiley, 2014

L. Smart, E. Moore, **Solid State Chemistry. An introduction**, CRC, 2012

C. E. Housecroft y A. G. Sharpe., **Inorganic Chemistry**, 5, Pearson, 2018

Complementary Bibliography

Winter, Mark J., **D-block chemistry, 1994**, Oxford University Press, 1994

Atkins, Peter, **Inorganic Chemistry**, Willey-VCH, 2008

N.N. GREENWOOD , A. EARNSHAW, **Chemistry of the Elements**, 2, Butterwoth Heinemann, 1997

Recommendations**Subjects that it is recommended to have taken before**

Inorganic chemistry I/V11G201V01204

Inorganic chemistry II/V11G201V01209

Structural Determination/V11G201V01206

Inorganic Chemistry III: Coordination Chemistry/V11G201V01304

IDENTIFYING DATA				
Organic Chemistry IV: Design of Organic Synthesis				
Subject	Organic Chemistry IV: Design of Organic Synthesis			
Code	V11G201V01310			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Álvarez Rodríguez, Rosana			
Lecturers	Álvarez Rodríguez, Rosana Martínez Fernández, Claudio Novegil Estévez, Diego Souto Salgado, José Antonio Vaz Araújo, Belén			
E-mail	rar@uvigo.es			
Web				
General description	In this subject, all previous knowledge of Organic Chemistry subjects will be integrated, in particular with regard to organic synthesis and its consequences in the creation of new elements. stereogenic. To do this, we will use the tools of retrosynthetic analysis, with special attention to the analysis of synthetic proposals that pass with selectivity (chemo, regio and stereoselectivity).			
	English Friendly program subject: Foreign students may request from the teaching staff: a) material and bibliographic references for the follow-up of the subject in English, b) attend tutorials in English, c) tests and evaluations in English.			

Training and Learning Results	
Code	
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
B3	Ability to manage information
B4	Ability for analysis and synthesis
C15	Know the main techniques of structural research, including spectroscopy
C19	Know the main synthetic routes in organic chemistry, including the interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds
C27	Demonstrate the ability to observe, monitor and measure chemical processes, by systematically and reliably recording them and presenting reports of the work done
C28	Interpret data derived from laboratory observations and measurements in terms of their meaning and relate them to the appropriate theory
D2	Capacity for teamwork

Expected results from this subject			
Expected results from this subject	Training and Learning Results		
Recognize structural elements in organic molecules	A3	B3	C19
	A5	B4	C28
Propose retrosynthetic sequences of target molecules	A3	B3	C19
	A5	B4	C28
Analyze alternative retrosynthetic proposals	A3	B3	C19
	A5	B4	C28
Design selective synthetic sequences of target molecules	A3	B3	C19
	A5	B4	C28
Assess the use of efficient structural simplification transformations	A3	B3	C19
	A5	B4	C28
Properly manage interconversions between functional groups and protecting groups.	A3	B3	C19
	A5	B4	C28

Study the reactions that can provide selectivity and its mechanisms	A3 A5	B3 B4	C19 C28	
Apply in the laboratory, rigorously, the corresponding safety rules, as well as the proper treatment of the waste	A3		C15 C27 C28	D2
Write in the notebook laboratory, rigorously, the experiments carried out.		B4	C27 C28	
Perform the synthesis of an organic molecule using a selective stepwise synthesis	A3 A5	B3 B4	C15 C27 C28	D2

Contents

Topic	
1. Design of the Organic Synthesis. Analysis retrosynthetic.	1.1. Target-oriented synthesis 1.2. The principles of retrosynthetic analysis 1.3. Strategic selection criteria 1.4. General principles of reactivity. Natural and unnatural polarity. 1.5 Selectivity. Basic concepts 1.6 Retrosynthetic strategies
2. Strategies based on transforms I. Selection of disconnections	2.1. C-X disconnections of monofunctional compounds 2.2. C-X disconnections of difunctional compounds (1, n) 2.3. C-C disconnections of monofunctional compounds 2.4. C-C disconnections of difunctional compounds (1, n) 2.5. Aromatic Compound Disconnections
3. Strategies based on functional groups I. Interconversion	3.1. Interconversion of functional groups. Oxidation levels 3.2. Functional group interconversion reactions 3.3. Oxidation reactions 3.4. Reduction reactions
4. Strategy based on functional groups II. Protective groups in Organic synthesis	4.1. Description of the protecting groups. 4.2. Sensitive to acid, basic, fluoride, oxidizing agents and reducing agents. 4.3. Selection of protecting groups
5. Strategy based on transforms II. Disconnection of unsaturated compounds	5.1. Stereoselective synthesis of olefins. Csp ² = Csp ² disconnections 5.2. Palladium catalyzed reactions. Csp ² -Csp ² , Csp ² -Csp, Csp-Ar and Ar-X (X = O, N) disconnections.
6. Strategy based on stereochemical	6.1. Description of stereochemistry. Chirality and descriptors. Topicity 6.2. Stereochemistry of chemical reactions. Product selectivity. Simple and induced diastereoselectivity.
7. Strategies based on molecular topology. Disconnection of cyclic compounds	7.1. Retrosynthetic analysis using topological strategies 7.2 Isolated ring retrosynthesis 7.3. Spiro ring retrosynthesis 7.4. Fused Ring Retrosynthesis 7.5. Bridging ring retrosynthesis
Experimental Section. The synthetic milestone of design and discovery of organic compounds with therapeutic applications.	4 sessions

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	24	48
Seminars	24	24	48
Laboratory practical	14	16	30
Essay questions exam	1	10	11
Essay questions exam	1	12	13

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

Methodologies

	Description
Lecturing	The material of the subject will be available on the Moovi platform in advance. The teaching staff will present, in a clear and structured way, the most relevant aspects of the subject assigned to each master session.

Seminars	The aspects discussed during the lectures will be worked on by solving the exercises proposed by teachers.
Laboratory practical	The laboratory work will be developed in 4 sessions of 3.5h. During the synthesis, they will have to write the laboratory notebook, rigorously and clarity, which will be delivered at the end of the practices. In addition, the students will carry out a questionnaire about the experiments carried out in the laboratory, through the Moovi platform.

Personalized assistance

Methodologies	Description
Lecturing	The teaching staff will dedicate the necessary time to answer the questions of the students related to the subject of the course
Seminars	The teaching staff will dedicate the necessary time to answer the questions of the students about the exercises and problems solved in the seminar sessions, as well as those proposed in the Moovi platform
Laboratory practical	The teaching staff will dedicate the necessary time to answer the questions of the students related to retrosynthetic analysis of the target molecule and sequence design synthetic During the laboratory sessions, the faculty will supervise the development of the experiments proposed by students as well as compliance with security rules.
Tests	Description
Essay questions exam	
Essay questions exam	

Assessment

	Description	Qualification	Training and Learning Results			
Laboratory practical	1. It is mandatory to carry out the laboratory practices 2. It will be valued: 2.1. The laboratory notebook (20% of practical qualification), structural analysis (25% of practical qualification), reaction mechanisms (20% of practical qualification), safety data sheets (10% of practical qualification) and questions about IUPAC nomenclature (15% of practical qualification) 2.2. Resolution of questions about work experimental, carried out in the laboratory, through the Moovi platform (10% of practical qualification)) 3. To achieve the experimental sessions it is mandatory to have achieved each one of the evaluated parts	30	A3 A5	B3 B4	C15 C19 C27 C28	D2
Learning outcome: All						

Essay questions exam	Learning outcome: - Recognize structural elements in organic molecules. - Propose retrosynthetic sequences of proposed molecules - Analyze alternative retrosynthetic proposals - Design selective synthetic sequences of target molecules . - Assess the use of efficient transformations of structural simplification. - Properly manage interconversions between functional groups and protecting groups. - Know the reactions that can provide selectivity and their mechanisms. Therefore, the qualification from the remaining sections will only be added when the score obtained in the sum of the written tests is equal to or greater than two points and a half. Two short tests (1 hour long; 15% each). To pass the subject, students must obtain a minimum of 50% in all written tests (short answer test and long answer test). The grade of the written tests will only be taken into account to reach the minimum of 50%, when the score obtained in those written tests is equal to or greater than 4.	30	A3 B3 C15 D2 A5 B4 C19 C27 C28
Essay questions exam	Learning outcome: - Recognize structural elements in organic molecules. - Propose retrosynthetic sequences of proposed molecules - Analyze alternative retrosynthetic proposals - Design selective synthetic sequences of target molecules . - Assess the use of efficient transformations of structural simplification. - Properly manage interconversions between functional groups and protecting groups. - Know the reactions that can provide selectivity and their mechanisms. Therefore, the qualification from the remaining sections will only be added when the score obtained in the sum of the written tests is equal to or greater than two points and a half. A long written test (2 hours long) To pass the subject, students must obtain a minimum of 50% in all written tests (short answer test and long answer test). The grade of the written tests will only be taken into account to reach the minimum of 50%, when the score obtained in those written tests is equal to or greater than 4.	40	A3 B3 C15 D2 A5 B4 C19 C27 C28

Other comments on the Evaluation

1. The participation of the students in any of the evaluation activities of the subject will imply that they acquire the condition of presented, therefore, they will be assigned a grade.
2. In addition, students may choose to be evaluated by a **single test** at the end of the semester and not by continuous evaluation. To do this, they will have to communicate it, in writing, to the subject coordinator at the beginning of the semester. In this case, the final evaluation will be 30% the laboratory work and 70% the single test .

June Assessment:

To achieve the subject it is mandatory to obtain a qualification equal or greater than 5 points in both of the evaluated parts, experimental and theoretical works.

July assessment:

1. The score obtained by students on the course: maximum of 3 points for laboratory practices
2. Written test: maximum 7 points.

Additional information:

1. The students who achieve the laboratory practices, in two previous courses, will not have to do the laboratory work again.

2. Serious conceptual mistakes, will mean the assignment of new activities aimed at solvent learning problems as soon as possible.

3. If dishonest behavior is observed during the written tests, the student will be called to repeat it orally.

Sources of information

Basic Bibliography

Clayden, J.; Greeves, N.; Warren, S., **Organic Chemistry**, 2nd, Oxford University Press, 2012

Starkey, S., **Introduction to strategies for organic synthesis**, 2nd, Wiley, 2018

Complementary Bibliography

Warren, S.; Wyatt, P., **Organic Synthesis the Disconnection Approach**, 2nd, Wiley, 2011

Sunjic, V.; Perokovic, V. P., **Organic Chemistry from Retrosynthesis to Asymmetric Synthesis**, 1st, Springer, 2016

Recommendations

Subjects that it is recommended to have taken before

Chemistry: Chemistry Lab I/V11G201V01105

Chemistry: Chemistry 1/V11G201V01104

Organic chemistry II/V11G201V01210

Chemistry: Chemistry Lab II/V11G201V01110

Chemistry: Chemistry 2/V11G201V01109

Organic chemistry I/V11G201V01205

Structural Determination/V11G201V01206

Organic Chemistry III: Concerted, Radical and Photochemical Reactions/V11G201V01305

IDENTIFYING DATA				
Project				
Subject	Project			
Code	V11G201V01401			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Álvarez Álvarez, María Salomé			
Lecturers	Álvarez Álvarez, María Salomé Vecino Bello, Xanel			
E-mail	msaa@uvigo.es			
Web	http://https://moovi.uvigo.gal/			
General description	This fourth-year module of the Bachelor's Degree in Chemistry aims primarily to familiarise students with the methodology, direction, management and organisation of projects in the field of chemistry. Using the knowledge acquired in Chemistry, Chemical Engineering and other related subjects, students should be able to develop a chemistry project. By the end of the course, students should be able to draft, plan and carry out industrial projects in the field of chemistry. In addition, students must take part in a collaborative project that provides solutions to societal problems. As part of the English Friendly programme, international students may request the following from teaching staff: a) materials and bibliographical references to follow the course in English, b) tutorials to be conducted in English, c) tests and assessments to be set in English.			

Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
B3	Ability to manage information
C4	Use computer tools properly to obtain information, process data, perform computational calculations and calculate matter properties
C5	Present material and scientific arguments in oral and written form to a specialized audience
D2	Capacity for teamwork
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Evaluate the feasibility of carrying out a project related to the competencies of a chemist.	A1 A4	B3	C4	D2
To organise, manage and carry out a project in the field of chemistry, as well as a collaborative project aimed at assessing and solving problems of relevance to society.	A1 A4	B3	C4 C5	D2 D3
Evaluate the potential impact (environmental, socioeconomic) of a project.	A1 A4	B3	C4 C5	D2
Elaborate structured technical reports and present them using appropriate audiovisual means.	A1 A4	B3	C5	D2 D3

Contents

Topic	
Subject 1. The projects in chemistry	Professional competitions of the chemists. Definition and aims and classification. Stages and organisation. Legal appearances
Subject 2. Design of a project	Analysis of the sector. Study of market. Size of the project. Location.
Subject 3. Engineering of the project	Diagrams of flow. Calculations and balances. Equipment.

Subject 4. Economic evaluation of a project	Investment and costs. Profitability. Analysis of risk.
Subject 5. Environmental evaluation of a project	Pollution. Preventive measures and/or of correction. Waste. Cycle of Life.
Subject 6. Documentation of a project	Project report. Methods. Standards. Drawings. Application of artificial intelligence at the various stages of the project.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	12	17	29
Seminars	28	39	67
Essay questions exam	1	1	2
Objective questions exam	1	1	2
Project	0	50	50

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

Methodologies

	Description
Lecturing	Teachers will present the key aspects of each topic, drawing on the resources available on the Moovi platform. Before each session, students will be able to work through the material provided by their teachers relating to the content to be covered in each topic.
Seminars	Students, with the support of their teachers, will design and carry out a specific project in the field of chemistry, as well as a collaborative project aimed at assessing and solving problems relevant to society, which will form part of the course assessment. They will also work on solving practical case studies related to the subject.

Personalized assistance

Methodologies	Description
Lecturing	Any queries students may have regarding the course content, problems or projects will be addressed either in person (during a tutorial in the lecturer's office, by appointment via email) or online (via the remote office), depending on the student's preference.
Seminars	Any queries students may have regarding the course content, problems or projects will be addressed either in person (during a tutorial in the lecturer's office, by prior appointment via email) or online (via the remote learning platform), depending on the student's preference.
Tests	Description
Objective questions exam	Any queries students may have regarding the course content will be addressed.
Essay questions exam	Any queries students may have regarding the course content and problems will be addressed.
Project	Any queries students may have regarding projects will be addressed either in person (during a tutorial in the lecturer's office, by prior appointment via email) or online (via the remote learning platform), depending on the student's preference.

Assessment

	Description	Qualification	Training and Learning Results
Essay questions exam	It will make a long proof of all the matter.	30	D3
Objective questions exam	They will make two exam tests during the course. Said exam tests consist in one splits type test and in another part of resolution of practical cases. The time to perform the exams tests will be 1 hour.	30	D3
Project	Students will undertake two projects: one specifically in the field of chemistry and the other a collaborative project, accounting for 30% and 10% of the final mark respectively. Both will be assessed on the basis of their written submission and oral presentation.	40	D2 D3

Other comments on the Evaluation

FIRST ANNOUNCEMENT

To pass the module, students must achieve a minimum of 40% of the marks allocated to the overall completion of the projects (written submission/final presentation) and the final examination.

CONDITION OF PRESENTED: Students' participation in any of the written assessments or the submission of any part of the projects will mean they are deemed to have sat the exam and will therefore be awarded a mark.

SECOND ANNOUNCEMENT

For the second session, the marks for both the two written assessments held during the course and the projects will be retained, provided that these marks are 4 or above. Students will be required to sit the parts they did not pass previously.

Ethical Commitment

Students are expected to demonstrate appropriate ethical behaviour. Should unethical behaviour be detected (e.g. cheating, plagiarism, use of unauthorised electronic devices), the student will be deemed not to meet the necessary requirements to pass the module in accordance with Articles 41 and 42 of the "*Reglamento sobre a avaliación, a cualificación e a calidade da docencia e do proceso de aprendizaxe do estudantado*" (approved by the Academic Senate on 18 April 2023 and amended by the Academic Senate on 22 December 2023) of the Universidade de Vigo.

Sources of information

Basic Bibliography

J. Frank Valle-Riestra, **Project evaluation in the chemical process industries**, McGraw-Hill, 1983

Manuel de Cos Castillo, **Teoría General del Proyecto**, Editorial Síntesis, 1997

H.F. Rase y M.H. Barrow, **Ingeniería de proyectos para plantas de procesos**, CECSA, 1977

Complementary Bibliography

Luis Cabra, Antonio de Lucas, Fernando Ruiz y María Jesús Ramos, **Metodologías del diseño aplicado y gestión de proyectos para ingenieros químicos**, Ediciones de la Universidad de Castilla-La Mancha., 2010

Arturo Jimenez Gutiérrez, **Diseño de procesos en ingeniería química.**, Editorial Reverté, 2003

Nassir Sapag Chain, Reinaldo Sapag Chain., **Preparación y evaluación de proyectos.**, Mc-Graw-Hill., 2000

J.M. Smith, H.C. Van Ness, M.M. Abbott., **Introducción a la termodinámica en Ingeniería Química.**, Mc Graw-Hill., 2007

A. Vian., **El pronóstico económico en química industrial.**, Alhambra., 1975

Eliseo Gómez, Domingo Gómez, Pablo Aragonés, Miguel Angel Sanchez, Domingo López., **Cuadernos de Ingeniería de Proyectos I.**, Universidad Politécnica de Valencia., 1997

Recommendations

Subjects that it is recommended to have taken before

Chemical engineering/V11G201V01301

IDENTIFYING DATA				
Chemistry of Materials				
Subject	Chemistry of Materials			
Code	V11G201V01402			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Blanco Formoso, María Bolaño García, Sandra			
Lecturers	Blanco Formoso, María Bolaño García, Sandra Vázquez González, Margarita			
E-mail	maiblancoformoso@uvigo.es bgs@uvigo.es			
Web				
General description	Estructura, propiedades y aplicación de los diferentes tipos de materiales.			

Training and Learning Results	
Code	
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
B1	Ability for autonomous learning
B3	Ability to manage information
B4	Ability for analysis and synthesis
C16	Know the relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids, crystals and other materials
C24	Know the properties and applications of materials
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject				
Expected results from this subject	Training and Learning Results			
Recognise the differences between the plastic and elastic deformation		B1 B3 B4	C16 C24	D3
Differentiate between electrical and ionic conductivity. Distinguish the intrinsic semiconductors of the *extrínsecos.		B1 B3 B4	C16 C24	D3
Distinguish hard magnetic materials and soft from his cycle of *histérisis.		B1 B3 B4	C16 C24	D3
Describe the optical properties of the metals and no metals		B1 B3 B4	C16 C24	D3
Explain the thermal properties more important of the materials.		B1 B3 B4	C16 C24	D3
Analyse and describe the characteristics of the alloys in function of his diagrams of phases.	A2 A3	B1 B3 B4	C16 C24	D3
Describe the properties of the different ceramic materials, polymers and compound.	A2 A3	B1 B3 B4	C16 C24	D3
Tackle the processes and basic technicians for the obtaining and characterisation of (*nano)material.	A2 A3	B1 B3 B4	C16 C24	D3

Contents		
Topic		
Subject 1. Introduction	Historical perspective of the development of the materials. Why study the materials? Classification of the materials. Need of new materials.	
Subject 2. Properties of the materials	Mechanical properties, electrical, magnetic, optical and thermal of the materials.	
Subject 3. Metallic materials and alloys, polymeric and ceramic materials.	Characteristics, properties and applications of the metals, alloys (diagrams of phases), polymers and ceramic.	
Subject 4. Compound materials	General characteristics. Classification. Materials reinforced.	
Subject 5. New materials and Nanomaterials	Nanoscience and nanotechnology. Methods of preparation. Properties to nanoscale.	
Subject 6. Characterisation of materials	Isotherms of adsorption and quimisorción to temperature programmed. Microscopy of vicinity and electronic. Foteoeléctric Spectroscopy.	

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	24	45	69
Seminars	6	23	29
Seminars	6	22	28
Problem and/or exercise solving	1	11	12
Problem and/or exercise solving	1	11	12

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

Methodologies	
	Description
Lecturing	The alumn@s will receive 24 hours of classes *expositivas in an only group, that will devote to the presentation of the fundamental appearances of each subject.
Seminars	They will devote to the resolution of doubts and questions that arise in the development of each subject, to the resolution of problems and/or exposed exercises by the profes@r and to the presentation by part of the alumn@s of some report and/or work related with the matter.
Seminars	(*)Dedicaranse á resolución de dúbidas e cuestións que xurdan no desenvolvemento de cada tema, á resolución de problemas e/ou exercicios expostos polo profes@r e á presentación por parte dos alumn@s dalgún informe e/ou traballo relacionado coa materia.

Personalized assistance

Methodologies Description	
Seminars	The alumn@s will be able to consult all type of doubts related with the matter in the *tutorías.
Seminars	

Assessment				
	Description	Qualification	Training and Learning Results	
Seminars	In addition to resolving practical exercises that allow to the alumn@s settle the knowledges on the subjects unrolled in the classes of theory, and to resolve all the exposed doubts, the classes of seminar will use also to carry out the continuous evaluation of the alumn@s. This process of continuous evaluation will make through the resolution of exercises and/or problems as well as by means of the realisation of reports and/or works that will be exposed by the alumn@s and that will be related with the contents of the matter. The evaluation of the Seminars of the subjects 1-3 will account for 25% of the final note.	25	A3 B3 B4	B1 C16 D3 C24
Seminars	In addition to resolving practical exercises that allow to the alumn@s settle the knowledges on the subjects unrolled in the classes of theory, and to resolve all the exposed doubts, the classes of seminar will use also to carry out the continuous evaluation of the alumn@s. This process of continuous evaluation will make through the resolution of exercises and/or problems as well as by means of the realisation of reports and/or works that will be exposed by the alumn@s and that will be related with the contents of the matter. The evaluation of the Seminars of the subjects 4-6 will account for 25% of the final note.	25	A3 B3 B4	B1 C16 D3 C24

Problem and/or exercise solving	A short test will be carried out throughout the cuatrimester which will account for 25% of the final note.	25	A3 B1 C16 D3 B3 C24 B4
Problem and/or exercise solving	A short test will be carried out throughout the cuatrimester which will account for 25% of the final note.	25	A3 B1 C16 D3 B3 C24 B4

Other comments on the Evaluation

Observations:

The participation of any of the proofs planned evaluation will involve the condition of presented and, therefore, the allocation of a qualification in the record of the matter. It will be necessary to surpass the two short proofs (obtain a minimum of 40% of the note in each one) to be able to take into account the other elements of evaluation.

Evaluation of July: The students that non surpass one or the two short proofs that make during the cuatrimestre, will have to present to the corresponding part in the announcement of July. This proof will substitute the results obtained in the tests/s short/s made along the cuatrimestre. The remaining elements of evaluation are not recoverable and the qualifications obtained will add to the one of the quoted proof as long as the qualification obtained was equal or upper to 4 on 10. In case to obtain a lower qualification, will be this the one who appear like final qualification of the matter.

If the student renounces to the continuous evaluation and opts by a global evaluation, each one of the short proofs will cost 50% of the final note. The students that non surpass one or the two short proofs that make during the cuatrimestre, will have to present to the corresponding part in the announcement of July.

Sources of information

Basic Bibliography

Callister, W.D., Rethwisch, D.G., **Introducción a la Ciencia e Ingeniería de los Materiales**, Reverté (trad. 9ªed),

Smart, L.E. Moore, E.A., **Solid State Chemistry. An introduction**, Taylor & Francis, 4ªed,

West, A.R., **West, A.R.. Solid state chemistry and its applications**, John Wiley & Sons.,

Levine, I.N., **Físicoquímica**, McGraw-Hill / Interamericana de España, S. A.,

Kirkland, A.I., Hutchison, J.L., **Nanocharacterisation**, RSC, Cambridge,

Singh, S. C, Hoboken J., **Nanomaterials**, John Wiley & Sons,

Vollath, D., **Nanomaterials : an introduction to synthesis, properties and application**, Wiley-VCH,

Complementary Bibliography

Recommendations

Subjects that are recommended to be taken simultaneously

Nanochemistry/V11G201V01403

Subjects that it is recommended to have taken before

Inorganic Chemistry IV: Transition Metals and Solid State/V11G201V01309

Physical Chemistry II: Surfaces and Colloids/V11G201V01208

Inorganic Chemistry II/V11G201V01209

Inorganic Chemistry III: Coordination Chemistry/V11G201V01304

Physics: Physics 2/V11G201V01107

IDENTIFYING DATA				
Nanoquímica				
Subject	Nanoquímica			
Code	V11G201V01403			
Study programme	Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4	1c
Teaching language	Castelán			
Department	Química Física			
Coordinator	Correa Duarte, Miguel Ángel Pastoriza Santos, Isabel			
Lecturers	Correa Duarte, Miguel Ángel Pastoriza Santos, Isabel			
E-mail	macorrea@uvigo.es pastoriza@uvigo.es			
Web				
General description	Esta asignatura optativa do 1º cuatrimestre de 4º do Grao en Química combina coñecementos de química cos de outras ciencias fundamentais e aplicadas nos temas que trata, como biotecnoloxía, medicina, física, materiais, inxeniería, etc. Por iso está pensada con un gran carácter práctico. Deste modo diferentes conceptos relacionados coa nanoquímica serán explicados en las clases maxistrais e seminarios (superhidrofobicidade, materiais autoreparables, células fotovoltaicas, propiedades ópticas, magnéticas de nanomateriais, etc) e despoés nas clases de laboratorio os alumnos, dende un punto de vista práctico, verán como estos coñecementos teñen una traducción directa na nanotecnoloxía, xenerando aplicacións reais e tanxibles (materiais autolimpiables, sensores colorimétricos, células fotovoltaicas, catalizadores, etc).			

Resultados de Formación e Aprendizaxe

Code	
A1	Que os estudantes saiban aplicar os seus coñecementos ó seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo
A5	Que os estudantes desenvolvan aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía
B4	Capacidade de análise e síntese
B5	Capacidade de adaptarse a novas situacións e adoptar decisións
C34	Seleccionar e utilizar distintos procedementos de obtención e caracterización de nanomateriais e coñecer o seu potencial no desenvolvemento de novas aplicacións
D2	Capacidade para traballar en equipo
D3	Capacidade para comunicarse de forma oral e escrita en castelán e/ou galego e/ou inglés

Resultados previstos na materia

Expected results from this subject	Training and Learning Results			
Coñecer os métodos de síntese de nanomateriais máis extendidos e ser capaz de describir os aspectos máis importantes dos mesmos.	A1 A5	C34	D3	
Coñecer técnicas básicas de análise de nanoestruturas.	A5	B4 B5	C34	
Coñecemento das principais aplicacións das nanoestruturas	A1	B4 B5	C34	D2 D3

Contidos

Topic	
Tema 1. Introducción a Nanoquímica. Mecanismos de obtención de nanomateriales. Propiedades de Nanomateriales	Introducción. Metodos de síntesis de nanomateriales Propiedades de los Materiales
Tema 2. Técnicas de caracterización de nanomateriales.	Microscopía de fuerzas atómicas e microscopía de efecto tunel.
Tema 3. Aplicaciones dos nanomateriales	Aplicaciones en nanomedicina, enerxía, catalises, etc...

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	12	20	32
Seminario	12	24	36

Prácticas de laboratorio	28	37	65
Exame de preguntas obxectivas	2	15	17

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

Metodoloxía docente

	Description
Lección maxistral	Exposición oral e directa, por parte do profesorado, dos coñecementos fundamentais correspondentes aos contidos da materia.
Seminario	Presentación e discusión de publicacións científicas e diferentes tópicos previamente asignados polo profesorado.
Prácticas de laboratorio	Realización, por parte do alumnado, de experimentos relacionados cos contidos da materia

Atención personalizada

Methodologies	Description
Lección maxistral	Resolución de dúbidas, mediante concertación de cita previa, ao través do Campus Remoto.
Seminario	Resolución de dúbidas, mediante concertación de cita previa, ao través do Campus Remoto.
Prácticas de laboratorio	Resolución de dúbidas, mediante concertación de cita previa, ao través do Campus Remoto.

Avaliación

	Description	Qualification	Training and Learning Results			
Lección maxistral	A finalidade desta proba coñecementos alcanzado polo alumnado. O seu peso, dependendo dos outros apartados da avaliación será: 40%-100%. A cualificación ha de ser polo menos 4.0 sobre 10 para que poida realizarse media cos outros apartados.	40	A5	C34		
Seminario	A súa realización é obrigatoria. Puntúanse por valoración da participación activa do alumno nos seminarios, resolución de problemas, exposición de traballos, etc.	30	A1	B4	C34	D2 D3
Prácticas de laboratorio	A súa realización é obrigatoria. Puntúanse por valoración do seu desenvolvemento experimental (15%) así como pola dun informe de prácticas. Este ha de confeccionarse de forma individual ou en grupo (segun determine o profesor), conter táboas, gráficas e os cálculos necesarios para a obtención dos resultados, así como unha análise dos mesmos, en relación co procedemento experimental e o fundamento teórico empregados. Debe entregarse ao profesor encargado do correspondente grupo de laboratorio no prazo que se establece (15%)	30	A1 A5	C34		D2 D3

Other comments on the Evaluation

Para aprobar a materia é necesario aprobar as prácticas de laboratorio e seminarios.

De realizarse unha proba escrita a puntuación debe ser polo menos 4 sobre 10 para poder facer media coas outras seccións da avaliación. A puntuación media total debe ser de 5 puntos sobre 10 ou superior para que poda superarse a materia.

A presentación de calquera exercicio que poida ser avaliado, ou a realización de práctica ou proba imposibilita que a cualificación sexa 'non presentado'.

No exame de Xullo (2ª oportunidade) manterase a cualificación obtida polo alumnado na presentación e nas prácticas de laboratorio realizadas durante o período docente. Iso significa que o alumnado unicamente realizará a proba de preguntas obxectivas no devandito exame.

Compromiso ético. Espérase que o alumnado presente un comportamento ético adecuado. En caso de detectar un comportamento non ético (copia, plaxio, utilización de aparellos electrónicos non autorizados, por exemplo), considerarase que esa persoa non reúne os requisitos necesarios para superar a materia.

Bibliografía. Fontes de información

Basic Bibliography

Kirkland, A.I., Hutchison, J.L., **Nanocharacterisation**, RSC, Cambridge, 2007

Dieter Vollath, **Nanomaterials : an introduction to synthesis, properties and application**, 2, Weinheim : Wiley-VCH, cop., 2013

Complementary Bibliography

C. Bréchnac, P. Houdy, M. Lahmani, **Nanomaterials and nanochemistry**, Berlin : Springer,, 2010

Ozin, Geoffrey A., **Nanochemistry : a chemical approach to nanomaterials**, Cambridge : RSC Publishing, cop., 2005

Recomendacións

IDENTIFYING DATA				
Organometallic Chemistry				
Subject	Organometallic Chemistry			
Code	V11G201V01404			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish			
Department				
Coordinator	Bolaño García, Sandra			
Lecturers	Bolaño García, Sandra García Fontán, María Soledad Martínez Estévez, Mónica			
E-mail	bgs@uvigo.es			
Web				
General description	In this subject we'll study the properties of the compounds that have, at least, one bond between a transition metal and a carbon atom. We'll also study their applications in different processes of organic synthesis catalized by transition metals. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English			

Training and Learning Results

Code	
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
B1	Ability for autonomous learning
B3	Ability to manage information
B4	Ability for analysis and synthesis
C38	Relate the structural bases of organometallic compounds with their physical, spectroscopic and chemical properties
C39	Select the appropriate techniques and procedures for problems of structural elucidation, synthesis, isolation and purification of organometallic compounds
D2	Capacity for teamwork

Expected results from this subject

Expected results from this subject	Training and Learning Results		
Define organometallic compound.		C38	
Rationalize the information provided by the usual spectroscopic techniques for the characterization of the different types of organometallic compounds.	A3	B1 B3 B4	C38 C39
Identify the main types of organometallic reactions.		B1	C38
Propose methods of synthesis for the different types of organometallic compounds.	A3	B1 B3 B4	C38 C39
Predict the stability and reactivity of the different types of organometallic compounds.	A3	B1 B3 B4	C38
Describe the most important catalytic cycles.	A3	B1	C38
Carry out in the laboratory the preparation, characterization and study of organometallic compounds.	A3		C38 C39 D2

Contents

Topic	
Subject 1. Introduction	Definition. History. Ranking. Types of ligands. Rule of the 18 electrons.
Subject 2. Organometallic compounds with type I Carbonyls, phosphines, carbenes and carbiners. ligands (I).	
Subject 7. Types of organometallic reactions (I). Ligand substitution reactions.	

Planning

	Class hours	Hours outside the classroom	Total hours

Lecturing	24	48	72
Problem solving	12	24	36
Laboratory practical	14	14	28
Essay questions exam	1	4	5
Essay questions exam	1	8	9

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

Methodologies	
	Description
Lecturing	Students, in a single group, will receive 24 hours of expository classes in which the teacher will present the most relevant aspects of each topic.
Problem solving	Students, in a single group, will receive 12 hours of seminar classes that will be dedicated to solving doubts or questions that arise in the development of each topic, and to the resolution of questions, exercises and problems proposed by the teacher.
Laboratory practical	Laboratory practices will be carried out in which the theoretical knowledge acquired will be applied. The practices will be carried out in 4 sessions of 3.5 hours and the students must reflect and interpret what is observed in the corresponding laboratory notebook.

Personalized assistance

Methodologies	Description
Lecturing	Students will be able to consult all kinds of doubts related to the subject during the tutorial hours.
Problem solving	Students will be able to consult all kinds of doubts related to the subject during the tutorial hours.
Laboratory practical	Students will be able to consult all kinds of doubts related to the subject during the tutorial hours.

Assessment

	Description	Qualification	Training and Learning Results
Problem solving	In addition to resolving practical exercises that allow to the students settle the knowledges on the subjects developed in the classes of theory, and to resolve all the exposed doubts, the classes of seminar, will use to carry out the continuous evaluation of the students. This process of continuous evaluation will make through the resolution of exercises inside and out of the classroom related with the contents of the matter as well as the resolution of short questions proposals by the professor. The global note of all the exercises will have to surpass the 3 on 10 to be taken into account in the final note.	20	A3 B1 C38 B3 C39 B4
Laboratory practical	The assistance to the face-to-face practical classes is compulsory. The evaluation in the practices of laboratory will consist of a part based in the behaviour and skill by direct observation of the/to professor/to as well as of the previous and back work to the experimental work. It needs a 5 on 10 to pass the course. Those students that have the practices approved in the previous course will be able to request not to repeat them in the current course keeping the qualification obtained.	20	A3 B1 C38 D2 B3 C39 B4
Essay questions exam	A short proof on the contents of the first part of the course. It will demand a minimum note of 3 points out of 10 to pass the course	30	B1 C38 B3 C39 B4
Essay questions exam	A final proof in which it will have a global evaluation of the course and will cost 40% of the final note. It requires a 3 on 10 to pass the course	30	B1 C38 B3 C39 B4

Other comments on the Evaluation

Requirements for passing the course

- Pass the laboratory practicals with a grade equal to or higher than 5 out of 10.

-A mark of 5 out of 10 in the global calification of all the methodologies/tests in continuous assessment or in the final exam in the second opportunity, considering the practical laboratory grade, for non-continuous assessment

Development of continuous evaluation

- The specific competences of the subject related to the competences of the degree will be evaluated explicitly in deliverable exercises and written tests. The basic, general and transversal competences will be assessed implicitly in the marking of the exercises.

- In order to take them into account in the final grade, a score higher or equal to that detailed in the description of each test will be required.

-Students who do not pass the subject at the end of the term will have to take a written test in the final evaluation period in July. This test will be worth 50% of the grade and will replace the results of the two essay question tests. The marks for the rest of the activities are not recoverable.

Non-continuous evaluation

The choice of the non-continuous assessment modality implies the renunciation of the right to continue the assessment of the remaining activities of the continuous assessment modality and of the grade obtained up to that moment in any of the tests that have already taken place.

In the case of choosing the non-continuous evaluation or not achieving the minimum mark required for continuous assessment, the student may take a test at the end of the term in which he/she will have to solve questions related to all the specific competences of the subject except the practicals. This test will be different in length from the one taken by those who opt for continuous assessment and the grade obtained will be 85% of the final grade. A 5 out of 10 will be required to pass the course.

Sources of information

Basic Bibliography

Housecroft, C. E.; Sharpe, A. G., **Inorganic Chemistry**, 5, Harlow: Pearson Education, 2018

Crabtree, R. H., **The organometallic chemistry of the transition metals**, 6, Wiley, 2014

Complementary Bibliography

Spessard, G. O., **Organometallic chemistry**, 3, Oxford University Press, 2015

Astruc, D., **Química organometálica con ejercicios corregidos**, 1, Reverté, 2003

Elschenbroich, Ch., **Organometallics**, 3, Wiley-VCH, 2006

Haiduc, I., **Basic organometallic chemistry**, 1, Walter De Gruyter, 1985

Toreki, R., **The Organometallic Hypertext Book**, <http://www.ilpi.com/organomet/index.html>, 2016

Recommendations

IDENTIFYING DATA				
Stereoselective Synthesis of Bioactive Compounds				
Subject	Stereoselective Synthesis of Bioactive Compounds			
Code	V11G201V01405			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Vaz Araújo, Belén			
Lecturers	Álvarez Rodríguez, Rosana Vaz Araújo, Belén			
E-mail	belenvaz@uvigo.es			
Web	http://https://cinbio.es/orchid			
General description	After receiving training on the properties of functional groups and the transformation processes between them, this course will address the creation of new stereocenters in organic molecules, detailing the conformational and electrostatic considerations of the molecules that may participate in the creation of new stereocenters.			
	#EnglishFriendly International students can request course materials in English from the instructors, as well as receive tutorials, quizzes, and assessments in the same language.			

Training and Learning Results

Code	
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
B4	Ability for analysis and synthesis
C42	Know synthetic strategies to obtain stereoselectively compounds with biological activity
D1	Ability to solve problems
D2	Capacity for teamwork

Expected results from this subject

Expected results from this subject	Training and Learning Results			
New	A4 A5	B4	C42	D1 D2

Contents

Topic	
1. INTRODUCTION	1.1. The importance of drugs 1.2. Drugs and Synthetic Organic Chemistry 1.3. Drugs and natural products 1.4. Drug discovery development: candidates and phases
2. FUNDAMENTALS OF STEREOSELECTIVE SYNTHESIS	2.1. Chirality 2.1.1. Stereogenic units 2.1.2. Prochirality, topicity and prostereogenic units 2.1.3. Assignment of absolute configuration 2.1.4. Description of stereoselectivity 2.2. Conformational analysis 2.2.1. Alkanes 2.2.2. Olefins. Allylic strain 2.2.3. Cyclohexanes and derivatives 2.2.4. Tetrahydropyrans. The anomeric effect 2.2.5. I strain 2.2.6. Bicyclic compounds 2.2.7. The Fürst-Plattner rule

3. KINETICS AND THERMODYNAMICS OF STEREOSELECTIVE REACTIONS

- 3.1. Formation of new stereocenters
 - 3.1.1. Non-stereoselective reactions
 - 3.1.2. Stereoselective reactions
- 3.2. Resolution of enantiomeric mixtures
- 3.3. Analysis of nucleophilic addition trajectories
- 3.4. The Hammond postulate
- 3.5. The Fukui postulate. Klopman-Salem equation
- 3.6. The Curtin-Hammett principle
- 3.7. Organocatalysis
 - 3.7.1. Activation modes in Organocatalysis
 - 3.7.2. Organocatalytic cascade reactions

4. ASYMMETRIC OXIDATION PROCESSES

- 4.1. Epoxidation of olefins
- 4.2. Epoxidation of chiral allylic alcohols
- 4.3. Sharpless asymmetric epoxidation
 - 4.3.1. Principles and applications
 - 4.3.2. Enantioselectivity model
 - 4.3.3. Synthetic applications
- 4.4. Sharpless asymmetric dihydroxylation
 - 4.4.1. Principles and applications
 - 4.4.2. Enantioselectivity model
 - 4.4.3. Synthetic applications

5. ASYMMETRIC REDUCTION PROCESSES

- 5.1. Catalytic hydrogenation of olefins
- 5.2. Catalytic enantioselective hydrogenation of olefins
- 5.3. Diastereoselective reduction of ketones
 - 5.3.1. Diastereoselective reduction of α -hydroxy ketones
 - 5.3.2. Diastereoselective reduction of β -hydroxy ketones
- 5.4. Enantioselective reduction of ketones
 - 5.4.1. Corey-Bakshi-Shibata (CBS) reaction
 - 5.4.2. Catalytic enantioselective transfer hydrogenation
 - 5.4.3. Catalytic enantioselective conjugate addition
 - 5.4.4. Enantioselective reduction of β -dicarbonyl compounds

6. STEREOSELECTIVE C-C BOND FORMATION PROCESSES

- 6.1. Enantioselective addition to carbonyl groups
 - 6.1.1. Organozinc reactions
 - 6.1.2. Reactions of alkynyl derivatives
 - 6.1.3. Nozaki-Hiyama-Kishi reaction
- 6.2. Diastereoselective reactions of carboxylic acid derivatives
 - 6.2.1. Oxazolidinone derivatives
 - 6.2.2. Pseudoephedrine derivatives
 - 6.2.3. Alkylation of chiral azaenolates
- 6.3. Enantioselective conjugate addition to α,β -unsaturated compounds
 - 6.3.1. Organozinc addition
 - 6.3.2. Asymmetric reduction
 - 6.3.3. Organocatalytic conjugate addition

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	24	48
Seminars	12	36	48
Laboratory practical	14	11	25
Problem and/or exercise solving	0	27	27
Essay questions exam	1	0	1
Essay questions exam	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

	Description
Lecturing	Description, by the teaching staff, of the contents of the subject under study, theoretical bases and/or guidelines for a work, exercise or project to be developed by the students.
Seminars	Activity to consolidate the knowledge acquired through the formulation and resolution of problems involving stereoselective transformations in the construction of functionalized skeletons with stereocenters.
Laboratory practical	Practical development of stereoselective synthesis processes using enantiopure chiral catalysts, including organocatalysis, complemented by spectroscopic analysis of the major stereoisomers of the synthetic transformations.

Personalized assistance

Methodologies	Description
Lecturing	Each student may request clarification from the instructor as needed to better understand the subject and correctly solve the exercises and problems. This request may also be addressed during office hours. The corresponding schedules and offices will be published on the faculty's website.
Seminars	Each student may request clarification from the instructor as needed to better understand the subject and correctly solve the exercises and problems. This request may also be addressed during office hours. The corresponding schedules and offices will be published on the faculty's website.
Laboratory practical	The laboratory practices already include a pre-learning design and methodological proposal required before implementation. The faculty provides personalized support.
Tests	Description
Problem and/or exercise solving	Similar to what was indicated in the Seminars.

Assessment						
	Description	Qualification	Training and Learning Results			
Laboratory practical	The practical classes will be assessed on a continuous basis, with questions from the instructor regarding the content and progress, as well as in the practical class report. It will account for 20% of the final grade. A minimum grade of 4.0 out of 10.0 is required to pass the course.	20	A4 A5	B4	C42	D1 D2
Problem and/or exercise solving	Each student will have access to tutoring sessions with the course instructors to address any questions that may arise during the course, individually, in any aspect: theory classes, seminar classes, problem-solving, and/or independent activities. The goal of tutoring sessions is to help students consolidate their knowledge and better address the various assessment activities (written tests, exercises). Deliverables: Students will complete assignments related to the course content. These assignments must adhere to the parameters specified by the instructor and must be submitted in writing through the designated platform or through oral presentations. These assignments will be part of the continuous assessment (20%).	20	A4 A5	B4	C42	D1 D2
Essay questions exam	A test on the content of the first topics, which will account for 20% of the final grade. A minimum score of 4.0 out of 10.0 on this test is required for continuous assessment.	20	A4 A5	B4	C42	D1 D2
Essay questions exam	A test covering ALL THE SUBJECT CONTENT, which will account for 40% of the final grade. A minimum score of 4.0 out of 10.0 on this test is required for continuous assessment.	40	A4 A5	B4	C42	D1 D2

Other comments on the Evaluation

Laboratory Practices:

Attendance at laboratory practical sessions is compulsory. Laboratory work will be assessed as indicated above. This section will include the following aspects: preparatory and/or follow-up work, performance during experimental work, and the laboratory notebook.

Minimum Requirements:

If the minimum requirements are not met in any of the previous assessments, the final grade for the course will be the weighted average of the components in which the minimum requirement has been achieved. The identification of serious conceptual errors will entail the assignment of specific activities aimed at acquiring the corresponding competencies. These activities will be assessed as part of the 20% allocated to course work submissions.

JULY ASSESSMENT:

The grades obtained during the course for laboratory work and problem-solving will be retained. A comprehensive exam covering all theoretical content of the course will be held, accounting for 60% of the final grade. A minimum score of 4 out of 10 must be achieved in this exam to pass the course. The mark obtained in the July exam will replace the marks from previous written tests.

STUDENTS REPEATING THE COURSE (SECOND AND SUBSEQUENT ENROLMENTS):

Students who were previously assessed as PASS in laboratory work will be granted a PASS in the laboratory component for the current academic year; therefore, they will not be required to repeat the experiments.

STATUS OF "PRESENTED":

Participation in any assessment activity will result in the student being recorded as "presented" and therefore receiving a grade. Assessment activities include attendance at laboratory sessions, submission of assignments and exercises set by the instructor, and sitting any tests.

NON-CONTINUOUS ASSESSMENT OPTION:

Students who wish to opt out of continuous assessment must submit a request to the course coordinator within the first three weeks of the semester. To pass the course, they must complete the laboratory practicals (20% of the overall course grade) and obtain a minimum mark of 5. In addition, they must pass a comprehensive exam covering all course content (minimum 5 out of 10), which will account for 80% of the final grade.

Sources of information

Basic Bibliography

Clayden, J.; Greeves, N.; Warren, S., **Organic Chemistry, 2nd ed.**, Oxford, 2012

Zweifel, G. S.; Nantz, M. H.; Somfai, P., **Modern Organic Synthesis. An Introduction**, Wiley, 2017

Complementary Bibliography

Corey, E. J.; Kürti, L., **Enantioselective Chemical Synthesis. Methods, Logic and Practice**, Direct Book Publishing. Dallas: Texas, 2010

Recommendations

Subjects that it is recommended to have taken before

Organic chemistry II/V11G201V01210

Organic Chemistry IV: Design of Organic Synthesis/V11G201V01310

Organic chemistry I/V11G201V01205

Structural Determination/V11G201V01206

Organic Chemistry III: Concerted, Radical and Photochemical Reactions/V11G201V01305

IDENTIFYING DATA**Enhancement of Analytical Chemistry**

Subject	Enhancement of Analytical Chemistry			
Code	V11G201V01406			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	González Romero, Elisa			
Lecturers	González Romero, Elisa			
E-mail	eromero@uvigo.es			
Web	http://quimica.uvigo.es/gl/			

General description In this subject, it will be described (in four main topics) the newest progress of the Analytical Chemistry based in the tendencies and advances in the analysis (Topic 1), the bioanalysis (Topic 2), the chemical sensors and biosensors (Topic 3), the automation and miniaturization (Topic 4) and the validation of methodologies (Topic 5). The Topic 6 is dedicated to device design, describing how devices are manufactured and how the various configurations on the market work (progres that will put in practice in the workshops). With all this, the students will be able to complete their training and integrate the knowledges obtained on Analytical Chemistry, providing them a wider vision and very current that will allow them tackle the resolution of real analytical problems in areas of special interest like the clinic, the biomedicine, the forensic sciences, the environment, the industry (both chemical and food), etc. Special emphasis will be placed on versatility of these techniques as a tool for solving problems in the aforementioned areas, whether the analysis is performed in the chemical laboratories (analysis centralised that involves transport and storage of the sample and in where special taking importance the automatization to reduce errors) or directly on sample collection site (analysis "in situ" or decentralised because of the advantages of the miniaturisation and, therefore, in the devices considers the portability, the easy handle and the rapidity of answer, especially, with which apply like methods of sifted).

With all this, pretends that the student can purchase the sufficient skill, in the first place, in the handle of the sources of bibliographic documentation and, second, in the necessary knowledge on the principles or foundations of the different methodologies that pose and that have given place to diverse commercial devices, so that it can apply the analytical methodology in the resolution of real problems.

Matter of the program English Friendly: the/ace international students will be able to follow the classes without difficulty then , so much the visual material (presentations in PowerPoint) like the bibliography recommended, presents in also in English, in addition to having to his disposal another material of support for the follow-up of the matter in English and to be able to request to the lecturer or faculty any another material or additional bibliographic references in this language. They will attend the interventions in class, the tutoring and the realisation of the proofs and evaluations also in English.

Matter Offered for the Program of Greater; to the students of this program that take this matter, will facilitate them material of support in Spanish (books of text, monographs, articles, etc.) so that they can follow fluently the contents, in addition to having of the bibliography recommended and the complementary.

Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
B4	Ability for analysis and synthesis
C30	Ability to understand, interpret and adapt the advances in the field of Analytical Chemistry
D1	Ability to solve problems

Expected results from this subject

Expected results from this subject	Training and Learning Results		
Recognize the main current trends in analytical chemistry.	B4	C30	
Use and recognize different bioanalytical methodologies.	A1	C30	
Describe and distinguish the different types of automatic analysis systems.	B4	C30	
Understand the advantages and limitations of automation.	A3	B4	C30

To train students in the development of miniaturized analytical tools and their application.	A1	C30		
Value the importance of the utilisation of the (bio)sensors for the obtaining of fast analytical information and reliable.	A3	C30		
Apply properly the methodological validation and the distinct technical chemometrics to the resolution of analytical problems.	A1 A3	C30	D1	
Acquire skills to approach an analytical problem in all its stages (from the selection of an appropriate analytical methodology, through the practical laboratory work, to the interpretation of results).	A1 A3	B4 C30	D1	

Contents

Topic	
Topic 1. Tendencies of the analytical methodology.	Social and economic demand. Demand in analytical chemistry and in the technological developments. Analysis centralised and analysis decentralised. Scope of the advances in the analytical techniques and his methodologies.
Topic 2. Bioanalysis.	Introduction. Matrix complexity. Inorganic biomolecules: ions and electrolytes. Organic biomolecules: micromolecules and macromolecules. Biomarkers. Methodologies based on catalytic and affinity reactions. Applications in the bioanalysis of compounds of interest.
Topic 3. Chemical sensors and biosensors.	Introduction. Recognition Systems. Methods of immobilisation. Functionalization and surfaces modification. Transduction and detection Systems. Mediators, indicators and markers or targets. Chemical sensors. Enzyme biosensors, immunosensors and genosensors. Applications.
Topic 4. Automation and miniaturisation	Introduction. Discreet, continuous and robotic methods. Flow Injection Analysis. Variants: segmented, stopped and sequential flow. The use of the information and communication technologies in the instrumental automation: remote control. Miniaturization in analytical procedures: sample preparation and/or measurement using optical, electroanalytical, chromatographic, and electrophoretic techniques. Applications.
Topic 5. Validation of methodologies.	Introduction. Legal requests and regulatory requirements. QC/QA. Chemometrics. Rejection of anomalous results. Comparison of analytical results. Control charts. Applications.
Topic 6. Design of Miniaturized Devices: How Are They Made? How Do They Work? (Workshops and Laboratory)	Measure of parameters of control of interest in different areas (clinical, biomedicine, forensic, military, environment, foods, etc.). Devices Point-of-Care, PoC (proofs in the point of attention to the patient) or Point-of-Need, PoN (proofs in the point of need): study of different configurations (PADs, LFDs, test strips, Chips, Tattoos and more) applied in the bioanalysis of different control parameters in the areas mentioned.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	31	55
Seminars	12	16	28
Laboratory practical	14	16	30
Workshops	1	14	15
Essay questions exam	2	20	22

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

Methodologies

	Description
Lecturing	The lecturing (55 min) pretend to give a global and faithful vision to the reality of the current Analytical Chemistry. Each one of the subjects will go documented with scientific articles, whose contents will serve to reinforce and expand the knowledges purchased in the theoretical classes, and with representative examples of the fundamental concepts that collect in each subject. All the information received has to complement with the bibliography recommended. The methodology education-learning will be centred in the student, by what the classes will be headed to to motivate/encourage a high participation by part of these in the classroom. Thus, the classes will develop of form very interactive with the students, using for the development of the same the didactic material on line, as well as the most suitable bibliography. The use of the Tics (MooVi) will be the resource that allow to the student the communication with the professor (in addition to the post-and and of the schedule of tutoring), at the same time to be the source of information of immediate access for them. In the platform of teleteaching, will be able to find the basic information and documentation on the matter that gives , the diary of activities, the suppositions proposed, the guide of practices, the planning of workshops and the qualifications.

Seminars	After the lecturing, it will devote the seminars to the resolution of practical suppositions, associated to problems/exercises, in which it pretends strengthen the level of understanding of the students in the subjects treated. These suppositions, in principle, will work in class in groups reduced, afterwards will pose a general debate on the same and, later, the student will have to resolve them to individual level. Also it will make the discussion of practical cases very current, whose aim is to reinforce the knowledges purchased in the theoretical classes and facilitate the learning when they have to tackle the experimental part of the matter. The seminars are mandatory.
Laboratory practical	The practical classes of laboratory have a fundamental paper in the teaching of the subject and, therefore, are compulsory. By a part, are indispensable for the understanding of the theories and concepts given in the classes; by another, allow to form to the student in the handle of the analytical methodology, as well as the norms and rules of the scientific work, so much to level of work in group like individual, including the editorial of reports. It treats , in definite, of aims of character *procedimental. In the development of the practices, is compulsory the fascicle of laboratory: the student will have to elaborate it of individual form, although it work in group or team. The use of the Tics (*MooVi) will be the resource that allow to the student the communication with the professor and his mates, at the same time to be the source of information of immediate access for them. In the platform of teleteaching, will be able to find the basic information and documentation for the preparation of the experiments to make in the laboratory, in addition to the material mentioned in previous sections.
Workshops	It would form part of the link of union between the seminars and the practical of laboratory in which the students will have to resolve, by himself same and with big autonomy, real practical suppositions with the design of methodological strategies of analysis and of devices or possible configurations of measure, including a description of the how works and/or how manufactures (Topic 6). So much in the seminars as in the workshops will do a follow-up of the personal work that was making the student in each moment. They will make debates that will serve for the resolution of real problems, as well as to expose complementary concepts, tackled or no in other matters, but necessary in the approach of said problem. This task is compulsory and will be subject to the personalised follow-up of the evolution of the student in the process of learning. The objective is to prepare a PowerPoint presentation that will be presented orally (10 min) on some topic of the subject.

Personalized assistance

Methodologies	Description
Lecturing	The tutoring program is designed to support students' study, providing them with personalized academic assistance that will help them better utilize the training and knowledge provided by the course. In addition to in-person and/or email tutoring, students' individual and group work will also be tutored through the MooVi platform or the remote campus. Tutoring sessions are held annually and will be scheduled (via email to all lecturer involved in teaching the course) and agreed upon between the student and the instructor, depending on the availability of both parties.
Seminars	The tutoring program is designed to support students' study, providing them with personalized academic assistance that will help them better utilize the training and knowledge provided by the course. In addition to in-person and/or email tutoring, students' individual and group work will also be tutored through the MooVi platform or the remote campus. Tutoring sessions are held annually and will be scheduled (via email to all lecturer involved in teaching the course) and agreed upon between the student and the instructor, depending on the availability of both parties.
Laboratory practical	The tutoring program is designed to support students' study, providing them with personalized academic assistance that will help them better utilize the training and knowledge provided by the course. In addition to in-person and/or email tutoring, students' individual and group work will also be tutored through the MooVi platform or the remote campus. Tutoring sessions are held annually and will be scheduled (via email to all lecturer involved in teaching the course) and agreed upon between the student and the instructor, depending on the availability of both parties.
Workshops	The tutoring program is designed to support students' study, providing them with personalized academic assistance that will help them better utilize the training and knowledge provided by the course. In addition to in-person and/or email tutoring, students' individual and group work will also be tutored through the MooVi platform or the remote campus. Tutoring sessions are held annually and will be scheduled (via email to all lecturer involved in teaching the course) and agreed upon between the student and the instructor, depending on the availability of both parties.
Tests	Description
Essay questions exam	The tutoring program is designed to support students' study, providing them with personalized academic assistance that will help them better utilize the training and knowledge provided by the course. In addition to in-person and/or email tutoring, students' individual and group work will also be tutored through the MooVi platform or the remote campus. Tutoring sessions are held annually and will be scheduled (via email to all lecturer involved in teaching the course) and agreed upon between the student and the instructor, depending on the availability of both parties.

Assessment			
	Description	Qualification	Training and Learning Results
Seminars	PRACTICAL CASES: application of the methodologies in the RESOLUTION OF PROBLEMS in environmental, clinical, alimentary industry, etc. It will do a personalised follow-up of the student and evaluable by part of the professor, considering the degree of participation by the students in the practical cases that pose in the classes of seminars for the resolution of analytical problems in different fields of application. Will take into account the capacity to resolve questions and questions that arise related with the subject, so much the form to expose them (capacity for synthesize, explain and transmit the information) as to defend them with vehemence.	10	A1 B4 C30 D1 A3
Laboratory practical	Practical and EXPERIMENTAL lab. IN THE LABORATORY The lecturers or professors involved will make a personalised follow-up of the experimental work, from the laboratory notebook and the final report made by the student in the sessions of laboratory, his progress, autonomy, attitude, aptitude and skills developed, as well as his capacity to work in group. It is important to indicate that it is IMPERATIVE and MANDATORY the assistance to ALL the sessions of laboratory and surpass the activity to opt to the approved in the matter. Logically, the students that do not have complete or suspend this activity, they will have not superated the practices of laboratory. It has to reach a minimum qualification of 4/10 to opt to the approved of the matter.	30	A1 B4 C30 D1 A3
Workshops	Resolution of PRACTICAL SUPPOSITIONS (design of experiments, preamble of the laboratory), It will do a personalised follow-up of the student and will evaluate the form to defend/present the information, confirmed by the reliable bibliographic research (capacity to look for, value, classify and select information), as well as the capacity to structure, synthesize, transmit, criticise and interrelate the contents for the resolution of the practical supposition or case posed. It will carry out oral work presentation to evaluate and value the capacity of oral transmission and debate (appearance so important in the interviews of work). The resolution of suppositions and the oral work presentation will score 15 % each one in the evaluation and both have MANDATORY character for all the students enrolled..	30	A1 B4 C30 D1 A3
Essay questions exam	It corresponds to the official proof (ordinary announcements and/or extraordinary) and IMPERATIVE/MANDATORY for all the students enrolled. It is constituted by three parts: theory (10%), theoretical-practical (10%) and problems (10%) that integrates the development of an analytical procedure and/or resolution of a practical supposition. To be able to compensate with the rest of the evaluation, will have to reach a final qualification total of 4/10 (and a minimum score of 4/10 in each one of the parts of the exam). The day and hour, as well as the classroom, will be public and the information will be collected in the academic programming of the centre, previously approved by Board of Faculty. OBSERVATION: In case to be several educational involved in the matter (in theory/seminars), the qualification that has to obtain the student in the part given and evaluable by each professor will have to be greater or the same to 3,5/10, being the necessary requirement so that it carry out the global weighting of the examination. No reached this qualification, the final result will be NOT PASS.	30	A1 B4 C30 D1 A3

Other comments on the Evaluation

Please, pay attention: translated content from main language (*castellano*) using the translation tool of DocNet App.

For better reading, please, go to main language and copy the text to google translator or another.

1.-The **continuous ASSESSMENT** WILL BE BASED ON THE GRADES FOR THE VARIOUS activities/test described in each section (see assessment items above). A grade of **5/10 is required for each of the assessed sections/activities/test to pass the subject**. Furthermore, a minimum grade of **4/10 is required for each of the proposed activities/test to pass the subject**. Failure to achieve the minimum grade required for any of the activities/tests will result in a fail grade for the subject. The grade recorded in the transcript will be the highest weighted grade achieved in the assessment, thus

reflecting the most accurate and realistic grade for the activities/tests completed by the student. (*Regulation on assessment grade and the quality of the teaching and of the process of learning of the student, approved in the *clausuro of 18 April 2023, *Título V. Of the *calificación of the student, *Art. 31.2.).*

The ASSISTANCE To THE LAB And To THE SEMINARS (WORKSHOPS), as well as the development and the realization of the activities/test associated (see the terms of assessment), is MANDATORY for ALL THE STUDENTS ENROLLED , receive to the continuous or global ASSESSMENT. The lab and the seminars/workshops are not recoverable in the second neither successive announcements.

The grade obtained in the distinct imperative activities/test of assessment, whenever it reach the minimum of 4/10, it will be maintained for the July all, and the student will only take the recoverable parts that he/she did not pass in the first call (official exam).

2.- GLOBAL ASSESSMENT: the grade obtained obtained in the mandatory activities (developed in the laboratory and in the seminars/workshops) will be transferred to the final grade for this exam. The student that wish to opt for global assessment must submit a signed document to the subject coordinator within two weeks from the beginning of the teaching class, stating their preference for global assessment. This will prevent them from returning to continuous assessment.

3.-Regarding to do the test or any official exam for the subject, it is MANDATORY to bring with you in order to access to the classroom: ID/DNI/NIF or driver's licence, SIMPLE CALCULATOR (not programmable or electronic) and 2 BLUE PENS. It is not allowed the use of another person's calculator. In summary, IT IS **NOT ALLOWED** the access to the classroom with the following UNAUTHORISED material: WHITE-OUTS (*tipex), carbon pens, MOBILE PHONES, SMARTWATCHES or ANY OTHER ELECTRONIC DEVICE, coats, jackets, parkas, marsupials sweatshirts, scarves and similar, etc.

The not allowed material and once detected in the interior of the classroom during the the proofs, it will be confiscated by the professor. Moreover, the *incumplimiento of these norms, established by the *profesorado and known by the students with quite *antelación to the proofs and/or exámenes when being published in the *GUÍA To EDUCATIONAL OF THE MATTER, consider fraudulent behaviour and *tendrá consequences of a *grave discipline (*Regulation on *evaluación, the *calificación and the quality of the teaching and of the process of learning of the student, approved in the *clausuro of 18 April 2023, *Título VII. Of the use of half *ilícitos, *Art. 41.).*

The use of means or material *ilícitos involve the *finalización of the proof and the immediate abandonment of the classroom, appearing a SUSPENSE in Records (certifying the fault in the file) and losing the rights to make ANY ACTIVITY, PROOF or EXAMINATION OF THE SUBJECT during the rest of the course. *También Notify the fault committed to the managers of the Centre and of the *Dpto. So that they notify, to his time, to the upper authorities so that they take the timely measures (*Regulation on *evaluación, the *calificación and the quality of the teaching and of the process of learning of the student, approved in the *clausuro of 18 April 2023, *Título VII. Of the use of half *ilícitos, *Art. 42 .).*

4.-All the activities that develop in the classroom or in the laboratories, the material of support (presentations), etc. are subject to the intellectual property and image rights. The educational of the matter do not allow to be recorded, neither by videos neither by audios or any another format like the screenshots, during the development of the face-to-face or online teaching classes . What communicates for the timely effects by the possible disciplinary consequences that can produce .

NOTE: it recommends the reading of the document *Regulation on assessment, the grade and the quality of the teaching and of the process of learning of the student, approved (Clausuro of April 18, 2023 , that it will be available in MooVi before to start the course.*

ASSESSMENT OF THE STUDENTS OF THE PROGRAM OF GREATER

- 1.-Assistance to the activities programmed 40%
- 2.-Follow-up of the activities made 30%
- 3.-The analysis at home (sensors and portable devices) 30%

Sources of information

Basic Bibliography

Miguel Valcárcel, Soledad Cárdenas, **Automatización y miniaturización en Química Analítica**, Primera, Springer, 2000

Susan R. Mikkelsen, Eduardo Cortón, **Bioanalytical Chemistry**, Primera, Wiley, 2004

Anthony P. F. Turner, Isao Karube and George S. Wilson, **Biosensors: Fundamentals and Applications**, Primera, Oxford University Press, 1987

Brian R. Eggins, **Chemical Sensors and Biosensors**, Wiley, 2002

Miguel Valcárcel Cases, M. Dolores Luque de Castro, **Flow-Injection Analysis**, Primera, Ellis Horwood Limited, 1987

Ángel Ríos, Alberto Escarpa, Bartolomé Simonet, **Miniaturization of Analytical Systems Principles Designs and Applications**, Primera, Wiley, 2009

J. C. Miller and J. N. Miller, **Statistics and chemometrics for analytical chemistry**, Quinta, Pearson Education Limited, 2005

Albert L. Lehninger, David L. Nelson, Michel M. Cox, **Principios de bioquímica**, Séptima, Omega, 2019

Complementary Bibliography

Paolo Ugo, Pietro Marafini, Marta Meneghello, **Bioanalytical chemistry. From biomolecular recognition to nanobiosensing**, Primera, De Gruyter, 2021

Banica Florinel-Gabriel, **Chemical sensors and biosensors: Fundamentals and applications**, Primera, Wiley, 2012

Guillermo Ramis Ramos, María Celia García Álvarez-Coque, **Quimiometría**, Primera, Síntesis, 2001

Alfred Pingoud, Claus Urbanke, Jim Hoggett, Albert Jeltsch, **Biochemical Methods: A Concise Guide for Students and Researchers**, Primera, Wiley-VCH, 2002

Recommendations

Subjects that are recommended to be taken simultaneously

Quality in Analytical Labs/V11G201V01407

Food, Agricultural and Environmental Analytical Chemistry/V11G201V01410

Immunochemistry/V11G201V01419

Subjects that it is recommended to have taken before

Biology: Biology/V11G201V01101

Analytical Chemistry II: Optical Methods of Analysis/V11G201V01207

Analytical Chemistry IV: Chromatographic and Affine Methods/V11G201V01306

Analytical Chemistry I: Principles of Analytical Chemistry/V11G201V01202

Analytical Chemistry III: Electroanalytical Methods and Separations/V11G201V01302

Biochemistry/V11G201V01201

IDENTIFYING DATA				
Quality in Analytical Labs				
Subject	Quality in Analytical Labs			
Code	V11G201V01407			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Calle González, Inmaculada de la			
Lecturers	Calle González, Inmaculada de la Pena Pereira, Francisco Javier			
E-mail	incalle@uvigo.es			
Web				
General description	Quality assurance in analytical laboratories is an increasingly important aspect. The aim of this subject is to introduce students in the final year of the degree to the general principles for the evaluation and continuous improvement of quality in analytical laboratories. Throughout the course, the regulatory standards and basic documentation of quality systems will be introduced, statistical tools used systematically to achieve analytical quality will be described and applied, the selection and validation of analytical methods and aspects related to laboratory management will be addressed. Students will also understand the difficulties in sampling and the importance of designing a sampling plan. In addition, students will learn how internal and external quality assessment is carried out. In the first case, through the control of blanks, reagents, the use of certified reference materials and, in the second case, through intercomparison exercises, audits and accreditations. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results				
Code				
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study			
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences			
B5	Ability to adapt to new situations and to make decisions			
C31	Know the control processes applied in the analytical laboratories to achieve their correct management and ensure the quality of the results			
C33	Know the metrology of chemical processes, including quality management			
D1	Ability to solve problems			

Expected results from this subject				
Expected results from this subject	Training and Learning Results			
Interpret the quality management standards applicable to the analytical laboratory.	A4	B5	C33	D1
Explain the main quality parameters.	A1		C31	
	A4		C33	
Calculate and interpret the different quality parameters.	A4	B5	C31	D1
			C33	
Interpret the application of different statistical tools.	A1	B5	C31	D1
	A4		C33	
Interpret the standards and validation parameters of an analytical method.	A1	B5	C31	D1
	A4		C33	
Explain the essential parameters for quality assessment.	A1		C31	
	A4		C33	

Contents	
Topic	
SUBJECT 1. Introduction to quality.	General concepts. Historical evolution of the concept of quality. Basic elements and commitments of quality. Quality in the analytical process. Analytical and metrological properties. Traceability. Implementation of quality systems.

SUBJECT 2. Regulatory standards and documentation of quality systems.	Standardization, certification and accreditation. Generic systems of quality management. Series of ISO 9000 standards. The standard UNE-EN ISO/IEC 17025. Good Laboratory Practice. Documentation used in quality systems. Management of quality documentation.
SUBJECT 3. Statistical tools to ensure the analytical quality.	Statistical proofs of significance. Components of uncertainty. Evaluation of uncertainties of unitary operations and of analytical processes. Expression of results.
SUBJECT 4. Selection and validation of methods of analysis.	Selection of methods of analysis. Concept and scope of the validation of an analytical method. Types of validation. Quality parameters of analytical methods.
SUBJECT 5. Management of laboratory, equipment and reagents.	Organisation and infrastructure of the laboratories. Materials and methods. Classifications of analytical methods. Quality of reagents.
SUBJECT 6. Quality in sampling.	Sampling in the analytical process (sampling plan, types of sampling, sample handling). Limitations of sampling. Quality assurance in sampling.
SUBJECT 7. Internal quality assurance.	Analytical references. Certified reference materials (preparation, selection and use of CRMs). Recovery studies. Application of t test. Activities of internal control. Blanks and control samples. Control charts.
SUBJECT 8. External quality assurance.	Intercomparison exercises (definition and types). Audits in a quality system (objectives, types, planning, performance and documents). Accreditation (concept, implications, accreditation bodies, process and documents of accreditation).

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	36	60
Seminars	12	24	36
Laboratory practical	14	10	24
Objective questions exam	2	10	12
Objective questions exam	0	18	18

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

Methodologies

	Description
Lecturing	The lecturer will develop the contents of the programme based on the material provided to the student through Moovi. In the lecture sessions, the lecturer will present the fundamental aspects of the subject, which should be complemented by the recommended bibliography.
Seminars	The seminar classes will help to reinforce the learning of the subject matter explained during the lectures by solving numerical problems and/or theoretical-practical exercises. The lecturer will regularly propose different problems, exercises or questionnaires that will be solved individually by the student and delivered for evaluation.
Laboratory practical	Laboratory experiments will be carried out in 4 sessions of 3.5 hours each. Prior to each practical session, the student will be provided with supporting material in Moovi for the preparation of the experiments to be carried out. Those students that have overcome lab practices in the previous academic year will not need to repeat them. In this case, the mark obtained in lab practices will be kept.

Personalized assistance

Methodologies	Description
Lecturing	The lecturer will resolve doubts in a personalised manner on any of the proposed activities (lectures, seminars, laboratory practicals and exams). For this purpose, the tutoring hours of the teaching staff will be used.
Seminars	The lecturer will resolve doubts in a personalised manner on any of the proposed activities (lectures, seminars, laboratory practicals and exams). For this purpose, the tutoring hours of the teaching staff will be used.
Laboratory practical	The lecturer will resolve doubts in a personalised manner on any of the proposed activities (lectures, seminars, laboratory practicals and exams). For this purpose, the tutoring hours of the teaching staff will be used.
Tests	Description
Objective questions exam	The lecturer will resolve doubts in a personalised manner on any of the proposed activities (lectures, seminars, laboratory practicals and exams). For this purpose, the tutoring hours of the teaching staff will be used.

Objective questions exam	The lecturer will resolve doubts in a personalised manner on any of the proposed activities (lectures, seminars, laboratory practicals and exams). For this purpose, the tutoring hours of the teaching staff will be used.
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Assessment						
	Description	Qualification	Training and Learning Results			
Seminars	For the evaluation of this activity, the teacher will propose to the students the resolution and delivery of problems, exercises and/or questionnaires in seminar classes.	5	A1 A4	B5	C31 C33	D1
Laboratory practical	The teacher will assess the experimental work carried out by the student in the laboratory sessions through observation and the evaluation of the obtained results delivered as a laboratory report.	15	A1 A4	B5	C31 C33	D1
	Attendance at laboratory sessions is compulsory. Absence from any laboratory session must be duly justified.					
Objective questions exam	There will be a first exam limited to approximately half of the subject. This exam may consist of short-answer questions, problems and multiple-choice questions. By taking the exam, the student will be prevented from receiving the grade "Not presented". Students who obtain a minimum score of 5 out of 10 will not be tested again on the contents of the first exam.	40	A1 A4	B5	C31 C33	D1
Objective questions exam	This final exam is compulsory. This exam may consist of short-answer questions, problems and/or multiple-choice questions. By taking the exam, the student will be prevented from receiving the grade "Not presented". Students who have passed the first part will take the second part of the subject. Students who have not passed the first part of the subject will have to take an examen of this first part of the subject (40% of the final grade).	40	A1 A4	B5	C31 C33	D1

Other comments on the Evaluation

Second call (July):

The marks obtained by the student during the course in the laboratory practices and seminars will be retained (20 % of the grade).

This exam may consist of short answer questions, problems and/or multiple choice questions.

Students can choose the global evaluation modality and they should inform in writing to the coordinator of the subject during the first month of the semester, in this case, the evaluation will be 85 % the exam and 15 % the laboratory practicals.

Sources of information

Basic Bibliography

R. Compañó Beltrán, Á. Ríos Castro, **Garantía de la calidad en los laboratorios analíticos**, Síntesis, 2002

M. Valcárcel, Á. Ríos, **La calidad en los laboratorios analíticos**, Reverté, 1992

E. Prichard, V. Barwick, **Quality assurance in analytical chemistry**, Wiley, 2007

Complementary Bibliography

S. Sagrado, E. Bonet, M.J. Medina, Y. Martín, **Manual práctico de calidad en los laboratorios - Enfoque ISO 17025 (2ª edición)**, AENOR, 2005

P.P. Morillas Bravo, **Guía para la aplicación de UNE-EN ISO/IEC 17025:2017**, AENOR, 2019

J.C. Miller; J.N. Miller, **Estadística y quimiometría para química analítica**, Prentice-Hall, 2002

G. Ramis Ramos; M.C. Álvarez Coque, **Quimiometría**, Síntesis, 2001

D.L. Massart, B.G.M. Vandeginste, L.M.C. Buydens, S. de Jong, P.J. Lewi, J. Smeyers-Verbeke, **Handbook of chemometrics and qualimetrics. Part A**, Elsevier Science, 1997

Recommendations

Subjects that are recommended to be taken simultaneously

Food, Agricultural and Environmental Analytical Chemistry/V11G201V01410

Enhancement of Analytical Chemistry/V11G201V01406

Subjects that it is recommended to have taken before

Analytical Chemistry II: Optical Methods of Analysis/V11G201V01207

Analytical Chemistry IV: Chromatographic and Affine Methods/V11G201V01306

Analytical Chemistry I: Principles of Analytical Chemistry/V11G201V01202

Analytical Chemistry III: Electroanalytical Methods and Separations/V11G201V01302

IDENTIFYING DATA				
Industrial Chemistry				
Subject	Industrial Chemistry			
Code	V11G201V01408			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Rosales Villanueva, Emilio			
Lecturers	Barreiro Xardón, Xan Rosales Villanueva, Emilio			
E-mail	emiliorv@uvigo.es			
Web				
General description	The chemical industry represents one of the most thriving sectors in the economies of many countries, serving as the basis for producing a wide variety of products that range from materials for general use, to materials with a high technological content and cutting-edge for other industries. Recent advances in obtaining new products together with new technologies to remedy environmental damage and increase productivity arise from innovations and continuous improvement developed in each of the stages of chemical processes. This subject aims to provide students with a global vision of Industrial Chemistry, ranging from the development and understanding of flow diagrams of chemical processes of great economic and social relevance to the quality principles that govern them. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code	
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
C45	Apply chemical and chemical engineering knowledge to industrial processes
D1	Ability to solve problems
D2	Capacity for teamwork
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject

Expected results from this subject	Training and Learning Results		
Appreciate the importance and complexity of the industrial chemical processes.	A3	C45	D1
Describe the main stages of an industrial chemical process and elaborate flow diagrams of simple processes.	A3	C45	D1 D2 D3
Identify the main raw materials used in the chemical industry and their characteristics.	A3	C45	D1 D2
Compare the diverse sources of energy used in the industry and make simple studies of energetic integration.	A3	C45	D1 D2
Describe the industrial chemical processes more usual in diverse productive sectors.	A3	C45	D2 D3

Contents

Topic	
General appearances of the Industrial Chemistry.	Introduction to the processes of the Chemical Industry. Characteristics and sectorial structure of the chemical industry. Situation of the chemical industry Spaniard in the European and world-wide context. Introduction to the diagrams of flow for processes of industrial chemistry
Raw materials used in the chemical industry	Classification and typology. Sources. Circular economy.
The energy in the chemical industry	General characteristics. Sources of traditional and alternative energy. Energetic integration.
Industrial chemical processes	Petrochemical, biotechnological processes and other productive processes for raw materials transformation.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	12	24	36
Problem solving	16	25	41
Seminars	3	9	12
Mentored work	4	30	34
Presentation	1	4	5
Laboratory practical	14	5	19
Essay questions exam	1	0	1
Objective questions exam	0.5	0.5	1
Oral exam	0.5	0.5	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
Lecturing	Presentation by the teacher of the general aspects of the programme in a structured way, with special emphasis on the fundamentals and the most important or difficult aspects for the student to understand. The professor will facilitate, through the platform MOOVI, the necessary material for a correct follow-up of the matter. The student will have to work previously the material delivered by the professor and consult the bibliography recommended to complete the information.
Problem solving	During the development of the subject will use the resolution of questions and problems so as to reinforce the appearances presented in the lectures.
Seminars	With the development of the syllabus, some activities focused to the work on a specific subject will be made, that will allow to deepen and complement the contents of the subject as it complement of the lecturing.
Mentored work	Inside the problem solving, the students working in groups will develop a work that will be based in the search of solutions for real problems where the students will have to provide a feasible and viable solution to proposed problem.
Presentation	The students will make by group a short presentation of the mentored work with the solution proposed for the problem assigned.
Laboratory practical	Laboratory experiments and field trips to companies related to subject will be carried out. The student will be provided with practice guide as well as the necessary support material for a proper understanding of the experiments to be carried out. The student will prepare a final report in which the main results and conclusions will be presented.

Personalized assistance	
Methodologies	Description
Lecturing	During the hours of tutorship the students, individually or in group, can consult with the lecturers any doubt posed on the subject. The lecturer will inform on the available schedule in the presentation of the subject.
Problem solving	During the hours of tutorship the students, individually or in group, can consult with the lecturers any doubt posed on the problem solving. The lecturer will inform on the available schedule in the presentation of the subject.
Laboratory practical	During the hours of tutorship the students, individually or in group, can consult with the lecturers any doubt posed on the laboratory practical. The lecturer will inform on the available schedule in the presentation of the subject.
Seminars	During the hours of tutorship the students, individually or in group, can consult with the lecturers any doubt posed on the seminars. The lecturer will inform on the available schedule in the presentation of the subject.
Mentored work	During the hours of tutorship the students, in groups or their members of individual way, can consult with the lecturer any doubt posed on the development of the work. The lecturer will inform on the available schedule in the presentation of the matter.
Presentation	During the hours of tutorship the students, in groups or their members of individual way, can consult with the lecturer any doubt posed on the presentation. The lecturer will inform on the available schedule in the presentation of the matter

Assessment		Qualification	Training and Learning Results
	Description		
Problem solving	After each subject will argue the most notable appearances by means of resolution of questions and problems	10	A3 C45 D1 D2 D3

Mentored work	It will be evaluated the solution presented together with structure of contents, quality of the content, sources consulted, format.	10	A3	C45	D1 D2 D3
Presentation	The student will present the mentored work for its discussion with the other students of the matter. It will be evaluated the oral presentation as well as the answers to the lecturer and the other students.	10	A3	C45	D1 D2 D3
Laboratory practical	The students will make diverse practices of laboratory and visits to companies. When finalising the diverse practical and in the dates indicated by the professors, they will have to deliver the reports of practices and make a questionnaire on the company visits.	10	A3	C45	D1 D2 D3
Essay questions exam	A global exam of for the evaluation of the acquired knowledge in the subject will be assessed.	25	A3	C45	D1 D3
Objective questions exam	In the final exam the student will have to answer a series of short questions or multiple-choice questions in which they will have to demonstrate their knowledge as well as their capacity for synthesis.	25	A3	C45	D3
Oral exam	There will be an individual oral examination of the laboratory practicals carried out in the course.	10	A3	C45	D3

Other comments on the Evaluation

ASSESSMENT: The participation of the student in any of the systems of evaluation of the subject (problem solving, mentored work, presentation and laboratory practical) will involve the qualification of the subject. It is required a minimum attendance to 90% of the laboratory practical to have right to its evaluation. Otherwise, the mark for this section will be 0.0 and they will have to take an exam in the FINAL EXAM. The evaluation by both essay and objective questions (50%) will be carried out in several exams along the course. If the students fail to pass the exam, they have to recover it in the FINAL EXAM.

A student who do not "officially renounces to continuous assessment", will fail if he/she does not achieve a MINIMUM mark of 4.0 points (out of 10) in each of the parts of the "FINAL EXAMINATION". If the minimum mark in the "FINAL EXAMINATION" is passed, the student will pass the course if the FINAL GRADE is ≥ 5.0 , that is, if the sum of the marks obtained in the different systems of evaluation of the course is ≥ 5.0 .

Second call: The same criteria will be applied in the second sitting. With regard to the July exam, the grade of the different assessment systems (laboratory practicals, problem solving and exercises) will be maintained, so students will only take the "FINAL EXAM".

STUDENTS RELEASED FROM CONTINUOUS ASSESSMENT: When the School releases a student from the continuous assessment process, his/her grade will be the sum of 90% of the mark obtained in the "FINAL EXAM" and 10% of the laboratory practicals mark. **ETHICAL COMMITMENT:** The student is expected to show appropriate ethical behaviour. If ethically reprehensible behaviour is detected (for example: copying, plagiarism, use of unauthorised electronic devices, etc.) the student will not be considered to meet the necessary requirements to pass the subject. In this case the overall grade for the current academic year will be a fail (0.0). The use of any electronic device will not be permitted during the assessment tests unless expressly authorised. Bringing an unauthorised electronic device into the examination room will be considered as a reason for failing the subject in the current academic year and the overall grade will be a fail (0.0).

Sources of information

Basic Bibliography

Vián Ortuño, A., **Introducción a la Química Industrial**, 2ª, Reverté, 1994

Sinnott, R.K., **Diseño en ingeniería química**, 5ª, Reverté, 2012

Díaz, M., **Ingeniería de bioprocesos**, Paraninfo, 2012

Wauquier, J.-P., **El refinado del petróleo**, 1ª, Dias de Santos, 2004

De Juana, J.M., **Energías renovables para el desarrollo**, 1ª, Thomson Paraninfo, 2003

Complementary Bibliography

Turton, R., **Analysis, synthesis, and design of chemical processes**, 2ª, Pearson education, 2013

Federación Empresarial de la Industria Química Española, **Radiografía del sector químico español 2022**, FEIQUE, 2022

Recommendations

Subjects that it is recommended to have taken before

Chemical engineering/V11G201V01301

IDENTIFYING DATA				
Química analítica ambiental y agroalimentaria				
Subject	Química analítica ambiental y agroalimentaria			
Code	V11G201V01410			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4	2c
Teaching language	#PortuguêsAmigável Castellano			
Department	Química analítica y alimentaria			
Coordinator	Leao Martins, Jose Manuel			
Lecturers	Leao Martins, Jose Manuel			
E-mail	leao@uvigo.es			
Web				
General description	La asignatura abarca los aspectos relacionados con el estudio de la problemática asociada al estudio desde el punto de vista analítico de la contaminación química del ambiente y los alimentos, con especial énfasis en los contaminantes más relevantes tanto naturales como antropogénicos, identificando las metodologías analíticas más eficaces para el control de los mismos. Materia del programa Português amigável: Los/as estudiantes internacionales podrán solicitar al profesorado: a) materiales y referencias bibliográficas para el seguimiento de la materia en lengua extranjera, b) atender las tutorías en lengua extranjera, c) pruebas y evaluaciones en en lengua extranjera.			

Resultados de Formación y Aprendizaje

Code				
A3	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			
A5	Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía			
B2	Capacidad de organización y planificación			
B3	Capacidad de gestión de la información			
C32	Adquirir conocimientos básicos sobre control y evaluación en medio ambiente y en seguridad agroalimentaria			
D4	Incorporar en el ejercicio profesional criterios de sostenibilidad y compromiso ambiental. Adquirir habilidades en el uso equitativo, responsable y eficiente de los recursos			

Resultados previstos en la materia

Expected results from this subject	Training and Learning Results			
Nueva	A3 A5	B2 B3	C32	D4

Contenidos

Topic				
Introducción a los Contaminantes Químicos y Tóxicos.	Concepto de contaminante químico y tóxico. Clasificación: naturales, antropogénicos y emergentes. Fuentes de contaminación. Procesos de transporte, transformación, acumulación y persistencia. Mecanismos de eliminación en el medio ambiente y en los alimentos.			
Fundamentos básicos de Toxicología	Principios y conceptos básicos: dosis, respuesta, NOAEL (Nivel Sin Efecto Adverso Observable), LOAEL (Nivel Más Bajo con Efecto Adverso Observable), DL50; (Dosis Letal para el 50%), IDA (Ingesta Diaria Admisible). Toxicocinética: absorción, distribución, metabolismo, excreción. Toxicodinámica: mecanismos de acción. Tipos de toxicidad: aguda, crónica, subcrónica, específica de órgano. Factores que afectan la toxicidad: edad, sexo, nutrición, interacciones químicas. Evaluación de riesgos toxicológicos.			
Toxicología ambiental	Toxicocinética ambiental: comportamiento de contaminantes en ecosistemas. Efectos sobre organismos y ecosistemas. Evaluación de riesgos ambientales: identificación, caracterización, gestión. Legislación y organismos de control ambiental.			
Toxicología Alimentaria.	Introducción a la toxicología de alimentos. Tipos de contaminantes en alimentos: naturales, antropogénicos, emergentes. Vías de exposición, dosis-respuesta, bioacumulación, transferencia en la cadena alimentaria. Aplicación de toxicocinética y toxicodinámica a los alimentos. Evaluación de riesgos alimentarios: metodología y normativa.			

Seguridad Ambiental y Alimentaria	Definición de seguridad ambiental y su relación con la salud humana. Conceptos de inocuidad, trazabilidad y gestión del riesgo. Perspectiva europea para el control de contaminantes químicos ambientales y alimentarios. Legislación aplicable a los contaminantes químicos objeto de estudio. Armonización metodológica: organismos involucrados.
Evaluación del Riesgo de Contaminantes.	Evaluación de la exposición y caracterización del peligro. Caracterización del riesgo: integración de toxicidad y exposición. Modelos de estimación de exposición: EDI, IDA. Factor de seguridad y margen de exposición (MOE). Normativa y organismos de control: UE, EFSA, CODEX Alimentarius, AESAN.
Análisis Químico Avanzado de Contaminantes	Técnicas de preparación de muestra: micro y nano extracción en fase sólida, QuEChERS, fraccionamiento. Técnicas avanzadas de análisis: GC-MS/MS. GC-HRMS, LC-MS/MS, LC-HRMS, ICP-MS. Métodos oficiales y de referencia, laboratorios nacionales e internacionales de referencia.

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección magistral	24	24	48
Seminario	12	12	24
Prácticas de laboratorio	14	14	28
Informe de prácticas, prácticum y prácticas externas	0	20	20
Examen de preguntas de desarrollo	6	0	6
Presentación	2	20	22

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

Metodologías

	Description
Lección magistral	La clase magistral es una sesión expositiva de unos 50 minutos en la que el docente presenta y organiza de forma sistemática los contenidos principales de la asignatura, ofreciendo al alumnado una visión clara y crítica de la química del medio ambiente y de los alimentos y su interacción. Se emplearán diversos materiales didácticos, como presentaciones, vídeos, apuntes, artículos científicos y bases de datos, para facilitar la comprensión, mantener la atención y reforzar el aprendizaje autónomo y reflexivo del alumnado.
Seminario	La actividad de seminario tiene una duración aproximada de 50 minutos por sesión. En ella, el estudiantado es protagonista, desarrollando sus capacidades de investigación, análisis, debate y creatividad. Se trabajará sobre casos prácticos, artículos científicos y materiales de divulgación, mientras el docente guía la discusión, resuelve dudas y asegura el cumplimiento de los objetivos de la sesión.
Prácticas de laboratorio	Las prácticas de laboratorio permiten al alumnado aplicar los conocimientos teóricos mediante metodologías analíticas para el control de contaminantes químicos en matrices ambientales y alimentarias. Estas actividades desarrollan habilidades técnicas, pensamiento crítico y aprendizaje autónomo, fomentan la integración de teoría y práctica, así como la responsabilidad, seguridad y trabajo en equipo. El alumnado completará su formación mediante trabajo autónomo, resolviendo cuestiones sobre las técnicas empleadas y realizando cuestionarios, informes breves o una prueba final, lo que permitirá adquirir una visión integral de la disciplina. La realización de los experimentos estará condicionada por las infraestructuras disponibles en la Facultad de Química de la Universidad de Vigo (dotación de equipamiento y material del que dispone el laboratorio de prácticas).

Atención personalizada

Methodologies	Description
Lección magistral	La clase expositiva (magistral) se adaptará a las necesidades e intereses del alumnado. Aunque su formato es principalmente unidireccional, se incorporarán estrategias que fomenten la participación, el diálogo y la aplicación práctica de los contenidos, mediante preguntas, casos, videos y otros recursos. El seguimiento se complementará con tutorías colectivas o individuales, según las necesidades del estudiantado.
Seminario	En las clases de seminario, el alumnado desarrollará, de manera individual o en grupo, un proyecto didáctico sobre un tema de la materia, utilizando recursos ofimáticos y creando videos de divulgación dirigidos a un público general. El docente realizará un seguimiento y supervisión continuos, facilitando la aplicación de los conocimientos a situaciones reales y ofreciendo tutorías personalizadas para un aprendizaje más individualizado.

Prácticas de laboratorio	La actividad práctica, individual o en grupo, permitirá al alumnado desarrollar un proyecto experimental vinculado a la materia, utilizando los recursos del laboratorio y con supervisión docente personalizada. El proyecto incluirá la determinación de contaminantes en el medio ambiente y en alimentos, cálculos a nivel de subtraza y la expresión de resultados en términos de toxicidad equivalente. Para un seguimiento óptimo, el alumnado contará con tutorías individualizadas, acceso al campus virtual y la participación activa del docente durante la actividad.
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Evaluación				
	Description	Qualification	Training and Learning Results	
Prácticas de laboratorio	La evaluación de las prácticas de laboratorio valora la adquisición de competencias técnicas, la aplicación del conocimiento teórico, la correcta ejecución de procedimientos, el análisis e interpretación de resultados y la elaboración de informes claros y coherentes. También se tendrá en cuenta la participación, colaboración, iniciativa y responsabilidad del alumnado. Esta evaluación integra habilidades técnicas, pensamiento crítico y comunicación científica, asegurando que los estudiantes sean capaces de realizar experimentos y comunicar los resultados de manera rigurosa.	25	A3 B2 C32 D4	A5 B3
Informe de prácticas, prácticum y prácticas externas	Se trata de una evaluación de una actividad grupal en la que el estudiantado deberá seleccionar una situación relacionada con la contaminación de alimentos y/o del medio ambiente y elaborar un trabajo de divulgación que comunique información científica con claridad y objetividad a un público general. Se evaluará la capacidad de trabajo en grupo, así como las habilidades de liderazgo y organización, y la capacidad para conectar el conocimiento científico de la química con la comprensión del público no especializado. El trabajo podrá presentarse en formato de video, exposición, póster, infografía u otro recurso creativo. La presentación y defensa se realizará en la clase de seminario, en fechas que se acordarán previamente entre alumnado y docente. En esta evaluación se valorarán el rigor científico, la relevancia social, la claridad, la creatividad y el uso de referencias bibliográficas fiables. Esta actividad tiene como objetivo medir las habilidades adquiridas durante el desarrollo de la asignatura, incluyendo la capacidad de comunicarse en un lenguaje científico adecuado, el pensamiento crítico y la aplicación del conocimiento a situaciones reales.	50	A3 B2 C32 D4	A5 B3
Examen de preguntas de desarrollo	El examen escrito tiene como finalidad realizar la evaluación individual del estudiantado, mediante la resolución por escrito de un cuestionario estructurado. El formato de la prueba podrá incluir preguntas de opción múltiple, de respuesta corta o de desarrollo, así como ejercicios de análisis y comprensión aplicados a casos prácticos, problemas u otras situaciones relevantes para la materia. Esta actividad evaluadora tiene por objeto valorar el nivel de adquisición de los conocimientos, destrezas y competencias desarrolladas a lo largo de la materia, de acuerdo con los resultados de aprendizaje establecidos en la guía docente.	25	A3 B2 C32 D4	A5 B3

Other comments on the Evaluation

Para **SUPERAR** la asignatura, será necesario obtener una calificación **GLOBAL FINAL** de 5,0 sobre 10. Esta calificación resulta de la ponderación de las notas obtenidas en teoría, seminarios y laboratorio.

La nota final se calculará a partir de la suma de las calificaciones ponderadas de las diferentes componentes evaluables de la asignatura.

Además, será **OBLIGATORIO** cumplir la **ASISTENCIA** a la actividad de laboratorio y obtener una calificación mínima de 5 en dicha actividad. En caso de no cumplirse una o ambas condiciones, se asignará una calificación global de la asignatura de 4,0, tanto en el acta correspondiente a la evaluación ordinaria como extraordinaria, y no se procederá al cálculo de la calificación ponderada.

En la evaluación, para el cálculo de la calificación mediante la ponderación de las partes evaluables, se requiere alcanzar una calificación mínima de 4,0 en el examen de teoría, 5,0 en la actividad teórico-práctica (seminarios) y 5,0 en la actividad de laboratorio.

En caso de no cumplimiento de cualquiera de estas condiciones, en el acta se reflejará la calificación de menor valor numérico obtenida en dicha evaluación por partes y **NO** se procederá al cálculo ponderado de la nota final de las partes evaluadas.

Los alumnos que **SUPEREN** las actividades evaluables, **EXCEPTO** el examen de preguntas de desarrollo, podrán recuperarlo en las siguientes oportunidades de recuperación establecidas y aprobadas por la *Junta de Facultad de Química*.

En este caso, hasta que finalice el proceso de evaluación del curso académico en vigor, se **CONSERVARÁN** las calificaciones obtenidas, siempre que la calificación final de cada una de ellas sea mayor o igual a 5.

Los alumnos que opten por la modalidad de evaluación **GLOBAL FINAL** deberán tener en cuenta que las actividades de carácter práctico de laboratorio son obligatorias. Por ello, la evaluación de dichas actividades requiere la asistencia presencial obligatoria. En caso de NO cumplirse este requisito, en el acta de evaluación se asignará automáticamente una calificación de 3,0.

El alumnado que opte por la evaluación **CONTÍNUA** está obligado a asistir y participar en todas las actividades evaluables, incluyendo clases teóricas, seminarios y prácticas de laboratorio. Para las clases de seminario y teoría se permite un máximo del 20 % de faltas de asistencia sin justificación. La asistencia a las prácticas de laboratorio es obligatoria en su totalidad, excepto en aquellos casos debidamente justificados y por causa mayor (cuestiones de salud, deceso u otras circunstancias contempladas en la ley y descritas en el BOE/DOGA). En estos casos, será imprescindible la presentación de documentos oficiales que lo acrediten. Si se supera estas condiciones, las actividades correspondientes se *considerarán automáticamente no superadas* y se asigna una calificación de 3 (sobre 10) en **acta ordinaria y extraordinaria**.

En el caso, la **RECUPERACIÓN** de la evaluación, de las partes evaluables, se realizará siguiendo los MISMOS CRITERIOS establecidos en la descripción del proceso de evaluación, siendo los mismos criterios la modalidad global y continua. El estudiante deberá elaborar, exponer y defender un nuevo trabajo de seminario de forma autónoma e individual. No se admitirá el trabajo realizado durante la evaluación continua.

El alumnado que haya superado la actividad práctica de laboratorio en primera matrícula, pero no la asignatura, conservará la calificación obtenida en prácticas de laboratorio para la convocatoria siguiente (segunda matrícula). En las matrículas posteriores, la actividad superada en la primera matrícula se considerará automáticamente con una calificación de 5,0 valores. Si el estudiante desea mejorar dicha nota, deberá realizar nuevamente toda la actividad de laboratorio y su respectiva evaluación.

La CALIFICACIÓN de la asignatura, con la obligatoriedad de aprobar todas las secciones evaluables (nota igual o superior a 4), se obtiene aplicando la siguiente ponderación:

Final = 25% T + 50% S + 25% L, donde T corresponde a teoría, S a seminarios y L a laboratorio.

Para superar la asignatura, la calificación final (F) deberá ser igual o superior a 5,0.

Para la recuperación de la evaluación de teoría y seminarios (teórico-práctica), se deberá realizar una prueba escrita en la misma modalidad que la establecida para la evaluación continua. Asimismo, se deberán realizar los mismos trabajos de evaluación indicados en la evaluación continua, con la excepción de que estos deberán entregarse el día de realización del examen ordinario o extraordinario, seguidos de su correspondiente defensa, aplicando los mismos criterios establecidos para la evaluación continua.

Esta asignatura forma parte del plan de estudios de una carrera experimental, por lo que la asistencia a las prácticas de laboratorio y su aprobación son obligatorias, siendo requisitos indispensables para poder realizar la evaluación completa de la asignatura. Para superar la materia, es imprescindible aprobar todas las actividades de laboratorio con una calificación igual o superior a 5. Asimismo, el alumnado debe cumplir las 14 horas de docencia de laboratorio establecidas en la guía docente, salvo en los casos debidamente justificados. El incumplimiento de cualquiera de estas obligaciones conlleva, de manera automática, la no superación de la asignatura en su totalidad, tanto en la evaluación continua como en la global.

ATENCIÓN: El alumno que desee optar por la modalidad de evaluación final deberá informar y entregar un documento escrito y firmado a los docentes responsables de la materia durante las dos primeras semanas desde el inicio de la docencia de la materia correspondiente.

En la presentación de la asignatura, así como en la página de la Facultad de Química, se encuentran disponibles las fechas de las actividades de evaluación.

Uso de la Inteligencia Artificial en esta materia

En esta materia, el uso de sistemas de IA por parte del estudiantado se permite en las siguientes tareas/actividades búsqueda y síntesis de fuentes, apoyo a la redacción, generar ejemplos de ejercicios, apoyo a la programación. Está prohibido su uso en la elaboración de informes en su íntegra, tratamiento de resultados experimentales, queda expresamente prohibido su uso en pruebas/exámenes escritos/orales.

Queda expresamente prohibido el uso de IA para: la sustitución total o sustancial de la autoría propia del estudiante, la presentación como propio de contenido generado por IA sin declararlo, la suplantación de identidad, la fabricación o

manipulación de datos, y cualquier otro uso que constituya fraude académico.

Cuando el uso de IA esté permitido, el estudiantado deberá declarar: la herramienta y versión empleada, los prompts o indicaciones relevantes utilizadas, las partes de la actividad en las que se ha empleado, y la revisión humana/crítica realizada sobre el resultado. Las citas deberán indicar herramienta, fecha y finalidad de la consulta.

El uso de IA contrario a lo establecido en esta guía docente podrá ser considerado fraude académico, conforme a la normativa disciplinaria aplicable, pudiendo conllevar la inadmisión del trabajo, la solicitud de pruebas adicionales o la apertura del procedimiento correspondiente.

Si el profesorado de esta materia emplea sistemas de IA como apoyo en la corrección o retroalimentación de las actividades evaluables, la calificación final se basará en todo caso en una revisión humana efectiva y no meramente formal, manteniéndose el criterio profesional como elemento determinante de la evaluación.

Fuentes de información

Basic Bibliography

Complementary Bibliography

J.P.F. D MELLO, **FOOD SAFETY**, CABI PUBLISHING CAB INT., 2003

Chunlong Zhang, **Fundamentals of Environmental Sampling and Analysis**, WILEY, 2007

CRUZ, KHMELINSKII, VIEIRA, **METHODS IN FOOD ANALYSIS**, CRC PRESS, 2014

F. W. Fifield , P. J. Haines, **Environmental Analytical Chemistry**, 978-0-632-05383-4, 2, Wiley-Blackwell, 2000

Möller, D., **Chemistry for Environmental Scientists**, <https://doi.org/10.1515/9783110735178>, Boston: De Gruyter, 2022

Zhen-Yu Tian, **Environmental Chemistry: Advanced Concepts and Applications**,

<https://doi.org/10.1007/978-981-96-0073-1>, Springer, 2025

Rodrigo Hoff, Luciano Molognoni, **Chemical Food Contaminants Analysis**, <https://doi.org/10.1007/978-1-0716-3806-4>, 1, Springer, 2024

de Dieter Schrenk, Alexander Cartus, **Chemical Contaminants and Residues in Food (Woodhead Publishing Series in Food Science, Technology and Nutrition)**, ISBN-10: 0081006748, ISBN-13: 978-0081006740, 2, Woodhead Publishing Ltd, 2017

Recomendaciones

Subjects that it is recommended to have taken before

Química analítica II: Métodos ópticos de análisis/V11G201V01207

Química analítica IV: Métodos cromatográficos y afines/V11G201V01306

Química analítica I: Principios de química analítica/V11G201V01202

Química analítica III: Métodos electroanalíticos y separaciones/V11G201V01302

Other comments

Para complementar el estudio de la asignatura y facilitar el acceso a recursos de apoyo, se podrá recurrir a información disponible en línea procedente de páginas oficiales de organismos públicos relacionados con la contaminación ambiental y alimentaria. A continuación, se presentan algunas de las fuentes más relevantes para esta asignatura:

<https://www.fao.org/home/es>

<https://www.fao.org/fao-who-codexalimentarius>

https://commission.europa.eu/about/departments-and-executive-agencies/health-and-food-safety_en

https://www.aesan.gob.es/AECOSAN/web/home/aecosan_inicio.htm

<https://aoaceurope.com/>

Aprendizaje basado en vídeo:

Plataforma: ☐ Youtube ☐ , ☐ JoVE ☐ , etc.

IDENTIFYING DATA				
Computational Chemistry				
Subject	Computational Chemistry			
Code	V11G201V01411			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Graña Rodríguez, Ana María			
Lecturers	Graña Rodríguez, Ana María			
E-mail	ana@uvigo.es			
Web				
General description	Computational Chemistry is a discipline using mathematical methods for the calculation of molecular properties or for the simulation of the molecular behaviour.			

Training and Learning Results

Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
B1	Ability for autonomous learning
B2	Organization and planning capacity
C36	Know the basics and be able to use different quantum mechanical methods to be applied to systems of chemical interest
D1	Ability to solve problems

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Describe the main methods of calculation of the computational chemistry, knowing his applications and limitations.				C36
Describe the elements that can contain a field of strengths of molecular mechanics.				C36
Choose levels of quantum calculation adapted for the treatment of a chemical problem.	A1	B2		C36
Describe fundamental algorithms employees in the calculations of computational chemistry.				C36
Obtain properties of chemical interest doing use of computational methods (static and dynamic).		B1	C36	D1
		B2		

Contents

Topic	
Subject 1. Introduction: methods of calculation in Computational Chemistry.	Definition, concepts, and types of Computational Chemistry studies. Molecular Mechanics methods. Hartree-Fock methods. Post Hartree-Fock methods. Density Functional Theory. Basis sets. Molecular Dynamics methods.
Subject 2. Conformational studies.	Potential energy surface. Characterization of singular points. Optimization of molecular geometries. Optimization of transition states. Constrained optimizations. Conduction methods. Conformational sampling. IRC methods.
Subject 3. Application to spectroscopy.	Introduction. Infrared spectra. Ramn spectra. UV-visible spectra. Excited states.
Subject 4. Applications to the calculation of energy properties.	Thermodynamics properties. Basis set superposition error. Isogyric reactions. Isodesmic reactions. Homdesmotic reactions. Gn and CBS methods.
Subject 5. Applications to the chemical reactivity.	Reactivity indices. Reaction dynamics.
Subject 6. Models of solvation.	Introduction. Continuum models of solvation. Inclusion of explicit solvent molecules. Mixed methods.
Subject 7. Applications to biomolecules.	Applications to biomolecules.
Subject 8. Artificial Intelligence in Computational Chemistry.	Introduction. AI as a tool in Computational Chemistry. Practical use, examples, and applications.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	22	48
Practices through ICT	14	14	28
Problem solving	6	18	24
Problem and/or exercise solving	6	18	24
Essay	0	26	26

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

Methodologies

	Description
Lecturing	Exhibition by part of the professor of theoretical and practical concepts.
Practices through ICT	Computational laboratory.
Problem solving	Resolution of problems by part of the students so much in paper as with computational assistance.

Personalized assistance

Methodologies	Description
Lecturing	Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is advised to previously contact her teacher.
Problem solving	Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is advised to previously contact her teacher.
Practices through ICT	Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is advised to previously contact her teacher.
Tests	Description
Problem and/or exercise solving	Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is advised to previously contact her teacher.
Essay	Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is advised to previously contact her teacher.

Assessment

	Description	Qualification	Training and Learning Results
Problem solving	Report of exercises of the subjects 1 to 3.	30 A1	B1 C36 D1 B2
Problem and/or exercise solving	Report of exercises of the subjects 4 to 7.	40 A1	B1 C36 D1 B2
Essay	Delivery of an individual work about practical classes.	30 A1	B1 C36 D1 B2

Other comments on the Evaluation

Sources of information

Basic Bibliography

J. B. Foresman, A. Frisch, **Exploring Chemistry with Electronic Structure Methods**, 3, Gaussian Inc, 2015
 Frank Jensen, **Introduction to computational chemistry**, 2, Wiley, 2006
 Joan Bertran Rusca, Vicenç Branchadell Gallo, Miquel Moreno Ferrer, Mariona Sodupe Roure, **Química Cuántica**, 1, Síntesis, 2000

Complementary Bibliography

A. Szabo, N. S. Ostlund, **Modern Quantum Chemistry**, 1, Dover, 1996

Recommendations

Subjects that it is recommended to have taken before

Physical Chemistry IV: Molecular Structure and Spectroscopy/V11G201V01307
 Physics: Physics I/V11G201V01102
 Mathematics: Mathematics 2/V11G201V01108
 Physical Chemistry III: Quantum Chemistry/V11G201V01303
 Physics: Physics 2/V11G201V01107
 Mathematics: Mathematics 1/V11G201V01103

IDENTIFYING DATA				
Environmental and Bioinorganic Chemistry				
Subject	Environmental and Bioinorganic Chemistry			
Code	V11G201V01412			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Valencia Matarranz, Laura María			
Lecturers	Pérez Lourido, Paulo Antonio Valencia Matarranz, Laura María			
E-mail	qilaura@uvigo.es			
Web				
General description	Know and interpret the role of metals and other inorganic compounds in the chemical processes present in the life and in the environment. Interpreting and analysing the chemical properties of the active centers of metalloproteins, mechanisms of performance of therapeutic and diagnostic agents.			

Training and Learning Results	
Code	
C40	Acquire knowledge about the variety of roles played by metal ions in Biology. Know the biomolecules that contain metal ions
C41	Evaluate health risk, and environmental and socioeconomic impact of chemical substances
D2	Capacity for teamwork
D4	Incorporate criteria of sustainability and environmental commitment into the professional exercise. Acquire skills in the equitable, responsible and efficient use of resources

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Purchase knowledges on the variety of papers that exert the metallic ions in Biology.	C40
Know the *biomoléculas that contain metallic ions	C41
Evaluate the sanitary risks, the environmental and socioeconomic impact of the chemicals	
Capacity to work in team	D2 D4
Incorporate in the professional exercise criteria of sustainability and environmental commitment.	
Purchase skills in the use *equitativo, responsible and efficient of the resources	

Contents	
Topic	
Essential elements and Metaloprotein	Concept and clasifcation
Bioinorganic chemistry of Zn	Biological Chemistry of Zn Homeostasis of Zn Metalloenzymes of Zn Metalloproteins in the genetic
Bioinorganic chemistry of iron	Biological Chemistry Homeostasis Metalloproteins of Fe
Bioinorganic Chemistry of copper.	Chemistry of the copper of biological interest Homeostasis of the copper Metalloproteínas of copper.
Bioinorganic chemistry of Cobaltous	Chemistry of the cobaltous with biological Cobalamin Metalloproteins with cobaltous
Bioinorganic Chemistry of manganese	Chemistry of the manganese with biological issues Homeostasis of the manganese Biological role of Mn
Bioinorganic chemistry of other transition metals.	Biologically relevant chemistry of other transition metals. Metalloproteins of these metals.

Metals and metallic compounds with application in medicine.	Applications in therapy, diagnosis and theragnostics of metals and metallic compounds
Environment	Environment concepts. Study of the biogeochemistry cycles of CHONPS Pollution. Evolution, transport and control of the pollutants
Atmosphere	Physical properties. Chemical composition. Chemical reactions. Inorganic pollutants.
Hydrosphere	Chemical composition. Chemical reactions. Inorganic pollutants.
Lithosphere	Soil formation Chemical composition. Chemical reactions. Inorganic pollutants. Radioactive contamination.
Practices of laboratory	4 practical sessions of 3.5 h related to the subject.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	26	52
Seminars	8	24	32
Debate	4	12	16
Laboratory practical	14	0	14
Objective questions exam	2	16	18
Objective questions exam	2	16	18

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

Methodologies

	Description
Lecturing	Presentation by the professor of the content of the subject matter under study, theoretical bases and/or guidelines for a work, exercise or project to be developed by the student
Seminars	Activities will be proposed related to the topics covered in the lectures on bioinorganic chemistry, as well as environmental issues.
Debate	Research papers and/or current topics related to bioinorganics and the environment will be discussed.
Laboratory practical	Practices in the laboratory related with the contents of the subjects will be done.

Personalized assistance

Methodologies	Description
Lecturing	The professors will solve the doubts related with the subjects proposed either in face-to-face form or by email
Seminars	The professors will solve doubts or questions related with the subjects
Laboratory practical	The professor will solve the doubts related with the practices
Debate	The professor will help with doubts or questions related with the subjects
Tests	Description
Objective questions exam	The professors will solve the doubts in face-to-face form or by email

Assessment

	Description	Qualification	Training and Learning Results
Seminars	Resolution of problems or exercises proposed about bioinorganic and environmental inorganic chemistry	20	C40 D2
Debate	Student presentation and defense of topics based on published papers and/or current issues related to the subject matter of bioinorganic chemistry and environmental inorganic chemistry.	20	C40 D2
Laboratory practical	The work in the laboratory by the students will be assessed.	10	C40 C41 D2 D4
Objective questions exam	Two exams will be held to assess the knowledge acquired in the bioinorganic chemistry and environmental inorganic chemistry sections.	50	C40 C41

Other comments on the Evaluation

Continuous assessment

For the first assessment opportunity, a minimum score of 5 out of 10 is required in each component of the assessment (e.g.,

seminars, laboratory sessions, exams) to pass the course. For the second assessment opportunity, only the grade corresponding to the exams may be retaken.

Comprehensive assessment

An objective-question exam will be administered; an overall score of 5 out of 10 is required to pass the course.

In order to guarantee a quality and individualized evaluation, any certifiable competence in this subject is likely to be verified by an oral evidence, at any time before the definitive closure of the minutes.

Sources of information

Basic Bibliography

Spiro, Thomas G; Stigliani, William M., **Química medioambiental**, 2, Pearson, 2009

Manahan S.E., **Environmental Chemistry**, 10, CRC Press, 2017

Crichton, R., **Biological inorganic Chemistry A New Introduction to Molecular Structure and Function**, 3, Elsevier, 2019

Gibbs, W., **CONCEPTS AND APPLIED PRINCIPLES OF BIOINORGANIC CHEMISTRY: VOLUME III**, 2, ML Books International, 2015

Complementary Bibliography

Baird, C.; Cann M., **Química ambiental**, 2, Reverte, 2012

Grau Ríos, Mario ; Grau Sáenz, María, **Riesgos en la industria**, 1, UNED, 2006

Domenech, X, Peral, J.; Costa López, J.; Simarro Dorado, J., **Química ambiental de sistemas terrestres**, 1, Reverté, 2012

Kaim, W.; Schwederski, B.; Klein, A., **Bioinorganic Chemistry -- Inorganic Elements in the Chemistry of Life. An Introduction and Guide**, 2, Wiley, 2013

Sigel, A.; Sigel, H.; Sigel, R.K.O., **The alkali Metal Ions: Their Role for Life**, 1, Springer, 2016

Dieguez, M.; Bäckvall, J-E.; Pàmies, O., **Artificial Metalloenzymes and MetalloDNAzymes in From Design to Applications.**, 1, Wiley, 2018

Kroneck, P.M.H.; Sosa torres, M.E., **Metals, Microbes, and Minerals: The Biogeochemical Side of Life**, 1, De gruyter, 2021

Sigel, A. Freisinger, E. Sigel, R.K.O., **Metals ions in bioimaging Techniques**, 1, De gruyter, 2021

Recommendations

Subjects that it is recommended to have taken before

Inorganic Chemistry IV: Transition Metals and Solid State/V11G201V01309

Inorganic chemistry I/V11G201V01204

Inorganic chemistry II/V11G201V01209

Biochemistry/V11G201V01201

Inorganic Chemistry III: Coordination Chemistry/V11G201V01304

Other comments

Knowledges of English

IDENTIFYING DATA				
Therapeutic Chemistry				
Subject	Therapeutic Chemistry			
Code	V11G201V01413			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	#EnglishFriendly			
Department				
Coordinator	Terán Moldes, María del Carmen			
Lecturers	Teijeira Bautista, Marta Terán Moldes, María del Carmen			
E-mail	mcteran@uvigo.es			
Web				
General description	It is an introductory course in therapeutic chemistry, in which as drugs work at molecular level and processes involved in their in vivo effects will be studied. Drug discovery and design strategies, as well as stages prior to their commercialization will also be discussed.			
	English Friendly subject. International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
B3	Ability to manage information
B4	Ability for analysis and synthesis
C43	Know the chemical compounds with therapeutic application
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject				
Expected results from this subject	Training and Learning Results			
Familiarize yourself with fundamental concepts of Therapeutic Chemistry	A4	B4		D3
Know the different types of pharmacological targets	A4	B3 B4		D3
Understand and be able to predict drug-target interactions	A3	B3	C43	D3
Know the different types of receptors and understand the signal transduction mechanisms.	A3 A4	B3 B4		D3
Differentiate a chemotherapeutic from a pharmacodynamic agent	A4	B4	C43	D3
Differentiate an agonist drug from an antagonist and from an inverse agonist	A4	B4	C43	D3
Relate the physicochemical properties of drugs with their pharmacokinetics.	A3	B3	C43	D3
Understand and be able to predict metabolic transformations	A3	B3	C43	D3
Know the different stages of drug development	A4	B3	C43	D3
Know and understand the strategies involved in discovering and optimizing leads	A4	B4	C43	D3
Know and understand the computational techniques of molecular modeling: docking strategies, QSAR and pharmacophore design	A4	B3	C43	D3

Contents	
Topic	
Subject 1. General aspects of Therapeutic Chemistry	1.1. Concept and objectives of Therapeutic Chemistry. 1.2. Drug nomenclature systems. 1.3. Drug classification systems.
Subject 2. Drug targets: proteins	2.1. Types of drug targets and location in cell. 2.2. Drug-target interactions. 2.3. Transport proteins as drug targets. 2.4. Structural proteins as drug targets.

Subject 3. Drug targets: enzymes	3.1. Enzyme inhibition mechanisms. 3.2. Design of enzyme inhibitors and types of enzyme inhibitors with therapeutic application. 3.3. Isoenzymes as drug targets. 3.4. Measurement and expression of enzyme inhibition.
Subject 4. Receptors	4.1. Structure and function of receptors. 4.2. Receptor types and signal transduction mechanisms. 4.3. Agonist, antagonist and inverse agonist drugs. 4.4. Measurement and expression of pharmacological effect.
Subject 5. Drug targets: nucleic acids and other biomolecules	5.1. Mechanisms of interaction between drugs and nucleic acids 5.2. Lipids and carbohydrates as drug targets
Subject 6. Pharmacokinetics and related issues	6.1. Drug transport mechanisms. 6.2. Absorption. Routes of drug administration and dosage forms. 6.3. Distribution, metabolism, and excretion.
Subject 6. Pharmacokinetics and related topics	6.1. Absorption and distribution: mechanisms of transport across biological membranes. 6.2. Drug administration ways. 6.3. Drug metabolism. 6.4. Drug excretion.
Subject 7. Drug discovery and development	7.1. The process of obtaining and getting new drugs to the market. 7.2. Lead discovery and optimization strategies.
Subject 8. Rational drug design	8.1. Biochemical based drug design approaches. 8.2. Computational aided drug design: docking and QSAR strategies, pharmacophore based drug design approach.
Laboratory practicals	Diversity-Oriented Solid-Phase Synthesis: Design, preparation, and study of peptidomimetic oligomers.
Possible visit to a pharmaceutical	

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	48	72
Seminars	12	18	30
Laboratory practical	14	14	28
Objective questions exam	0	6	6
Essay questions exam	2	12	14

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

Methodologies

	Description
Lecturing	In these sessions the professor will present in a structured form the general contents of the program, doing emphasis in important or difficult aspects of the subject. In addition, the professor, in advance and through the Moovi platform, will make available to the student the material that will be used in these sessions. In order to better understand the content explanations, students should previously check and complete this material by using the recommended literature.
Seminars	They will devote time to discuss the most complicated aspects of the treated subjects by solving exercises and questions, using molecular modeling programs, as well as presenting review works related with the content of the subject.
Laboratory practical	Laboratory practices will be developed in 4 sessions of 3.5 h each. Three sessions will be devoted to the synthesis and study of different peptidomimetics. The last session will consist of visiting a pharmaceutical company to learn about their facilities and products.

Personalized assistance

Methodologies	Description
Lecturing	The teachers will be available to have tutoring sessions with the students, which will be arranged in advance. In the tutoring sessions, either in person or online, such as email or the virtual campus, all queries related to the study of the contents of the subject will be answered.
Seminars	The teachers will be available to have tutoring sessions with the students, which will be arranged in advance. In the tutoring sessions, either in person or online, such as email or the virtual campus, all queries related to the study of the contents of the subject will be answered.
Laboratory practical	The teachers will be available to have tutoring sessions with the students, which will be arranged in advance. In the tutoring sessions, either in person or online, such as email or the virtual campus, all queries related to the study of the contents of the subject will be answered.

Tests	Description
Objective questions exam	The teachers will be available to have tutoring sessions with the students, which will be arranged in advance. In the tutoring sessions, either in person or online, such as email or the virtual campus, all queries related to the study of the contents of the subject will be answered.
Essay questions exam	The teachers will be available to have tutoring sessions with the students, which will be arranged in advance. In the tutoring sessions, either in person or online, such as email or the virtual campus, all queries related to the study of the contents of the subject will be answered.

Assessment						
	Description	Qualification	Training and Learning Results			
Seminars	The participation and resolution of all the tasks proposed by the teacher for the seminar classes will be qualified.	25	A3 A4	B3 B4	C43	D3
Laboratory practical	Attendance at the laboratory practical sessions will be mandatory. The laboratory work will be evaluated with a APT or NO APT. For this evaluation, compliance with the safety regulations related to the handling of chemical substances and waste removal, planning and development of proposed experiments, analysis of results and the laboratory notebook quality will be taken into account. The evaluation will be done through the systematic observation of student work. The mark of the laboratory practices will be obtained from the resolution of the tasks and works proposed by the teachers in relation to the experiments performed and the visit to the industry.	15	A3	B4	C43	D3
To pass the subject it is essential to obtain APT at work from laboratory.						
Objective questions exam	A short exam (one hour long) will be carried out at week eight. In this exam will enter the subject explained until that moment.	20	A3 A4	B3 B4	C43	
Essay questions exam	A global exam will be carried on closing date of evaluation in order to analyze the adquired competencies.	40	A3 A4	B3 B4	C43	

Other comments on the Evaluation

Participation of students in any of the evaluation parts will involve the condition of presented and therefore the obtaining of a qualification. The presentation of some work in seminars, the attendance to laboratory practical (two or more sessions) or the performance of some written exams will be considered evaluation acts.

Students should have a minimum mark in some of the evaluation parts in order to pass the subject (5 or more points). This minimum mark should be of 4 points over 10 in the global exam, as well as in seminars and laboratory practicals.

If the required minimums are not obtained, the final mark will be the weighted mark of the highest-scoring failed part (seminars, laboratory practicals or global exam).

Evaluation in the July Call

The mark achieved in seminars and laboratory practical will be maintained (maximum 40%). A written global exam about all theoretical contents of the subject will be performed (60%). In order to pass the subject (global score equal to or greater than 5) in this call, students must achieve a minimum mark of 5 points out of 10 in the written exam.

Students of subsequent enrollment

Those students who were previously evaluated as APT will be awarded the APT mention for the monitoring of the laboratory practical, not being necessary the completion of the experimental work again. However, they must perform the tasks or works proposed by the teachers in relation to the laboratory practices in order to achieve the mark for the Laboratory practical (15%).

Non-continuous evaluation option

Students who do not wish to opt for continuous assessment must request it from the subject coordinator. This request will be made during the first three weeks of the course. To pass the subject they will have to do the work of laboratory, obtain the APT qualification, and perform a global test in which all the subject contents will be evaluated, including the laboratory practical. The minimum mark of this exam must be 5 points over 10.

Sources of information

Basic Bibliography

G. L. Patrick, **An introduction to Medicinal Chemistry**, 7th, Oxford University Press, 2023

N. K. Dunlap, **Medicinal Chemistry**, 1st, Garland Science, 2018

C. Rostron, **Drug Design and Development**, Oxford University Press, 2020

A. Delgado, C. Minguillón, J. Juglar, **Introducción a la Química Terapéutica**, 2ª, Diaz de Santos, 2003

E. Stevens, **Medicinal Chemistry: The Modern Drug Discovery Process**, 1st, Pearson Advanced Chemistry, 2013

Complementary Bibliography

C. Avendaño, **Introducción a la Química Farmacéutica**,

C. G. Wermuth, D. Aldous, P. Raboisson, D. Rogman, **The practice of Medicinal Chemistry**, 4th, Elsevier, 2015

J. M. Beale Jr, J. H. Block, **Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry**, 12th, Wolters Kluwer, 2011

Recommendations

Subjects that it is recommended to have taken before

Biology: Biology/V11G201V01101

Organic chemistry II/V11G201V01210

Organic Chemistry IV: Design of Organic Synthesis/V11G201V01310

Organic chemistry I/V11G201V01205

Stereoselective Synthesis of Bioactive Compounds/V11G201V01405

Biochemistry/V11G201V01201

Organic Chemistry III: Concerted, Radical and Photochemical Reactions/V11G201V01305

IDENTIFYING DATA				
Computing Techniques for Chemistry				
Subject	Computing Techniques for Chemistry			
Code	V11G201V01415			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Otero Martínez, Nicolás			
Lecturers	Hermida Ramón, José Manuel Otero Martínez, Nicolás			
E-mail	nom05@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	The subject "Computational Techniques in Chemistry" aims to introduce students to the use of advanced computer tools, based on free software, beyond office automation packages already used during the previous courses of the degree, thus expanding skills for work and/or or research.			
	The subject is divided into four blocks in which the general aspects of the GNU/Linux operating system and how to install it, creation of documents in LaTeX with chemical applications, Fortran and Python will be considered. The students will be taught combining small theoretical sessions together with practical examples that the students will verify in situ, and always supervised by the professors responsible for the subject.			
	The evaluation will consist of carrying out some written tasks (programs and documents in LaTeX) with a weight of 50% together with the preparation of reports explaining how the aforementioned tasks have been implemented (with a weight of 30%) and systematic observation of the work done during the practical sessions in a presentation at the end of the course (20%). There will also be the possibility of not using continuous evaluation with a written exam whose weight will be 100% if requested.			
	English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results				
Code				
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study			
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy			
B1	Ability for autonomous learning			
B2	Organization and planning capacity			
B3	Ability to manage information			
C37	Acquire basic knowledge of programming and be able to use appropriate computer packages to solve problems of chemical interest			
D1	Ability to solve problems			

Expected results from this subject				
Expected results from this subject	Training and Learning Results			
Python/Fortran program creation	B1	C37	D1	
	B2			
Utilization of a distribution of the GNU/Linux operative system	A1			
	A5			
Preparation of presentations and/or text documents with *LaTeX	B2	C37		
	B3			

Contents	
Topic	

GNU/Linux operative system	- Installation of a distribution. - Graphic environment. - Introduction to the command line. - Installation of programs. - Installation and configuration of an integrated development environment.
Introduction to LaTeX	- Structure of the documents. - Common elements of all types of documents or classes. - Tools for technical texts. - Presentations (Beamer). - Applications for chemicals.
Python 3	- Structure of the source code of the programs and fundamentals of Python. - Variables and strings. - Type of data. - Syntax and basic commands. - Programming some practical examples.
Modern Fortran	- Structure of the source code of the programs and fundamentals of Fortran. - Variables and arrays. - Syntax and basic commands. - Programming some practical examples.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	12	12	24
Problem solving	12	27	39
Practices through ICT	14	28	42
Autonomous problem solving	12	27	39
Essay	2	4	6

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

Methodologies

	Description
Lecturing	Theoretical classes given through an on-screen presentation (available to students on the Moovi platform). In these classes the basic contents will be introduced, emphasizing the most important and difficult issues. Practical examples will be shown.
Problem solving	Aimed at solving problems and/or tasks and discussing them. The necessary material will be provided through the Moovi platform.
Practices through ICT	Application from what is discussed in the lecture and in the problem solving sessions to more general, but related, cases to the subject. Through the Moovi platform, the practice scripts and the work rules in the laboratory will be provided.
Autonomous problem solving	(*)Destinados á resolución de tarifas que integren os contados dados e exerciten as competencias a adquirir. A través da plataforma Moovi proporcionarase o material necesario.

Personalized assistance

Methodologies	Description
Lecturing	The student needing help will have the possibility of attend to "special tutorial sessions to solve doubts, mainly following the schedules indicated previously. To optimize the time, it is convenient that the student contacts with the professor with previously enough.
Practices through ICT	The student needing help will have the possibility of attend to "special tutorial sessions to solve doubts, mainly following the schedules indicated previously. To optimize the time, it is convenient that the student contacts with the professor with previously enough.
Problem solving	The student needing help will have the possibility of attend to "special tutorial sessions to solve doubts, mainly following the schedules indicated previously. To optimize the time, it is convenient that the student contacts with the professor with previously enough.
Autonomous problem solving	

Assessment

	Description	Qualification	Training and Learning Results
Problem solving	The students will give all the written work made in the session, such as creation of documents in LaTeX and Fortran/Python source code.	20	B1 C37 D1 B2

Practices through ICT	The students will give all the written work made in the session, such as creation of documents in LaTeX and Fortran/Python source code.	30	A1 A5	B1 B3	C37	D1
Autonomous problem solving	(*)Presentación da resolución de tarefas complexas que integren o coñecementos e competencias da materia.	30	A1	B1	C37	D1
Essay	The students will present the results of their practices made using LaTeX and explaining the design of his applications of Fortran/Python.	20	A1 A5	B1 B2 B3	C37	D1

Other comments on the Evaluation

Sources of information

Basic Bibliography

Jay LaCroix, **Learn Linux TV**, Youtube, 2022

Complementary Bibliography

Jay LaCroix, **Mastering Ubuntu Server : explore the versatile, powerful Linux Server distribution Ubuntu 22.04 with this comprehensive guide**, 4, Packt Publishing Limited, 2022

Richard Blum, Christine Bresnahan, **Linux command line and shell scripting bible**, 3, John Wiley & Sons, 2015

Collaboratively writing open-content textbook, **LaTeX**, <https://en.m.wikibooks.org/wiki/LaTeX>, 2022

J. Mulero, J.M. Sepulcre, **LATEX con palabras clave**, Publicacions de la Universitat d'Alacant, 2016

Collaboratively writing open-content textbook, **Python Programming**, https://en.m.wikibooks.org/wiki/Python_Programming,

Python 3 Tutorial, <https://www.tutorialspoint.com/python3/>,

Alberto Cuevas Álvarez, **Python 3**, RA-MA Editorial, 2016

David Beazley, Brian K. Jones, **Python Cookbook**, 3, O'Reilly, 2013

Fortran Tutorial, <https://www.tutorialspoint.com/fortran/index.htm>,

Collaboratively writing open-content textbook, **Fortran**, <https://en.m.wikibooks.org/wiki/Fortran>,

Michael Metcalf, John Reid, Malcolm Cohen, **Modern Fortran Explained (Numerical Mathematics and Scientific Computation)**, 4, Oxford University Press, 2011

William H. Press, Brian P. Flannery, Saul A. Teukolsky, William T. Vetterling, **Numerical Recipes in Fortran 77: The Art of Scientific Computing**, 2, University Press, 1992-1996

Recommendations

Subjects that it is recommended to have taken before

Chemistry: Chemistry 1/V11G201V01104

Chemistry: Chemistry 2/V11G201V01109

Mathematics: Mathematics 2/V11G201V01108

Mathematics: Mathematics 1/V11G201V01103

IDENTIFYING DATA				
Theory of Organic Reactions				
Subject	Theory of Organic Reactions			
Code	V11G201V01417			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Alonso Gómez, José Lorenzo			
Lecturers	Alonso Gómez, José Lorenzo			
E-mail	lorenzo@uvigo.es			
Web	http://https://www.chemistrywithatwist.com/			
General description	This course aims to deepen students' knowledge of all aspects of reactivity and reaction mechanisms in Organic Chemistry. Emphasis will be placed on the factors affecting the stabilities of reaction intermediates, chemoselectivity, and stereoselectivity. This knowledge will enable students to predict and rationalize chemical behaviour. English Friendly Programme: International students may request the following from the teaching staff: a) materials and bibliographic references in English for following the course; b) attendance at tutorials in English; c) assessment tests in English.			

Training and Learning Results				
Code				
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences			
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy			
B5	Ability to adapt to new situations and to make decisions			
C44	Know the main methods for the study of organic reactions mechanisms			
D2	Capacity for teamwork			
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English			

Expected results from this subject				
Expected results from this subject	Training and Learning Results			
Comprise the principles and theories related with the main types of chemical reactions and his characteristic.	A4 A5	B5	C44	D3
Know the methods of study of the mechanism of an organic reaction.	A4 A5	B5	C44	D3
Know the methods to study and propose intervals of reaction.	A4 A5	B5	C44	D3
Apply in the laboratory, of rigorous way, the norms of security and corresponding hygiene, as well as the suitable treatment of the waste generated		B5	C44	D2 D3
Collect data and draft in the fascicle of laboratory, of clear form, concise and rigorous, the experiments realized and the conclusions that extract .	A4 A5	B5		D2 D3

Contents	
Topic	
1. Reaction kinetics	Reaction kinetics. Reaction coordinates. Theory of the been transitional. Equation of Arrhenius. Expressions of speed of reaction. Kinetic and thermodynamic control. Postulate of Hammond. Principle of Curtin-Hammett
2. Employment of Isotopes in reaction kinetics	Applications of the reaction kinetics to the study of the mechanisms of reaction. Kinetic isotopic effects. Substituent effects. Correlation of Hammett.
3. Relation Structure-Reactivity	Electronic effects. Esteric effects. Effects of the dissolvent.
4. Intervals of Reaction	Stereochemistry and mechanisms of reaction with Carbocations, Carbanions, Radicals, Carbenes, Nitrenes, and Benzynes
5. Acid-Base Reactions	Relationship of acidity and basicity to structure. Specific acid catalysis. General acid catalysis. Specific base catalysis. General base catalysis.
6. Impact of chirality on reactivity beyond stereoselectivity	Chirality. Chirality-induced spin selectivity (CISS). Chirality-enhanced water splitting. Chirality-enhanced CO ₂ reduction.
Practices	Correlation structure-reactivity

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	24	36	60
Seminars	11	24	35
Laboratory practical	14	14	28
Problem and/or exercise solving	1	8	9
Presentation	1	4	5
Problem and/or exercise solving	1	12	13

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

Methodologies	
	Description
Lecturing	It Will provide previously the material of the subject through the platform *Moovi. The teaching staff will expose of way structured the contents of the subject. The possible doubts arisen in the moment of the exhibition be able to be cleared during these exhibitions.
Seminars	They Will work the concepts entered in the lectures through problems and questions formulated pole teaching staff. Besides, the students will work envelope the concepts exposed in kind and will resolve problems and additional exercises that will be evaluated.
Laboratory practical	The work of laboratory will develop in 4 sessions of 3.5 h. The students will have to *confeccionar a fascicle of laboratory with the experiments carried out, where will collect besides the derivative conclusions of the experimental work. Incidentally, the students will present a final report of the work realized in the laboratory.

Personalized assistance	
Methodologies	Description
Lecturing	The teaching staff will clear the doubts and questions arisen during the exhibition of the subjects, related with the subject.
Seminars	The teaching staff will explain and will resolve the questions exposed pole students in regard to the exercises and problems resolved in the sessions of seminars.
Laboratory practical	The teaching staff will supervise and will guide the development of the experiments proposed in the sessions of practices. Besides it will render special attention to the fulfilment of the measures of security and hygiene in the laboratory.
Tests	Description
Problem and/or exercise solving	Before each proof of evaluation (short proofs and final examination) the teaching staff will devote the necessary time to answer the questions of the students related with the subject.
Presentation	The teaching staff will supervise and guide the development of the work for its subsequent presentation in a seminar session.
Problem and/or exercise solving	Before each proof of evaluation (short proofs and final examination) the teaching staff will devote the necessary time to answer the questions of the students related with the subject.

Assessment					
	Description	Qualification	Training and Learning Results		
Seminars	How part of the continuous evaluation, will value the participation and the resolution of the exercises proposed pole teaching staff inside the classroom. It Will value besides the resolution of exercises and additional problems, similar to the resolved during the sessions of seminar.	10	A4 A5	C44	D3
Laboratory practical	1. It IS mandatory to realize the practices of laboratory, as well as follow the norms of hygiene and security in the laboratory and the collected of waste to obtain the condition of APT. 2. Besides, it will value (20%): - the fascicle of laboratory - the final report. 3. So that the students surpass the subject will owe to obtain the qualification of APT in the work of practices of laboratory.	20	A5	B5 C44	D2 D3

Problem and/or exercise solving	They Will realize two proofs: The first proof envelope the contents of the first subjects, that will suppose 20% of the final qualification. It Will demand a minimum note of 2.5 points on 10.0 in this proof to surpass the subject. In the case that no surpass the minima demanded in of the previous proofs, the final qualification obtained in the subject will be the qualification pondered of the proof of global evaluation.	30	A4 B5 C44 D3 A5
Presentation	The students will #analyze and will explain the results of investigation collected in a recent article of investigation related with the subject of the course in a session of seminars. It Will value the capacity of synthesis and understanding of the work presented as well as the questions that do on them other works of the students.	10	A4 B5 C44 D3 A5
Problem and/or exercise solving	They Will realize two proofs: This second proof envelope ALL The CONTENTS OF The SUBJECT, that will suppose a 30% of the final qualification. It Will demand a minimum note of 4.0 points on 10.0 in this proof to surpass the subject. In the case that no surpass the minima demanded in of the previous proofs, the final qualification obtained in the subject will be the qualification pondered of the proof of global evaluation.	30	A4 B5 C44 D3 A5

Other comments on the Evaluation

SAT/ASSESSED STATUS (PRESENTADO/A): A student's participation in any of the course's assessment activities will confer "assessed" status and will therefore result in the assignment of a grade. Assessment activities include attendance at laboratory practical sessions, the submission of assignments and exercises set by the teaching staff, and sitting any test.

JULY ASSESSMENT (SECOND SITTING): The grades obtained by students during the course in problem solving, laboratory practicals, and assignments will be retained. A test covering all the theoretical content of the course will be held; it will account for 50% of the final grade and will replace the marks from the written tests. A minimum of 4 out of 10 must be achieved in this test in order to pass the course and for the remaining assessment components to be taken into account. If a student has a grade of PASS (APTO/A) for the laboratory work but obtains a mark below 5 out of 10 in the practicals assessment, a written test on the experimental part will be held, accounting for 20% of the final grade.

STUDENTS IN THEIR SECOND OR SUBSEQUENT ENROLMENT: Students who were graded PASS (APTO/A) for the laboratory work in the previous academic year will be awarded a PASS (APTO/A) in the monitoring of laboratory work for the current academic year, and will not be required to repeat the experiments. Nevertheless, they must complete the deliverables and the written test on the experimental part in order to obtain the corresponding grade for the experimental part of the course in the current academic year.

NON-CONTINUOUS ASSESSMENT OPTION: Students who do not wish to opt for continuous assessment must request this within the first three weeks of the course from the course coordinator.

To pass the course, these students must complete the Laboratory Practical, obtain a grade of PASS (APTO/A) for the work carried out in the laboratory, and obtain a grade of 5 or higher out of 10 in the written test on the experimental part. In addition, they must obtain at least 5 out of 10 in a test assessing all the course content. In this case, the final grade will consist of a maximum of 2 points from the laboratory practicals and a maximum of 8 points from the written test.

In the event of doubt regarding students' acquisition of learning outcomes, additional oral assessment tests may be held.

Sources of information

Basic Bibliography

J. Clayden, N. Greeves, S. Warren., **Organic Chemistry**, Oxford University Press, 2012

Complementary Bibliography

Felix A. Carroll., **Perspectives on Structure and Mechanism in Organic Chemistry**, Wiley, 2010

Francis A. Carey, Richard J. Sundberg, **Advanced Organic Chemistry : Part A: Structure and Mechanisms**, Springer, 2007

Recommendations

Subjects that it is recommended to have taken before

Chemistry: Chemistry Lab I/V11G201V01105

Chemistry: Chemistry 1/V11G201V01104

Organic chemistry II/V11G201V01210
Organic Chemistry IV: Design of Organic Synthesis/V11G201V01310
Chemistry: Chemistry Lab II/V11G201V01110
Chemistry: Chemistry 2/V11G201V01109
Organic chemistry I/V11G201V01205
Physical Chemistry V: Chemical Kinetics/V11G201V01308
Organic Chemistry III: Concerted, Radical and Photochemical Reactions/V11G201V01305

IDENTIFYING DATA				
Immunochemistry				
Subject	Immunochemistry			
Code	V11G201V01419			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Simón Vázquez, Rosana			
Lecturers	Pérez Potti, André Simón Vázquez, Rosana			
E-mail	rosana.simon@uvigo.es			
Web	http://portalcientifico.uvigo.gal/grupos/17720/detalle			
General description	The aim of the Immunochemistry course is to provide students with a basic understanding of how the immune system works and to explore in greater depth the use of its components in the development of immunodetection techniques.			
	Among these components, antibodies are particularly important. These are specialized proteins capable of recognizing many different types of molecules, both biological and synthetic in origin. Antibodies make it possible to develop a wide range of analytical, diagnostic, and therapeutic techniques, either through their binding to other molecules such as enzymes, particles, or drugs, or in their free form. Their extraordinary detection capacity is used in many different fields, including medicine, the chemical and pharmaceutical industries, agriculture, and the marine sector, among others. In this course, we will also review the chemistry of the components of the immune system, with the aim of understanding the remarkable capacity of this system to protect us against pathogens and other diseases, such as cancer.			

Training and Learning Results	
Code	
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
B2	Organization and planning capacity
B4	Ability for analysis and synthesis
C49	Acquire sufficient knowledge, skills and abilities for the practice of immunochemistry in different fields
D1	Ability to solve problems
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English
D5	Ability to develop their professional activity based on respect for fundamental rights and equal opportunities, within the framework of professional ethics and ethical commitment

Expected results from this subject	
Expected results from this subject	Training and Learning Results

Identify the cellular and molecular components involved in immune responses.	A3	B2	C49	D1
Understand the diversity of receptors in the immune system.	A4	B4		D3 D5
Identify the interactions between immune system receptors and their ligands and understand their complexity.				
Understand the different methodologies for obtaining antibodies for their subsequent use in the laboratory and/or in therapy.				
Understand and use scientific concepts, terminology, and instrumentation.				
Understand the theoretical and technical aspects of different immunochemical assays.				
Develop a procedure to carry out an immunochemical technique in the laboratory.				
Apply knowledge and technology related to Immunochemistry to aspects concerning the production, analysis, and diagnosis of biological and/or chemical processes and resources.				
Apply knowledge of Immunochemistry to isolate, identify, handle, and analyze specimens and samples of biological and/or chemical origin, as well as to characterize their constituents.				
Communicate, in written and oral form, a critical analysis of a scientific paper regarding the application of immunochemical techniques in different fields.				

Contents

Topic	
Subject 1. Historical introduction. Principles of Immunochemistry.	1.1. Discovery and identification of molecular components such as antibodies, receptors and antigen. 1.2. Development of techniques such as agglutination/precipitation, neutralization, lysis by the complement system, which allowed the characterization and understanding of the immunological reaction. 1.3. The relevance of transplants and allergy for the development of Immunology.
Subject 2. Components of the immune system. Basic concepts.	2.1. Membrane receptors and soluble molecules. 2.2. Cells.
Subject 3. Introduction to Cellular Immunology	3.1. Main cells of the immune system and their function. 3.2. Phenotype and cellular differentiation. 3.3. The clusters of differentiation (CDs) as markers of cellular populations.
Subject 4. Basic concepts of Immunochemistry and Immunogenetics	4.1. Antibodies. 4.2. Receptors involved in the immune response. 4.3. Concept of antigen, hapten and immunogen. 4.4. Antibody-antigen and TCR-peptide-MHC interaction. 4.5. Principles of the genetic diversity of receptors.
Subject 5. Immunoassay concepts	5.1. Obtaining of antibodies in the laboratory. 5.2. Purification and scaling techniques. 5.3. Chemical modification of antibodies.
Subject 6. Immunochemistry techniques	6.1. Homogeneous techniques. □Precipitation □Agglutination □Complement. Quantification of components 6.2. Heterogeneous techniques. □Principles of colorimetry, fluorescence, chemiluminescence and radioactivity. □Visualization techniques: optics, fluorescence, electronic, confocal □ELISA: direct, indirect, competitive, sandwich □EIA, RIA □Western Blot and Dot Blot □Immunoprecipitation □Immunofluorescence □Enzymatic techniques: Immunohistochemistry / Immunocytochemistry
Subject 7. Immunoassays in the pharmaceutical industry	7.1. Relevance in the development of medicines and clinical aspects.

Laboratory practices	1. Culture and manipulation of mouse immune cells (freezing and thawing) 2. Flow cytometry 3. ELISA 4. Dot Blot
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Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	46	70
Seminars	12	10	22
Laboratory practical	14	4	18
Objective questions exam	2	25	27
Laboratory practice	0	5	5
Problem and/or exercise solving	0	8	8

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

Methodologies

	Description
Lecturing	The professor will present the basic foundations and principles of Immunochemistry. The aim of the theoretical classes is for students to acquire a basic understanding of the fundamental principles of Immunology and their possible applications in analysis, diagnosis, and therapy.
Seminars	The seminars will consist of exercises, debates, and tasks designed to reinforce the knowledge acquired during the lectures. In addition, practical case studies and problems will be used to allow students to apply and assess their knowledge.
Laboratory practical	The laboratory work is aimed at developing competence in the application of immunochemical techniques.

Personalized assistance

Methodologies	Description
Lecturing	The master classes will be participatory. Personalized support will be provided by the teachers responsible for each topic during the corresponding weekly tutoring hours.
Seminars	The seminars will be participatory. The responsible professor will be available to solve doubts related with the exercises or any theoretical or practical content.
Laboratory practical	The professors responsible will provide personalized supervision to each student during laboratory practicals and will offer the necessary support to ensure understanding of the aims, methodology, techniques, and interpretation of results.

Assessment

	Description	Qualification	Training and Learning Results
Objective questions exam	A FINAL WRITTEN EXAM will be conducted, accounting for 40% of the final grade for the course. In this mandatory exam, the fundamental contents of the course (lectures, laboratory practicals, and seminars) will be evaluated through OBJECTIVE QUESTIONS (multiple choice and/or short answer).	40	A3 B2 C49 D1 A4 B4 D3 D5
Laboratory practice	The skills and competencies acquired during the laboratory practicals will be CONTINUOUSLY ASSESSED through the presentation of reports, multiple-choice and short-answer questions, or problem-solving. The evaluation of the practicals will account for 30% of the final grade.	30	A3 B2 C49 D1 A4 B4 D3 D5
Problem and/or exercise solving	The work and participation in the seminars will be CONTINUOUSLY ASSESSED, as well as the student's ability to solve problems and exercises. This part will account for 30% of the final grade.	30	

Other comments on the Evaluation

Attendance at all face-to-face activities is **compulsory** in order to pass the course, except in the case of duly justified absences.

To pass the course, students must obtain a minimum mark of 5 out of 10 in the final written examination or test.

If this minimum mark is not achieved, the student's final grade will be the mark obtained in the final written examination.

Failure to attend the final written examination will be recorded as "Absent".

In subsequent examination sessions, students who have failed the course will only be required to sit the final examination.

The mark obtained in the continuous assessment component, including laboratory practicals and seminars, will be maintained.

ATTENDANCE AT PRACTICAL SESSIONS AND ASSESSMENT

Attendance below 75% of the practical sessions, even when justified, will result in a failing grade for the course. In this case, students will be required to take a single written examination in order to pass the course. This examination will consist of two parts:

- 70% theoretical component.
- 30% practical component.

To pass the course, students must obtain a minimum mark of 5 out of 10 in the single examination.

In this case, the final grade will consist of 70% of the mark obtained in the single examination and 30% of the mark obtained in the seminars.

Sources of information

Basic Bibliography

Complementary Bibliography

Regueiro J.R., Martínez Navas E., González Rodríguez S., Corell Almuzara A. López Larrea C., **Inmunología : biología y patología del sistema inmunitario**, 978-84-9110-420-9, 5ª, Editorial Médica Panamericana, 2022

Wild D., **The Immunoassay Handbook. Theory and applications of ligand binding, ELISA and related techniques.**, 4ª, Elsevier, 2013

Carlberg C., Velleuer E., **Molecular Immunology: How Science Works**, 1ª, Springer, 2022

Álvarez Vallina, L., **Anticuerpos Monoclonales. Realidades y perspectivas**, Editorial Complutense S.A, 2004

Álvarez-Vallina L., González-Fernández A., Magadán Mompó S. et al., **Immunotechnology and its applications**, Ediuno, 2022

Greenfield E. A., **Antibodies: A Laboratory Manual**, Cold Spring Harbor Laboratory Press, 2014

Campos Ferrer A., Muñoz Ruiz C., Rubio Pedraza G., **Manual de Prácticas de Inmunología**, Masson, 2004

Recommendations

Subjects that it is recommended to have taken before

Biology: Biology/V11G201V01101

Biochemistry/V11G201V01201

IDENTIFYING DATA				
Internships				
Subject	Internships			
Code	V11G201V01981			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Peña Gallego, María de los Ángeles			
Lecturers	Peña Gallego, María de los Ángeles			
E-mail	mpena@uvigo.es			
Web	http://quimica.uvigo.es/es/docencia/practicas-externas/			
General description	The aim of this matter is that the students carry out a stay in a company with the end to make tasks related with the professional field of the Chemistry. By means of the realisation of internships periods in companies the students will be able to apply the knowledges and competitions adquired during his studies, to complement and reinforce his training and to facilitate his incorporation to the labour market. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results

Code			
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study		
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues		
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences		
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy		
B1	Ability for autonomous learning		
B2	Organization and planning capacity		
B5	Ability to adapt to new situations and to make decisions		
D2	Capacity for teamwork		
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English		
D4	Incorporate criteria of sustainability and environmental commitment into the professional exercise. Acquire skills in the equitable, responsible and efficient use of resources		
D5	Ability to develop their professional activity based on respect for fundamental rights and equal opportunities, within the framework of professional ethics and ethical commitment		
D6	Ability to understand the meaning and application of the gender perspective in different areas of knowledge and professional practice with the aim of achieving a more just and equal society		

Expected results from this subject

Expected results from this subject	Training and Learning Results		
Perform tasks to test the critical and reflexive capacity.	A1	B1	D2
	A3	B2	D3
	A4	B5	D4
	A5		D5
			D6
Take decisions and put in practice the capacity of analysis and synthesis in the resolution of practical problems.	A1	B1	D2
	A3	B2	D3
	A4	B5	D4
	A5		D5
			D6

Contents

Topic	
The students will integrate in the company organization and will coordinate with the members of the work group assigned.	

The students will make activities related to the exert of the profession and with the knowledges and the competences of his studies.

The activities made by the students will be supervised and evaluated by the academic tutor and the company tutor.

Planning

	Class hours	Hours outside the classroom	Total hours
Practicum, External practices and clinical practices	0	120	120
Report of practices, practicum and external practices	0	30	30

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

Methodologies

	Description
Practicum, External practices and clinical practices	Students develop activities in a context related to the exercise of a profession, during a certain period, performing the functions assigned and foreseen in the internship proposal.

Personalized assistance

Methodologies	Description
Practicum, External practices and clinical practices	The subject coordinator will resolve any doubts on a personalised basis
Tests	Description
Report of practices, practicum and external practices	The academic tutor will resolve any queries on a personalised basis

Assessment

	Description	Qualification	Training and Learning Results
Practicum, External practices and clinical practices	The qualification will take into account the performance evaluation of the student made by the company tutor and the monitoring made by the academic tutor.	80	
Report of practices, practicum and external practices	When concluding the practices, the students will have to deliver to his academic tutor a final memory to be evaluated.	20	

Other comments on the Evaluation

* This matter will be ruled by the established in the Normative of External Practices of the Degree in Chemistry.

* The academic tutor will make the global evaluation of the external practices (**Annex V**) considering:

(70%) The report made by the company tutor (**Annex IV**) in which it will value elements related with the practices made by the student as punctuality, assistance, responsibility, capacity of work in groups and integration in the company, quality of the work made, etc.

(20%) The memory that students must elaborated at the conclusion of the internship period in which they will have to appear, among others, a concrete and detailed description of the tasks performed and the departments within the company to which the student was assigned, a relation of the problems proposed and the procedure followed for his resolution, the level of integration inside the company and the relations with the personnel and a critical reflection about the education received during the degree studies and its adequation for the realization of external practices. The memory will have a minimum extension of 10 and a maximum of 20 pages of A4 size, including cover, index and annexes. Minimum margins of 2 cm, size of letter of 12 points, simple leading and paragraph justification are recommended. Tables and figures will appear numbered consecutively along the text and must include a brief heading to describe its content.

(10%) The assessment of the academic tutor (**Annex V**) of the aptitude and attitude showed by the student during the development of the activities made.

Sources of information

Basic Bibliography

Complementary Bibliography

IDENTIFYING DATA				
Final Year Dissertation				
Subject	Final Year Dissertation			
Code	V11G201V01991			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	18	Mandatory	4th	2nd
Teaching language	#EnglishFriendly Spanish Galician English			
Department				
Coordinator	Peña Gallego, María de los Ángeles			
Lecturers	Peña Gallego, María de los Ángeles			
E-mail	mpena@uvigo.es			
Web	http://quimica.uvigo.es/traballo-fin-de-grao			
General description	According to the memory of the Degree in Chemistry of the University of Vigo, the End of Degree project is a mandatory subject of 18 credits ECTS in the second term of the fourth course. The objective of the subject is to offer the students the opportunity to apply the knowledges, skills and competences adquired during the Degree studies. The TFG is an original work that each student will do individually under the supervision of one or two tutors. TFG subjects can correspond to experimental and/or theoretical works and/or of bibliographic reviews on subjects related with the contains in the Degree in Chemistry. The final stage of the TFG will consist in a written report and its public presentation. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
A1	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
B1	Ability for autonomous learning
B2	Organization and planning capacity
B3	Ability to manage information
B4	Ability for analysis and synthesis
B5	Ability to adapt to new situations and to make decisions
C1	Ability to know and understand essential facts, concepts, principles and theories related to Chemistry
C2	Use correctly chemical terminology, nomenclature, conversions and units
C3	Recognize and analyze chemical, qualitative and quantitative problems, proposing strategies to solve them through the evaluation, interpretation and synthesis of data and chemical information
C4	Use computer tools properly to obtain information, process data, perform computational calculations and calculate matter properties
C5	Present material and scientific arguments in oral and written form to a specialized audience
C6	Know the basics and tools for resolution of analytical problems and characterization of chemical substances
C7	Distinguish the main types of chemical reactions and their characteristics
C8	Know the characteristic properties of the elements and their compounds, including the relations between groups and their variations in the periodic table
C9	Know the structural aspects of chemical elements and their compounds, including stereochemistry
C10	Know the characteristics of the different states of matter and the theories used to describe them
C11	Know the principles of Thermodynamics and its applications in Chemistry
C12	Know the kinetics of chemical change, including catalysis and reaction mechanisms
C13	Know the principles and applications of electrochemistry
C14	To know the principles of quantum mechanics and its application in the description of the structure and properties of atoms and molecules

C15	Know the main techniques of structural research, including spectroscopy
C16	Know the relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids, crystals and other materials
C17	Know the nature and behavior of functional groups in organic molecules
C18	Know the properties of aliphatic, aromatic, heterocyclic and organometallic compounds
C19	Know the main synthetic routes in organic chemistry, including the interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds
C20	Know the structure and reactivity of the main classes of biomolecules and the chemistry of important biological processes
C21	Know mathematical concepts based on previous ones and be able to use them in the different contexts of Chemistry
C22	Know and apply the foundations of Physics necessary to understand the theoretical and practical aspects of Chemistry that need it
C23	Know the principles and procedures of chemical engineering
C24	Know the properties and applications of materials
C25	Safely handle chemical substances, considering their physical and chemical properties, evaluating the risks associated with their use and laboratory procedures and including their environmental repercussions
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work
C27	Demonstrate the ability to observe, monitor and measure chemical processes, by systematically and reliably recording them and presenting reports of the work done
C28	Interpret data derived from laboratory observations and measurements in terms of their meaning and relate them to the appropriate theory
C29	Demonstrate ability for numerical calculations and interpretation of experimental data, with correct use of units and estimation of uncertainty
C30	Ability to understand, interpret and adapt the advances in the field of Analytical Chemistry
C31	Know the control processes applied in the analytical laboratories to achieve their correct management and ensure the quality of the results
C32	Acquire basic knowledge on environmental control and evaluation and agro-food security
C33	Know the metrology of chemical processes, including quality management
C34	Select and use different procedures for obtaining and characterizing nanomaterials and know their potential in the development of new applications
C35	Acquire theoretical and experimental knowledge in advanced aspects of Physical Chemistry
C36	Know the basics and be able to use different quantum mechanical methods to be applied to systems of chemical interest
C37	Acquire basic knowledge of programming and be able to use appropriate computer packages to solve problems of chemical interest
C38	Relate the structural bases of organometallic compounds with their physical, spectroscopic and chemical properties
C39	Select the appropriate techniques and procedures for problems of structural elucidation, synthesis, isolation and purification of organometallic compounds
C40	Acquire knowledge about the variety of roles played by metal ions in Biology. Know the biomolecules that contain metal ions
C41	Evaluate health risk, and environmental and socioeconomic impact of chemical substances
C42	Know synthetic strategies to obtain stereoselectively compounds with biological activity
C43	Know the chemical compounds with therapeutic application
C44	Know the main methods for the study of organic reactions mechanisms
C45	Apply chemical and chemical engineering knowledge to industrial processes
C46	Know the principles and procedures of environmental technology applied to the industry
C47	Know the principles and procedures of industrial health and safety
C48	Be able to determine the behavior of a material
C49	Acquire sufficient knowledge, skills and abilities for the practice of immunochemistry in different fields
C50	Know the concepts of company, institutional and legal framework of companies, and organization and management of companies
D1	Ability to solve problems
D2	Capacity for teamwork
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English
D4	Incorporate criteria of sustainability and environmental commitment into the professional exercise. Acquire skills in the equitable, responsible and efficient use of resources
D5	Ability to develop their professional activity based on respect for fundamental rights and equal opportunities, within the framework of professional ethics and ethical commitment
D6	Ability to understand the meaning and application of the gender perspective in different areas of knowledge and professional practice with the aim of achieving a more just and equal society

Expected results from this subject

Expected results from this subject

Training and Learning Results

New

A1	B1	C1	D1
A2	B2	C2	D2
A3	B3	C3	D3
A4	B4	C4	D4
A5	B5	C5	D5
		C6	D6
		C7	
		C8	
		C9	
		C10	
		C11	
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		C46	
		C47	
		C48	
		C49	
		C50	

Contents

Topic

(*)Dado o seu carácter especial, a materia non ten contidos propios.

Planning

	Class hours	Hours outside the classroom	Total hours
Mentored work	160	256	416
Presentation	0.5	33.5	34

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

Methodologies

Description

Mentored work	Individual work that each student will make of autonomous form under the supervision of one or two tutors. The allocation of the subject of work will do in accordance with the Rule of the TFG of the Faculty of Chemistry.
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Personalized assistance

Methodologies	Description
Mentored work	

Assessment

	Description	Qualification	Training and Learning Results			
Mentored work		30	A1	B1	C1	D1
			A2	B2	C2	D2
			A3	B3	C3	D3
			A4	B4	C4	D4
			A5	B5	C5	D5
					C6	D6
					C7	
					C8	
					C9	
					C10	
					C11	
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					C45	
					C46	
					C47	
					C48	
					C49	
					C50	

Presentation	70	A1	B1	C1	D1
		A2	B2	C2	D2
		A3	B3	C3	D3
		A4	B4	C4	D4
		A5	B5	C5	D5
				C6	D6
				C7	
				C8	
				C9	
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				C49	
				C50	

Other comments on the Evaluation

TFG is ruled by the norms approved in the Junta de Facultad and published in the web page web of the faculty.
The TFG Commission will do public, with sufficient advance, the criteria of evaluation that will use the tutor and the jury.
The TFG Commission will do public, with sufficient advance, the conditions for the written report and the public defences.
All the information generated by the TFG Commission will be included in the TFE module and/or in the web page of the faculty.

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

