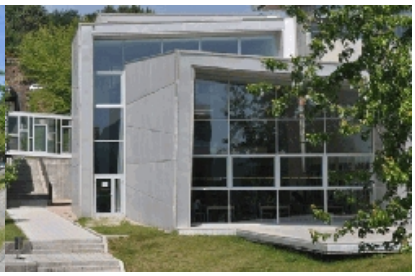
(*)Facultade de Química

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 stablisment of the Universitary 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 no the pioneering spirit of the chemists in research of 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

(*)Grao en Química

Subjects

Year 2nd

Code	Name	Quadmester	Total Cr.
V11G200V01301	Física III	1st	6
V11G200V01302	Química analítica I	1st	9

V11G200V01303	Química física I	1st	6
V11G200V01304	Química orgánica I	1st	9
V11G200V01401	Ferramentas informáticas e de comunicación en química	2nd	6
V11G200V01402	Métodos numéricos en química	2nd	6
V11G200V01403	Química física II	2nd	9
V11G200V01404	Química inorgánica I	2nd	9

Year 3rd

Code	Name	Quadmester	Total Cr.
V11G200V01501	Determinación estrutural	1st	6
V11G200V01502	Enxeñaría química	1st	9
V11G200V01503	Química analítica II	1st	9
V11G200V01504	Química orgánica II	1st	6
V11G200V01601	Química analítica III	2nd	6
V11G200V01602	Química biolóxica	2nd	9
V11G200V01603	Química física III	2nd	9
V11G200V01604	Química inorgánica II	2nd	6

Year 4th

Code	Name	Quadmester	Total Cr.
V11G200V01701	Proxecto	1st	6
V11G200V01702	Química de materiais	1st	6
V11G200V01703	Química inorgánica III	1st	9
V11G200V01704	Química orgánica III	1st	9
V11G200V01901	Química alimentaria	2nd	6
V11G200V01902	Química ambiental	2nd	6
V11G200V01903	Química de fármacos	2nd	6
V11G200V01904	Química industrial	2nd	6
V11G200V01905	Química sostible	2nd	6
V11G200V01981	Prácticas externas: Prácticas en empresas	2nd	6
V11G200V01991	Traballo de Fin de Grao	2nd	18

IDENTIFYING DATA				
Physics 3				
Subject	Physics 3			
Code	V11G200V01301			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Martínez Piñeiro, Manuel Hermida Ramón, José Manuel			
Lecturers	Hermida Ramón, José Manuel Martínez Piñeiro, Manuel Peña Gallego, María de los Ángeles			
E-mail	mmpineiro@uvigo.es jose_hermida@uvigo.es			
Web				
General description	The matter intends to be an introduction to Quantum Mechanics and Statistical mechanics, oriented to theirs applications in Chemistry.			

Competencies		
Code		Typology
CE3	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: principles of quantum mechanics and its application in the description of the structure and properties of atoms and molecules	
CE14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules	• know
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• Know How
CE22	Process and perform computational calculations with chemical information and chemical data	• Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know How
CT3	Learn independently	• Know How
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• Know How
CT7	Apply theoretical knowledge in practice	• Know How
CT8	Teamwork	• Know How
CT9	Work independently	• Know How
CT12	Plan and manage time properly	
CT13	Make decisions	• Know How
CT14	Analyze and synthesize information and draw conclusions	
CT15	Evaluate critically and constructively the environment and oneself	

Learning outcomes	
Learning outcomes	Competences
To describe in an unified way the electromagnetic field by means of Maxwell's laws. Apply the basic boundary conditions in the vacuum or in materials.	CE3 CT1 CT12 CT14
To derive the equation of propagation of an electromagnetic wave, and describe its main characteristics. Relate this concept with the electromagnetic spectrum.	CE3 CT12 CT14
To explain the empirical phenomena related with the interaction of radiation with matter which cannot be explained by the Classical Theory, and the solutions proposed (wave-corpuscle duality, quantization of the radiation).	CE3 CT12 CT14 CT15

To know the postulates of Quantum Mechanics and their consequences in the reformulation of the microscopic theory of the Classical Physics.	CE3 CT1 CT12 CT14 CT15
To explain the essentials of the theory of mathematical operators, including the concepts of eigenfunction and eigenvalue, spectrum, linearity and hermiticity, complete sets of eigenfunctions, etc.	CE3 CT1 CT9 CT12 CT14
To write the fundamental operators of Quantum Mechanics (position, linear and angular moment, Hamiltonian of simple systems).	CE3 CE19 CT1 CT9 CT12 CT14
To apply the previous concepts to the quantum- mechanical study of simple systems, like a particle in a square well potential, or to a harmonic oscilator potential, by resolving the time-independent Schrödinger equation.	CE3 CE19 CT1 CT3 CT6 CT8 CT12 CT13 CT14
To calculate the eigenfunctions and eigenvalues of the angular momentum operator.	CE3 CE19 CT6 CT12 CT14
To resolve the wave equation of the hydrogen atom, and calculate its eigenfunctions (orbitals).	CE3 CE19 CT6 CT8 CT12 CT14
To resolve the Schrödinger equation for many-electron atoms by means of approximate methods.	CE3 CE19 CE20 CT1 CT5 CT6 CT9 CT12 CT13 CT14
To explain in a simple way the transitions between states and the absorption and emission spectra.	CE3 CE19 CE20 CE22 CE23 CT1 CT6 CT8 CT9 CT12 CT14 CT15

To know the laws of Statistical Mechanics, which govern the behaviour of many-particle systems, in particular the Maxwell-Boltzmann statistics. Derive the partition function of a system and know in detail its physical meaning.	CE14 CE20 CE22 CE23 CT1 CT4 CT5 CT6 CT7 CT8 CT12 CT13
To apply the Maxwell-Boltzmann statistics to the case of the ideal gases of atoms and polyatomic particles to estimate thermodynamic properties, using microscopic properties like the mass, the molecular geometry and the vibrational frequencies.	CE14 CE19 CT1 CT4 CT5 CT6 CT7 CT8 CT12 CT13

Contents

Topic	
Electromagnetic field: equations of Maxwell.	Displacement current. Maxwell equations. Energy. Waves equations.
Quantización Of radiation. Wave-corpuscle duality	Ultraviolet catastrophe photoelectric Effect X-rays. Bragg condition. Braking radiation. Compton effect Wave-corpuscle duality
Principles of Quantum Mechanics	Limitations of Classical Physics and origin of Quantum Mechanics De Broglie Hypothesis Uncertainty Relationship Quantum Mechanics Postulates Virial Theorem
Quantum-mechanical Study of model systems	Introduction. Particle in a box of potential. Harmonic oscillator. Angular moment and rigid rotor.
Approximate methods	Introduction. Method of variations. Method of perturbations.
Hydrogen-like Atoms	Introduction. Resolution of the radial part of the equation of Schrödinger. Hydrogen-like Orbitals. Angular and magnetic moments electronic. Electronic spin. Spin-orbit coupling. Hyperfine structure. Spectra of Hydrogen-like atoms
Polielectronic atoms	Approximation of independent electrons. Antisymmetry Principle. Slater orbitals and basic functions. SCF-HF Method Terms and electronic levels. Spectra of polielectronic atoms
Statistical mechanics	Nomenclature and postulates. Canonical ensemble. Canonical partition function. Systems of non-interacting particles. Molecular partition function. Canonical partition function for a pure ideal gas. Boltzmann distribution law for non-interacting molecules. Statistical thermodynamics for ideal gases. Introduction to the study of real systems.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	25	50	75
Problem solving	26	39	65
Introductory activities	1	1	2
Problem and/or exercise solving	4	0	4
Essay questions exam	4	0	4

*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 points of each subject and presentation of those which are going to be tackled in the seminars
Problem solving	Resolution of numerical problems, theoretical questions and development of the theoretical points proposed in the masterclasses with the participation of the student.
Introductory activities	Presentation of the subject with a brief desription of: sections, contents, distribution of the sections in the short tests and in the final exam general norms of evaluation,etc.

Personalized assistance

Methodologies	Description
Lecturing	Discussion of the main points of the subject. Answers to the questions related with the points raised by the students not only in the master session but also in the seminars. The students will know before the beginning of the course the schedules of the the tutorial sessions offered by the professors of the subject. In those tutorials the student will be able to review his/her examinations
Problem solving	Answers to the questions related with the points the students may have raised in the classes devoted to problem resolution and in the tutorial sessions. The students will know before the beginning of the course, the schedules of the the tutorial sessions offered by the professors of the subject. In those tutorials the student will be able to review his/her examinations

Assessment

	Description	Qualification	Evaluated Competencess
Problem solving	It will consist on the resolution of exercises and tests in the classroom. Nevertheless, the teacher will be able too to ask the student to deliver the solution to previously proposed exercises, that he/she has resolved in an autonomous way. In this case the teacher may ask the student tho explain to him indivdually how he/she has resolved the exercise.	25	CE19 CE20 CE22 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Essay questions exam	At the end of the course a full written test will take place in which the students can take on those aspects that they did not pass in the short written tets or improve in those they did pass.	37.5	CE3 CE14 CE19 CE20 CT6 CT7 CT9 CT12 CT13 CT14

Problem and/or exercise solving	During the course two short written tests will take place. They will correspond, respectively, to the contents of the sections 1 to 3 and 4 to 8 respectively. If any of those written tests is not passed the student must take on the corresponding part of the final exam (December/January). The student must take on the whole subject in the second-opportunity exam (June/July).	37.5	CE3 CE14 CE19 CE20 CT6 CT7 CT9 CT12 CT13 CT14

Other comments on the Evaluation

During the course two short written tests will take place corresponding to sections 1-3, the first one, and to sections 4-8, the second. Both will contain problems and questions and, if they are passed, the student, is not obliged to take on the corresponding part of the subject in the (first-call) final exam (December/January), although he/she can do so in order to improve his/her mark. On a voluntary basis the student may participate in the seminars by solving exercises on the board. Also voluntarily the student may solve at home some proposed exercises and deliver them to the teacher. The final exam will include the whole subject but is divided into two parts corresponding to the two tests so the student can take on any or both of them, even if they have passed the short written test of that part.

The student though, must reachin the written tests a global minimum mark of 3.5/10 in order to accumulate the points obtained by resolving exercises independently or in the classroom.

In the second-opportunity evaluation (July) the student should do a full written test; the points obtained by exercise resolution (troubleshooting section) will be mantained.

On a voluntary basis, the students will be able to participate in the resolution of exercises in the seminars or deliver the answer to the written exercises proposed in the classroom.

It will be understood that any student who has not taken any written test (short or the final exam) has not really followed the subject and will not be given a mark (his/her qualification will be "no presentado").

Sources of information

Basic Bibliography

Complementary Bibliography

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M. Alonso y E.J. Finn, Física, 2000, Pearson Educación
I. N. Levine, Fisicoquímica, 2004, McGraw-Hill
P.W. Atkins y J. de Paula, Atkin's Physical Chemistry, 2014, Oxford Univ. Press
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Recommendations

Subjects that continue the syllabus

Physical chemistry II/V11G200V01403

IDENTIFYING DATA				
Analytical chemistry 1				
Subject	Analytical chemistry 1			
Code	V11G200V01302			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Pérez Cid, Benita			
Lecturers	Bendicho Hernández, José Carlos Pena Pereira, Francisco Javier Pérez Cid, Benita			
E-mail	benita@uvigo.es			
Web				
General description	The main objective of the course Analytical Chemistry (I) is to provide students with an overview on qualitative and quantitative chemical analysis, in both applied and theoretical issues. The different subjects addressed in the course will establish the basis for learning other more advanced topics, particularly those associated with the design and application of more complex analytical methods. Classrooms will be supplemented by hands-on experiments and seminars.			

Competencies		
Code		Typology
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	• Know How
CE1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.	• know • Know How
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	• know • Know How
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances	• know • Know How
CE17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management	• know • Know How
CE18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry	• know • Know How
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• Know How
CE21	Recognize and implement good scientific practices for measurement and experimentation	• Know How
CE22	Process and perform computational calculations with chemical information and chemical data	• Know How
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	• Know How
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work	• Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	• Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	• know • Know How
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	• Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• know • Know How
CT3	Learn independently	• Know How
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• know • Know How
CT7	Apply theoretical knowledge in practice	• know • Know How
CT8	Teamwork	• Know How
CT9	Work independently	• Know How
CT12	Plan and manage time properly	• Know How
CT13	Make decisions	• Know How
CT14	Analyze and synthesize information and draw conclusions	• Know How

CT15 Evaluate critically and constructively the environment and oneself	• Know How
CT16 Develop an ethical commitment	• Know How

Learning outcomes

Learning outcomes	Competences
Recognise the importance of the Analytical Chemistry in function of its aims.	CE4 CE19 CT4 CT14
Identify the fundamental stages of the analytical process like methodology for the resolution of analytical problems and select the appropriate analytical method.	CB5 CE4 CE19 CT4 CT14
Describe the basic analytical properties (accuracy, precision, sensitivity and selectivity) and the types of errors that can affect to the experimental results.	CE19 CE20 CT1 CT4 CT6 CT14
Describe the fundamentals of sampling and sample preparation for the determination of different analytes.	CE4 CE19 CT1 CT4 CT14
Calibration, use and cleaning of the material used in the analytical laboratory.	CB5 CE21 CE26 CT7 CT9 CT12
Prepare solutions of exact concentration (primary pattern) and approximate (secondary and reactive pattern auxiliaries) in function of its purpose and handle properly the concentration units.	CB5 CE1 CE17 CE21 CE25 CT6 CT7 CT9 CT12 CT13
Explain and interpret the basic knowledges of the separation and identification of chemical species in solution using a systematic separation approach.	CB5 CE2 CE4 CE19 CE21 CE26 CT3 CT7 CT9 CT12 CT13 CT14
Describe the principles of the quantitative chemical analysis (volumetric and gravimetric) and its experimental limitations.	CE2 CE4 CE19 CT1 CT14
Identify and evaluate the possible interaction between concurrent reactions: acid-base, complexes, precipitation and redox.	CB5 CE2 CE18 CE19 CE20 CT7 CT9 CT12 CT14

Elaborate and interpret titration curves of acid-base, complexes, precipitation and redox and know select the most suitable indicators.	CB5 CE2 CE18 CE19 CE20 CT5 CT7 CT9 CT12 CT14
Describe the foundations of the gravimetric analysis and the factors that influence the purity of precipitates.	CE2 CE20 CT1 CT4 CT14
Carry out, in the laboratory, the precipitation and the separation by filtration in gravimetric analysis.	CE2 CE17 CE19 CE21 CE25 CE26 CE28 CT7 CT8 CT12
Use properly the gravimetric and volumetric techniques, including the suitable handling of the necessary equipment.	CB5 CE17 CE19 CE21 CE26 CE27 CT7 CT9 CT12 CT14
Handle the systematic calculation in the volumetric (direct, indirect and back titrations) and gravimetric analysis and learn how to interpret the results obtained.	CB5 CE20 CE22 CE28 CE29 CT6 CT7 CT14 CT15 CT16

Contents	
Topic	
Subject 1: Analytical Chemistry and analytical process.	The Analytical Chemistry as a metrological science. Classification of the analytical methods. The analytical process: steps. Types of analytical problems and working scales. Conceptual and technical hierarchy.
Subject 2: Evaluation of the analytical results.	Analytical properties. Errors in Analytical Chemistry: classification. Basic statistics applied to the expression of the results. Comparison and rejection of the results. Concept of traceability.
Subject 3: Introduction to the qualitative and quantitative Chemical Analysis .	Previous operations to the analysis. Sampling and sample treatment. Decomposition and dissolution. Introduction to the analytical separations. Qualitative analysis: characteristics of the binary answers. Classical quantitative analysis and instrumental. Methodologies of quantification. Calculable and relative methods.
Subject 4: Quantitative analysis: volumetric and gravimetric.	Volumetric reactions. Pattern solutions. Direct, indirect and back titrations. Formation, properties and purity of the precipitates. Calculations in volumetric and gravimetric analysis .
Subject 5: Acid-base titrations	Behaviour of monoprotic, polyprotic and amphoteric species. Titration curves. Detection of the end point: acid-base indicators. Titrant reagents. Analytical applications.
Subject 6: Complexometric titrations	Stability of the complexes. Masking reactions. Titration curves . Detection of the end point: metallochromic indicators. Analytical applications.

Subject 7: Precipitation titrations.	Factors affecting the solubility of precipitates. Titration curves. Detection of the end point: Mohr, Volhard and Fajans methods. Analytical applications.
Subject 8: Redox titrations	Factors influencing the redox potential. Titration curves. Detection of the end point: redox and specific indicators. Analytical applications.
Qualitative analysis (Laboratory)	Separation and identification of chemical species. (3 sessions) Resolution of an analytical problem by using a systematic separation procedure. (2 sessions)
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 acetylsalicycil 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. (1 session) Determination of active chlorine in a bleach sample . (1 session)

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	26	35	61
Seminars	26	39	65
Laboratory practical	42.5	12	54.5
Essay questions exam	2	9	11
Essay questions exam	3.5	16	19.5
Laboratory practice	2	6	8
Practices report	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 are theoretical classes (two hours each week) in which the professor will offer a global vision of each one of the subjects of the program, specially in the most relevant issues and in those with more difficulty for the student. Classroom sessions will develop in an interactive way with the students, commenting with them the on-line material (available in the platform Tem@) and the most adapted bibliography for the preparation, in depth, of each subject.
Seminars	Each week will be devoted two hours to seminars, in which will be solved problems and/or exercises aimed at reinforcing the knowledges acquired during the classroom sessions. In some sessions the professor will explain to the students the problems type that allow him carry out the approach and resolution of the same. Instead, in other sessions, will be the own students those that will resolve and will explain in the blackboard the exercises proposed in the bulletins (on-line material). Will be able to request to the students that deliver, of individual form, some of these exercises resolved, that will be corrected by the professor.
Laboratory practical	Students will do experiments in the laboratory, in an individual way, in 3.5 hours per session. The student will have the scripts of the practices in the platform Tem@, so that they can have a previous knowledge of the experiments to perform. 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 approved the laboratory practices in the academic year 2018-19, do not need to repeat them. In this case, marks reached in the laboratory sessions will be maintained.

Personalized assistance	
Methodologies	Description
Laboratory practical	Time devoted by the teacher to solve all doubts and queries raised by students during the course. The teacher will inform students in advance on the suitable timetable for tutorials.
Seminars	Time devoted by the teacher to solve all doubts and queries raised by students during the course. The teacher will inform students in advance on the suitable timetable for tutorials.
Tests	Description
Laboratory practice	Time devoted by the teacher to solve all doubts and queries raised by students during the course. The teacher will inform students in advance on the suitable timetable for tutorials.

Essay questions exam	Time devoted by the teacher to solve all doubts and queries raised by students during the course. The teacher will inform students in advance on the suitable timetable for tutorials.
Practices report	Time devoted by the teacher to solve all doubts and queries raised by students during the course. The teacher will inform students in advance on the suitable timetable for tutorials.
Essay questions exam	Time devoted by the teacher to solve all doubts and queries raised by students during the course. The teacher will inform students in advance on the suitable timetable for tutorials.

Assessment

	Description	Qualification	Evaluated Competencess
Laboratory practical	The teacher will carry out a follow-up the performance of students in the laboratory sessions (skills acquired). It is important to indicate that it is COMPULSORY the assistance to all the laboratory sessions.The lack of assistance, even being justified, will penalize the mark (in case of justified absences are recommended to made the practice in another group). If the number of absences is upper than 25 % of the laboratory sessions, students will not be allowed to pass the course.	15	CB5 CE1 CE2 CE4 CE17 CE18 CE19 CE20 CE21 CE22 CE25 CE26 CE27 CE28 CE29 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15 CT16
Seminars	The teacher will evaluate the exercices/problems included in the worksheets and solved by students.	15	CE1 CE2 CE4 CE18 CE19 CE22 CT4 CT5 CT6 CT7 CT9 CT14

Laboratory practice	At the end of the laboratory sessions, students will carry out a exam so that practical skills acquired can be evaluated. It is mandatory to overcome this examination to pass the practical part of the course.	15	CB5 CE28 CE29 CT1 CT3 CT6 CT7 CT9 CT12 CT13 CT15 CT16
Essay questions exam	Students will carry out a second written exam corresponding to the four last subjects of the program. This exam consists of theoretical questions and numerical exercises and it will be made the day of the final exam. Students who have not passed the exam corresponding to the first four subjects, will need to pass the examination of the whole course. In the last case, the exam will represent 50 % of the final mark .	30	CB5 CE1 CE2 CE4 CE18 CE19 CE20 CE22 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14 CT16
Practices report	During the laboratory sessions, students will elaborate a noteboodk in which reflects the experimental work performed (reactions, procedures, observations, results, etc.). This notebook will be evaluated by the professor.	5	CE20 CT1 CT3 CT6 CT9 CT12 CT14 CT15 CT16

Essay questions exam	Students will carry out a first written exam corresponding to the four first subjects of the program. This exam consits of test questions and numerical exercises. If students pass this exam, they only need to pass the examination corresponding to the rest of subjects in the final exam.	20	CB5 CE1 CE2 CE4 CE19 CE20 CE22 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14 CT16

Other comments on the Evaluation

Ordinary Announcement: 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 pass the written and laboratory examinations. Written exams will consist of theoretical or test questions and numerical exercises. To pass these exams it will be necessary to have a balance in the marks of both parts. The corresponding mark of the laboratory practices will be only taken into account once students have passed the theoretical examination. The participation of the student in any of the acts of evaluation of the course will involve the condition of presented and, therefore, the allocation of a mark. For this effect, they are considered acts of evaluation the assistance to practical laboratory sessions (three or more) and the realisation of written exams.

Extraordinary Announcement: In the July announcement the students will have to repeat the written exams (theory and/or laboratory) that have not passed in the ordinary announcement. It will be preserved the mark reached by the student, during the course, in the other activities that appear in the evaluation section, with the exception of seminars. The theoretical exam will represent 65 % of the final mark.

Sources of information

Basic Bibliography

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J. Guiteras, R. Rubio, G. Fonrodona, Curso Experimental en Química Analítica, Síntesis, 2003, Madrid

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

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M. Válcarcel, A.I. López Lorente, M.A., López Jiménez, Fundamentos de Química Analítica: una aproximación docente-discente, Universidad de Córdoba, 2016, Córdoba

J. A. López Cancio, Problemas Resueltos de Química Analítica, Thompson, 2005, Madrid

Recommendations

Subjects that continue the syllabus

Analytical chemistry II/V11G200V01503
Analytical chemistry 3/V11G200V01601

Subjects that are recommended to be taken simultaneously

Physics 3/V11G200V01301
Physical chemistry I/V11G200V01303
Organic chemistry I/V11G200V01304

IDENTIFYING DATA				
Physical chemistry I				
Subject	Physical chemistry I			
Code	V11G200V01303			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Hervés Beloso, Juan Pablo			
Lecturers	Hervés Beloso, Juan Pablo Mandado Alonso, Marcos			
E-mail	jherves@uvigo.es			
Web				
General description	Physical Chemical I is one of the first contacts of a student of Chemistry with the Physical Chemistry. This discipline studies the properties and the behaviour of the chemical systems employing the methods of the Physics. This matter presents the rigorous macroscopic treatment of chemical systems in equilibrium, systems already entered in Chemistry I. Taking advantage of the basic knowledge of the principles of the Thermodynamics, they will be applied to systems of chemical interest to obtain a quantitative description of them. For this purpose, it is fundamental to be familiarised with differential calculus in more than a variable and integral calculus in one variable, skill already seen in Mathematics II. The knowledge on the macroscopic description of the chemical systems that will be reached in this subject are complementary with the contents of the subject Physical Chemistry III the following year. The experimental applications of these knowledges will be studied in the subject of the second tern Physical Chemistry II.			

Competencies		
Code		Typology
CE6	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: principles of thermodynamics and their applications in chemistry	• know • Know How
CE18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry	• know • Know How
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• know • Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• know • Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• know • Know How • Know be
CT1	Communicate orally and in writing in at least one of the official languages of the University	• know • Know How • Know be
CT3	Learn independently	• know
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• know • Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• know • Know How
CT7	Apply theoretical knowledge in practice	• Know How
CT8	Teamwork	• Know be
CT9	Work independently	• Know How
CT12	Plan and manage time properly	• Know How
CT13	Make decisions	• Know How • Know be
CT14	Analyze and synthesize information and draw conclusions	• know • Know How
CT15	Evaluate critically and constructively the environment and oneself	• know • Know How • Know be

Learning outcomes	
Learning outcomes	Competences

Employ the concept of function of state to calculate the variations of the distinct functions of thermodynamic state of a pure substance.	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Obtain the entropy of a substance from calorimetric measures	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Establish if a process that suffers a pure substance is spontaneous or no from the calculation of the variations of the thermodynamic properties	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Handle thermodynamic tables to obtain values of the distinct functions of thermodynamic state of reaction and calculate the thermodynamic functions of reaction to distinct temperatures	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Calculate the fugacity function for a real gas from his equation of state or from experimental measures	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Calculate the thermodynamic constant of reactions in solution, from the concentrations of the species or from the thermodynamic functions	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Calculate the thermodynamic characteristics of a change of phase, and know the interval of applicability of the equations employed	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Calculate the thermodynamic properties of an ideal solution from his composition	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Calculate the colligative properties of a solution from the concentration of the solute and the properties of the dissolvent. Establish when these results can be applied to a real case	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Calculate the activities and activity coefficients of non-electrolytic solutions and employ the suitable model for the calculation of the mean ionic activity coefficient. Obtain this coefficient from experimental measures	CE6 CE18 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Employ pertinent experimental measures of the galvanic cells to determine functions of state of reaction	CE6 CE18 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Determine the activity and/or the mean ionic activity coefficient of an electrolite by means of experimental measures of EMF of galvanic cells	CE6 CE18 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Analyse the importance of the interphase and of the distinct phenomena associated to the interphase in the thermodynamic processes of the material systems	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Establish the importance of the superficial tension and the distinct processes associated in function of the nature of the system	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Differentiate between processes of physical and chemical adsorption and describe the models employed for his description	CE6 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Contents	
Topic	
The laws of the thermodynamic in Chemistry.	First Law of thermodynamics. Internal energy. Enthalpy. Heat capacities . Thermochemistry. Second law of thermodynamics. Entropy. Molecular interpretation of the entropy. Third law of thermodynamics. Calculation of the variations of entropy.
Thermodynamic functions	Gibbs Equations. Maxwell relationships. Calculation of variations of the state functions . Open systems. Partial Molar quantities. Chemical potential. Chemical potential of an ideal gas. Chemical potential of the real gases.
Phase equilibrrium in systems of one component.	Concepts of component, phase and degree of freedom. Equilibrium conditions between phases. Phases Rule. First order transitions. Clapeyron and Clausius Equations.
Ideal Solutions.	Molar partial Volume. Gibbs-Duhem Equation. Ideal solutions: Raoult law. Vapour pressure diagrams. Ideal diluted solutions: Henry Law. Colligative Properties
Non-ideal Solutions.	Deviations of the Raoult law. Activity and activity coefficient . Electrolitic solutions. Debye-Hückel theory.

Chemical equilibrium	Equilibrium conditions . Extent of reaction. Perfect gas equilibria. Equilibrium is solution reactions. Response of equilibria to temperature. Le Chatelier´s principle. Acid-base equilibria. Solubility Product. Salt effects. Electrochemical cells. Nerst Equation.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	31	57
Seminars	26	38	64
Problem and/or exercise solving	0	14	14
Self-assessment	0	10	10
Essay questions exam	5	0	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 in the brief exposition by the professor of the fundamental aspects of each subject, employing the available material in the TEMA platform. Also numerical problems will be proposed for helping to comprise and settle concepts.
Seminars	Seminar will be devoted to the resolution of problems and will deepen on those aspects that present greater difficulties to the students. These classes will be mainly a task for the students under the supervision of the professor.

Personalized assistance

Tests	Description
Self-assessment	Students will solve autonomously questionnaires-type test through the TEMA platform and will be individually tutorized by the professor.
Problem and/or exercise solving	Students will solve autonomously proposed problems and will be individually tutorized by the professor.

Assessment

	Description	Qualification	Evaluated Competencess
Self-assessment	Test type proofs in the platform TEMA.	Up to 10,0	CE6
			CE18
			CE19
			CE20
			CT3
			CT4
			CT5
			CT7
			CT9
			CT12
			CT13
			CT14
			CT15

Problem and/or exercise solving	Proposed problems for each chapter of the subject. The students will solve part of them in short tests carried out in the seminars.	Up to 15,0	CE6 CE18 CE19 CE20 CE23 CT1 CT3 CT4 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Essay questions exam	Global written exam	Minimum 75	CE6 CE18 CE19 CE20 CT1 CT3 CT4 CT6 CT7 CT9 CT12 CT13 CT14

Other comments on the Evaluation

- The student's voluntary work (self-evaluating tests + proposed problems) may constitute up to 25% of the final grade as long as the student performs at least half of the activities proposed throughout the course.

- A written test of the first half of the subject will be made. This test can eliminate material. The completion of this test is the minimum condition for the subject to be qualified.

- There will be a global written test at the end of the semester (about three hours) about all the content of the subject. This global test will involve at least 75% of the final grade. If the students have passed the written test of the first half of the subject (≥5) they may choose either the global written test exam or the second half of the subject. In the first case, the mark of the global test will be the average of the exams of the first and second half of the subject.

IMPORTANT: To pass the subject, it is mandatory to achieve a minimum score of 4 points out of 10 in the global test.

- In the following calls the previous percentages and the grades obtained in the voluntary work and in the short test carried out during the course will be maintained, except in the case of change of professor, who will be the one that establishes new norms.

Sources of information

Basic Bibliography

Complementary Bibliography

Levine, Fisicoquímica, McGraw-Hill. 5ª Ed, 2004

Atkins, Química Física, Panamerica, 8ª Ed, 2008

Engel, Química Física, Pearson, 2006

Chang, Fisicoquimica, McGraw-Hill, 2008

Rodríguez Renuncio, Termodinámica Química, Sintésis, 2ª Ed, 2000

Levine, Problemas de Fisicoquímica, McGraw-Hill, 2005
Rodríguez Renuncio, Problemas resueltos de Termodinámica Química, Sintésis, 2000
Metz, Fisicoquímica. Problemas y Soluciones, McGraw-Hill, 1991

Recommendations
Subjects that continue the syllabus
Physical chemistry II/V11G200V01403

IDENTIFYING DATA

Organic chemistry I

Subject	Organic chemistry I			
Code	V11G200V01304			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	2nd	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Iglesias Antelo, María Beatriz			
Lecturers	Iglesias Antelo, María Beatriz Muñoz López, Luis Terán Moldes, María del Carmen Vaz Araújo, Belén			
E-mail	bantelo@uvigo.es			
Web	http://secretaria.uvigo.gal/docnet-nuevo/guia_docent/index.php?centre=311&ensenyament=V11G200V01&assignatura=V11G200V01304&any_academic=2019_20			
General description	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. In this subject, students reach an understanding of the fundamental principles of Organic Chemistry, regarding organic compounds structure and reactivity. Following two lessons on general concepts, the reactivity of functional groups with multiple carbon-oxygen and carbon-carbon bonds (including aromatic compounds) is studied.			

Competencies

Code		Typology
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	• know
CE10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds	• know
CE11	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: nature and behavior of functional groups in organic molecules	• know
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	• know
CE13	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main synthetic routes in organic chemistry, including interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds	• know
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• know • Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• Know How
CE21	Recognize and implement good scientific practices for measurement and experimentation	• know • Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• know • Know How
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	• know • Know How
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work	• Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	• Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	• know • Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know How
CT3	Learn independently	• Know How
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT7	Apply theoretical knowledge in practice	• Know How
CT8	Teamwork	• Know How
CT9	Work independently	• Know How
CT12	Plan and manage time properly	• Know How
CT13	Make decisions	• know • Know How

CT14 Analyze and synthesize information and draw conclusions	• know • Know How
CT15 Evaluate critically and constructively the environment and oneself	• know • Know How

Learning outcomes

Learning outcomes	Competences
Distinguish the most usual reactions in Organic Chemistry. Relate the energetic profile to a particular reaction. Differentiate the types of reagents. Differentiate the types of reaction intermediates.	CE2 CE19 CT1 CT3 CT4 CT7 CT9 CT12 CT14
Establish the influence of the structure and the chemical features of the functional groups present in a molecule on its reactivity.	CE2 CE11 CT1 CT3 CT4 CT7 CT9 CT12 CT14
Explain the reactivity of carbonyl compounds by means of a nucleophilic addition mechanism and the reactivity of carboxylic acids and their derivatives by means of an addition-elimination mechanism.	CE2 CE10 CE11 CE13 CT1 CT3 CT4 CT7 CT9 CT12 CT14
Explain the reactivity of organic compounds with multiple carbon-carbon bonds by means of an electrophilic addition mechanism.	CE2 CE10 CE11 CE13 CT1 CT3 CT4 CT7 CT9 CT12 CT14
Explain the reactivity of aromatic compounds through an electrophilic substitution mechanism.	CE2 CE10 CE11 CE13 CT1 CT3 CT4 CT7 CT9 CT12 CT14
For each transformation, describe in detail the reaction mechanism, indicating reaction steps, transition states, intermediates etc.	CE2 CE11 CT1 CT3 CT4 CT7 CT9 CT12 CT14

Predict the result of the reaction of a specific substrate with a given reagent in specific conditions, regarding regioselectivity and stereoselectivity of the process.	CE11 CE12 CE13 CE19 CT1 CT3 CT4 CT7 CT9 CT12 CT14
Apply the rules for safety and health in laboratory work and carry out the treatment and correct elimination of the waste generated.	CE25 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14 CT15
Carry out correctly the usual experimental procedures in simple organic preparations.	CE21 CE26 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14
Carry out the work up of the reaction product, as well as its isolation and purification by means of usual techniques (extraction, distillation, recrystallization and chromatography).	CE21 CE26 CE27 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14
Write and describe appropriately the completed experiments in the laboratory notebook, so that they can be reproduced.	CE23 CE27 CE28 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14 CT15
Look for and select information regarding the subjects studied.	CE20 CT4 CT5 CT8 CT14 CT15

Contents	
Topic	
Lesson 1. Configurational stereoisomerism	Functional groups. Three-dimensional representation of organic structures. Absolute configuration of stereogenic centres, cyclic compounds and alkenes.

Lesson 2. Reactivity of organic compounds	Acid-base reactivity of organic compounds. Reaction mechanisms: stepwise reactions. Energetic profile of a reaction. Heterolytic bond cleavage. Ionic reactions. Reaction intermediates: carbanions. Redox reactivity of organic compounds. Formal states of oxidation.
Lesson 3. Addition reactions to carbon-carbon multiple bonds	Structure and general reactivity of functional groups with carbon-carbon multiple bonds: alkenes and alkynes. Hydrogenation: heats of hydrogenation and stability of alkenes and dienes; homolytic bond cleavage; concerted reactions. Electrophilic addition reactions to alkenes. Addition of HX; reaction intermediates: carbocations; regioselectivity; electrophiles and nucleophiles. Hydration reactions; orientation and stereochemistry. Addition of halogens (X2). Dihydroxylation reactions. Addition reactions to 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. Electrophilic aromatic substitution reactions in substituted systems: orientation and reactivity. Modulation of the reactivity of aromatic rings.
Lesson 5. Reactions of nucleophilic addition to the carbonyl group	Structure and general reactivity of the carbonyl group (aldehydes and ketones). General mechanism for the nucleophilic addition reaction. Non reversible nucleophilic additions: addition of organometallic compounds (alkynyl anions, organolithium and organomagnesium reagents); addition of stabilized carbanions; addition of hydride. Reversible nucleophilic additions: addition of oxygen and sulphur compounds (water, alcohols and thiols); addition of nitrogen compounds (amines and other nitrogen compounds); addition of hydrogen cyanide.
Lesson 6. Reactions of nucleophilic substitution at the carbonyl group	Structure and general reactivity of carboxylic acids and their derivatives. Relative reactivity of acid derivatives: basicity and electrophilic character. Non reversible addition-elimination reactions: leaving group. Reversible addition-elimination reactions: basic catalysis and acid catalysis. Reactions with water and alcohols; reactions with ammonia and amines. Structure and reactivity of nitriles. Reactions of nitriles.
Practice 1	Separation of organic compounds mixtures by using two techniques: acid-base extraction (liquid-liquid extraction) and chromatography. Five sessions.
Practice 2	Electrophilic addition to a double bond. One session.
Practice 3	Reduction of a ketone. One session.
Practice 4	Preparation of a hydrazone. One session.
Practice 5	Hydrolysis of an ester. One session.
Practice 6	Synthesis project. Three sessions.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	25	25	50
Problem solving	26	50	76
Laboratory practical	42	10	52
Essay	0	10	10
Essay questions exam	6	31	37

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

Methodologies

	Description
Lecturing	Exposition by the teaching staff of the syllabus' general aspects, with special emphasis in its fundamental features. The teaching staff will facilitate, through the virtual classroom, all the material needed for the student's personal work. Prior to class, the student must use this material and consult the recommended bibliography to complete the information, in order to improve his/her academic progress in the subject.
Problem solving	Two hours each week will be devoted to discussing the most prominent aspects of the topic, to solve questions arisen in the development of the lesson and to the resolution of the proposed exercises.

Laboratory practical	Laboratory experiments will be carried out, individually, in 3.5 h sessions. The students will find, in advance, in the virtual classroom, the material needed for the preparation of the experiments. At the start of each session the professor will do an exposition of the contents to be developed. During the experiments the student will elaborate a laboratory notebook recording all the observations pertinent to the experiment. At the end of the session the student will answer some questions regarding the work done.

Personalized assistance

Methodologies	Description
Problem solving	The teaching staff will attend students' queries regarding the different topics within the subject. Attention to students schedules will be available through the subject's virtual classroom and other means provided by the university. Additionally, the teaching staff will use online channels to communicate with the students (electronic mail and tools within the virtual classroom).
Tests	Description
Essay	The teaching staff will tutor the students while preparing and carrying out a short laboratory project.

Assessment

	Description	Qualification	Evaluated Competencess
Problem solving	Class participation and resolution by the student of all the problems and/or exercises proposed in time/conditions established by the teaching staff will be evaluated.	25	CE2 CE10 CE11 CE12 CE13 CE19 CE20 CT1 CT4 CT7 CT8 CT9 CT14
Laboratory practical	Assistance to practical classes is mandatory. Monitoring of laboratory work will be evaluated as APT/NO APT. The following aspects will be considered in this section: pre-lab questionnaires, development of the experimental work, laboratory notebook, final questions. In order to pass the subject it is indispensable to be evaluated as APT.	0	CE21 CE25 CE26 CE27 CE28 CT12 CT13 CT14 CT15
Essay	The student will elaborate a report prior to the execution of a short project in the laboratory during the last week of practical classes.	15	CE20 CE23 CE25 CT1 CT4 CT5 CT9 CT14

Essay questions exam	First test: 15%. It will cover contents corresponding to the first three lessons. Second test: 15%. It will cover contents corresponding to the last three lessons. Written test for the experimental part: 15%. To be taken by the students that have achieved the APT mention in the monitoring of the laboratory work. In this test, student acquisition of competences and skills related to the experimental aspects of the subject will be evaluated. Global test: 15%. In this test, student acquisition of competences and skills related to the theoretical aspects of the subject will be evaluated.	60	CE2 CE10 CE11 CE12 CE13 CE19 CT3 CT7 CT12 CT14

Other comments on the Evaluation

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

- Achieve mention **APT** in the evaluation of the laboratory work.
- Achieve a **minimum mark of 3 points out of 10** in each of the two short theoretical tests (first test and second test) and in the written test for the experimental part.
- Achieve a **minimum mark of 4 points out of 10** in the global test.

  If any of the previous conditions is not fulfilled, the final mark for the subject will be the mark obtained for the Exams (Essay questions exam) section multiplied by 0.6 (60%).

- Achieve a minimum mark of 5.0 in the weighted addition of the marks for all the sections (problem solving, essay, exams [essay questions exam]).

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.

The participation of the student in any of the acts of evaluation for the subject will involve the condition of *presentado/a* and, therefore, the assignment of a mark. The acts of evaluation that will be considered are: assistance to laboratory practices (25% or more) or the delivery of reports/exercises (25% or more) or taking any examination.

Students of 2nd and subsequent enrollment . Those students who passed the laboratory practices during the 2014-15 or 2015-16 courses or were evaluated as APT during the 2016-17, 2017-18 or 2018-19 courses will be awarded the APT mention for the monitoring of laboratory work in the academic course 2019-20, not being necessary the completion of the experimental work again. However, they must **elaborate the report of the project** (15%) and take **the written test for the experimental part** (15%) to achieve the mark for the experimental part of the subject in the academic course 2019-20.

EVALUATION IN JULY

The Exams (Essay questions exam) section can be repeated in July, in the following way:

- **Exams (45%)** . It will be carried out a global test in which the competences acquired in the theoretical aspects of the subject will be evaluated. The student must achieve a **minimum mark of 4 points out of 10** so that the result of this test will be taken into account in the global mark of the subject. This result will substitute the marks obtained for the three theoretical tests carried out during the semester (first test, second test and global test).
- **Written test for the experimental part (15%)** . A **minimum mark of 3 points out of 10** must be achieved. The new mark will substitute the one achieved in the written test for the experimental part taken at the end of the semester.

The final mark will be the weighted addition of the marks for all the sections (problem solving, essay, exams [essay questions exam]), as long as all the required minima are reached. If this is not the case, the final mark for the subject will be the mark obtained for the Exams (Essay questions exam) section multiplied by 0.6 (60%). In case that this mark was lower than the one obtained in the end of semester evaluation, the official mark will be this last one.

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 edición en español, Edicións Omega, 2007,

WADE, L.G., Química Orgánica, 9ª edición en español, Pearson-Educación, 2017, México

Complementary Bibliography

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

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-CALVO, F.: GARCÍA, J. I., Química Orgánica: Ejercicios comentados, Garceta, 2012,

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,

Recommendations

Subjects that continue the syllabus

Organic chemistry II/V11G200V01504

Organic chemistry III/V11G200V01704

Subjects that are recommended to be taken simultaneously

Physics 3/V11G200V01301

Analytical chemistry 1/V11G200V01302

Physical chemistry I/V11G200V01303

IDENTIFYING DATA				
IT tools and communication in chemistry				
Subject	IT tools and communication in chemistry			
Code	V11G200V01401			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	English			
Department				
Coordinator	Silva López, Carlos			
Lecturers	Correa Duarte, Miguel Ángel Hermida Ramón, José Manuel Pérez Juste, Ignacio Pérez Juste, Jorge Silva López, Carlos			
E-mail	carlos.silva@uvigo.es			
Web				
General description	The course aims to familiarize students with the use of chemical information sources (scientifical and technical in general) with emphasis on its use through the Internet, as well as with the use of all types of software tools for statistical calculations and chemical modeling . Attention is also paid to the acquisition of important communication skills (writing scientific and technical documents, academic, web design, etc).			

Competencies	
Code	Typology
CE20 Evaluate, interpret and synthesize data and chemical information	• Know How
CE22 Process and perform computational calculations with chemical information and chemical data	• Know How
CE23 Present oral and written scientific material and scientific arguments to a specialized audience	• Know How
CT1 Communicate orally and in writing in at least one of the official languages of the University	• Know How
CT2 Communicate at a basic level in English in the field of chemistry	• Know How
CT3 Learn independently	• Know How
CT4 Search and manage information from different sources	• Know How
CT5 Use information and communication technologies and manage basic computer tools	• Know How
CT8 Teamwork	• Know How
CT9 Work independently	• Know How
CT10 Work at a national and international context	• Know How
CT14 Analyze and synthesize information and draw conclusions	• Know How
CT15 Evaluate critically and constructively the environment and oneself	• Know How
CT16 Develop an ethical commitment	• Know How
CT18 Generate new ideas and show initiative	• Know How

Learning outcomes	
Learning outcomes	Competences
(*)Distinguish and handle the distinct sources of scientific and technical information (books, magazines, summaries, databases, pages web, patents, etc.).	CE23 CT1 CT2 CT4 CT5 CT9 CT14 CT16
(*) Differentiate and classify the scientific magazines and the contributions to the same, respect to their thematic, aim and scope.	CT2 CT4 CT5 CT8 CT9 CT14

(*) Find and absorb information in a fast and effective way.	CE23 CT1 CT2 CT3 CT5 CT8 CT9 CT10 CT15 CT18
(*) Resume and classifiy the information for its effective broadcasting.	CE23 CT1 CT2 CT5 CT8 CT10 CT16
(*) Argue the own opinions showing critical sense.	CE23 CT1 CT2 CT5 CT8 CT10 CT16
(*) Performd simple written documents for the diffusion of knowledges and the scientific and technical results (p.ej. Articles, reports, works).	CE23 CT1 CT2 CT5 CT8 CT10 CT16
(*) Handle with critical spirit the network (""""internet"""") as an information source.	CE22 CT3 CT5 CT9 CT14 CT16
(*) Perform academic oral presentations on subjects related with the Chemistry, using audiovisual media.	CE23 CT1 CT2 CT14 CT18
(*) Organise the bibliography, with or without help of bibliographic tools.	CE20 CT3 CT4 CT5 CT9 CT14 CT15
(*) Use computer programs for the preparation of figures and charts.	CE22 CT4 CT5 CT9
(*) Comprehend the basic principles and utility of simulation programs of chemical processes.	CE22 CT5 CT9 CT14
(*) Comprehend and explain texts in English related with Chemistry.	CE23 CT1 CT2 CT3 CT8
(*) Draft simple documents and perform short oral presentations in English, on subjects related with Chemistry.	CE23 CT1 CT2 CT3 CT8 CT14

(*) Identify the most important programs of molecular modelling and understand the usefulnes of the results obtained.	CE20 CT3 CT4 CT14

Contents	
Topic	
The scietific literature: general aspects.	Structure and classification of the literature. General rules of a literature search. Function, organization and use of a scientific library.
Information Sources	Books. Journals. Technical reports. Conference Proceedings. Patents. Thesis. Government Publications. Standards. Videos. Dictionaries. Directories Encyclopedias Databases
Using Internet	Basic Internet services. Remote connection and file transfer utilities. Search engines. Electronic lists and subscription services. Other services. Structure, function and design of web pages.
Indexing and abstracting services	Identification of a scientific paper. The ISI Web of Knowledge (WOK). The Chemical Abstract Service (CAS) and the Scifinder. Other abstracting services. Handbooks.
Bibliographic Managers	Classification of bibliographic references: general principles. Use of popular software packages: Refworks and Endnote as examples.
Preparation of a scientific, technical or academic document	Parts of a scientific document. References, tables and figures : general principles. Use of computer templates. General aspects of the scientific style and the use of English. How to write: CVs, progress reports, grant requests and other academic documents.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	14	28	42
Computer practices	26	52	78
Problem solving	2	22	24

Essay questions exam	1.5	4.5	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	The theoretical aspects of the subject are presented
Computer practices	Computer lab exercises: literature searches, use of bibliographic managers, use of statistical packages, report writing.
Problem solving	Report or article writing in English language. Simple exercises with modelling software

Personalized assistance

Methodologies	Description
Computer practices	Hands-on exercises in a computer laboratory
Problem solving	Monitored problem solving tasks

Assessment

	Description	Qualification	Evaluated Competencess
Computer practices	Typically, literature searches	20	CE22 CE23 CT1 CT2 CT3 CT4 CT5 CT9 CT15 CT16
Problem solving	Tipically, database searches and use of utilities of modelling software.	40	CE22 CE23 CT1 CT2 CT3 CT4 CT5 CT8 CT10 CT14 CT15 CT18
Essay questions exam	Written exam consisting of short questions.	40	CT1 CT2 CT14 CT15

Other comments on the Evaluation

Attendance at practical lectures (seminars) is compulsory. The student will be given a rating (0-10) as long as he/she has attended 3 or more seminar sessions, has delivered at least two reports on the exercises or practices proposed by the teacher or has done a written exam.

If the student fails in the first call he/she will be asked to improve some of the exercises or perform new ones provided by the teacher. In addition he/she will have to undergo a more thorough exam, which will weight 50% of the final grade.

Sources of information

Basic Bibliography

Complementary Bibliography

Douville, J.A., The literature of chemistry, 1st, American Library Association
Kaplan, S.M., The English-Spanish Spanish-English dictionary of chemistry, 2ª, Wiley, 2014
Day, R.A.; Gastel, B., How to write and publish a scientific paper, 7ª, Cambridge Univ. Press, 2011

Recommendations

Subjects that are recommended to be taken simultaneously

Numerical methods in chemistry/V11G200V01402
Physical chemistry II/V11G200V01403
Inorganic chemistry I/V11G200V01404

IDENTIFYING DATA				
Numerical methods in chemistry				
Subject	Numerical methods in chemistry			
Code	V11G200V01402			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Galician			
Department				
Coordinator	Besada Morais, Manuel			
Lecturers	Besada Morais, Manuel Estévez Guiance, Laura Pena Pereira, Francisco Javier			
E-mail	mbesada@uvigo.gal			
Web				
General description	"Machine translation into english of the original teaching guide" This matter is the mathemetical practical version of application to observed data and of numerical solution of numerous problems that have difficult, or impossible, analytical solution. It will allow to the student to obtain skills to handle big amounts of numerical information and consolidate the handle of a scientific calculator of big power.			

Competencies		
Code		Typology
CB3	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	• know • Know How
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	• know • Know How
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• know • Know How
CE22	Process and perform computational calculations with chemical information and chemical data	• know • Know How
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	• know • Know How
CT3	Learn independently	• know • Know How
CT4	Search and manage information from different sources	• know • Know How
CT5	Use information and communication technologies and manage basic computer tools	• know • Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• know • Know How
CT7	Apply theoretical knowledge in practice	• know • Know How
CT9	Work independently	• know • Know How
CT12	Plan and manage time properly	• know • Know How
CT13	Make decisions	• know • Know How
CT14	Analyze and synthesize information and draw conclusions	• know • Know How

Learning outcomes	
Learning outcomes	Competences
Use the numerical and symbolic packages of **MATLAB.	CE22 CE29 CT5

Control distinct bases of numbering and *enterarse of the existence of errors committed in the approximations	CB3 CE29 CT6 CT9 CT13 CT14
Look for approximations of roots of equations of a variable and systems of equations.	CB3 CB5 CE19 CE22 CE29 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14
Use *polynomials that adjust to several points of the plane.	CB3 CB5 CE19 CE22 CE29 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14
Derive and integrate numerically, relate these numerical and analytical concepts and understand the because of his need.	CB3 CB5 CE19 CE22 CE29 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14
Handle adjust of data to distinct types of curves of previous election by means of computer packages.	CB3 CB5 CE19 CE22 CE29 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14

Contents	
Topic	
Subject 1. *Introduction the analysis **numerica.	Systems of numbering Need of the numerical methods. *Fontes And analysis of the error. Available *software.

Subject 2. Approximation of roots of equations of a variable.	*Condicionamiento Of the calculation of roots. Methods of separation of roots- Method of the *bisection. Method of Newton-**Raphson. *Theorem of the point did.
Subject 3. *Numerical interpolation.	The general problem of *interpolation. *Interpolation of *Lagrange. Error of *interpolation and excellent election of *nodes. *Interpolation **polinomial.
Subject 4. It adjust of curves.	It adjust of data. Straight of regression by square minima. Approximation of functions by square minima. *Interpolation **polinomial to *pieces.
Subject 5. Derivation And numerical integration.	Diagrams of *derivación numerical *based in *interpolation. Formulas of *derivación *finite. Error of *derivación. Formulas of integration with *polynomial *interpolation. Error of integration. Formulas of *quadratures.
Subject 6. Optimization.	Direct methods of solving optimization problems. One Variable. Several variables. Without restrictions. With restrictions.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	13	26	39
Computer practices	26	52	78
Objective questions exam	4	12	16
Problem and/or exercise solving	2	8	10
Essay	0	7	7

*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 of the theoretical bases and orientation by part of the *profesorado on the contents of the matter
Computer practices	Development in the classrooms of computing of the exercises that propose in the theoretical classrooms using the scientific calculator **MATLAB.

Personalized assistance

Methodologies	Description
Computer practices	The students will work of autonomous way with the permanent supervision of the professor

Assessment

	Description	Qualification	Evaluated Competencess
Computer practices	At the end of the sessions in the classrooms of computing, the student will resolve some exercises of the even type that the ones of the realised in the classroom.	25	CE19 CE22 CE29 CT6
Objective questions exam	During the course will realise **alomenos three partial proofs short type test and practical type that will explain a 25 by one hundred in the final qualification. Besides, in a final proof, will realise another tests type test of **tódala matter that *contabilizará another 10 by one hundred in the final qualification.	35	CE19 CE22 CE29 CT6
Problem and/or exercise solving	When finalising the course **realizaráse a practical proof resolving some practical exercises in the classroom of computing	30	CE19 CE22 CE29 CT6
Essay	**Participacion With *aprovechamiento in all the activities proposed by the *profesorado, are these to realise inside or out of the classroom.	10	CE19 CE22 CE29 CT6

Other comments on the Evaluation

Students who do not pass the subject in the ordinary session and intend to do so in the extraordinary call, will maintain the qualifications obtained during the course in each of the previous sections, except for the qualifications of the practical tests of computer science, that can be recovered, and the two tests carried out. At the end of the course they will be evaluated in

the corresponding exam. In this case, the student must contact the professor in sufficient time to agree on the work to be done before the final tests.

The participation of the student in any of the assessment acts of the subject will entail the condition of "presented" and, therefore, the assignment of a qualification. Evaluation acts are considered as assistance to computer science practices (four or more), the carrying out of a test or the delivery of a minimum of 25% of the problems or exercises entrusted by the teacher.

The three partial assessment tests will be on February 21, March 2 and April 30. The final test will be held on May 21st.

Sources of information
Basic Bibliography
Chapra, S.C.; Canale, R.P., Métodos numéricos para ingenieros. Sexta edición., 2015, McGraw-Hill, 2015, McGraw-Hill
Besada, M., MATLAB: todo un mundo, 2007, Servizo de publicacións da Universidade de Vigo
Bober, W.; Tsai, C.; Masory, O., Numerical and Analytical Methods with Matlab, 2009, CRC Press, CRC Press
Complementary Bibliography

Recommendations

IDENTIFYING DATA				
Physical chemistry II				
Subject	Physical chemistry II			
Code	V11G200V01403			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	2nd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Mosquera Castro, Ricardo Antonio Fernández Nóvoa, Alejandro			
Lecturers	Fernández Nóvoa, Alejandro Gómez Graña, Sergio Mosquera Castro, Ricardo Antonio Pastoriza Santos, Isabel Pérez Juste, Jorge			
E-mail	mosquera@uvigo.es afnovoa@uvigo.es			
Web				
General description	Application of the principles and methods of Quantum Mechanics to the study of molecular structure and spectroscopy.			

Competencies		
Code		Typology
CE3	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: principles of quantum mechanics and its application in the description of the structure and properties of atoms and molecules	• know • Know How
CE6	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: principles of thermodynamics and their applications in chemistry	• know • Know How
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	• know • Know How
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• know • Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• know • Know How
CE21	Recognize and implement good scientific practices for measurement and experimentation	• know • Know How
CE22	Process and perform computational calculations with chemical information and chemical data	• know • Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• know • Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	• know • Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	• know • Know How
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	• know • Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• know • Know How
CT3	Learn independently	• know • Know How
CT4	Search and manage information from different sources	• know • Know How
CT5	Use information and communication technologies and manage basic computer tools	• know • Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• know • Know How
CT7	Apply theoretical knowledge in practice	• know • Know be
CT8	Teamwork	• Know be
CT9	Work independently	• Know be
CT12	Plan and manage time properly	• Know be

CT13 Make decisions	• know • Know be
CT14 Analyze and synthesize information and draw conclusions	• know
CT15 Evaluate critically and constructively the environment and oneself	• Know be

Learning outcomes

Learning outcomes	Competences
Formulate molecular Hamiltonians, with use of the Born-Oppenheimer approximation and discussion of their consequences.	CE3 CE20 CE22 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14
Work with potential energy profiles and surfaces and understand related concepts.	CE3 CE19 CE20 CE22 CE28 CE29 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14
Apply MO and EV methods for describing the chemical bond in simple systems and understand the limitations of these methods.	CE3 CE8 CE19 CE20 CE21 CE22 CE23 CE27 CE28 CE29 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14 CT15
Describe orbital localization techniques and the basis for atomic orbital hybridisation.	CE3 CT1 CT3 CT4 CT6 CT9

Apply, with understanding of their foundations and their limitations, the main calculation methods (HF, DFT, post-HF) for the study of molecular structures.	CE3 CE19 CE20 CE22 CE23 CE28 CE29 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14
Describe the forms of radiation-matter interactions and formulate the selection rules of electrical dipole.	CE8 CT1 CT3 CT4 CT6 CT9
Relate the radiation frequency with the molecular motion responsible of a spectroscopic transition.	CE8 CT1 CT3 CT4 CT6 CT7 CT9
Justify the broadening of spectral lines and the enviromental effects on different spectra.	CE8 CT1 CT3 CT4 CT6 CT9
Interpret rotation and vibration-rotation spectra to obtain structural information, making use of simple quantum-mechanical models (rigid and flexible rotor and harmonic and anharmonic oscillators), selections rules and line assignment techniques.	CE3 CE8 CE19 CE20 CE22 CE23 CE27 CE28 CE29 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14
Discuss the Franck-Condon principle and its consequences.	CE3 CE8 CT1 CT3 CT4 CT6 CT9

Interpret electronic and photoelectronic spectra and obtain structural information.	CE3 CE8 CE19 CE22 CT1 CT3 CT4 CT5 CT6 CT7 CT9
Describe the different deactivation processes of excited electronic states and their representation in a Jablonski diagram.	CE8 CE19 CT1 CT3 CT4 CT6 CT9
Describe the foundations of magnetic resonance spectroscopies, and interpret the physical origin of chemical shifts and couplings in NMR spectra.	CE8 CE19 CE22 CT1 CT3 CT4 CT6 CT9
Describe the instrumental peculiarities of the spectroscopic techniques in different spectral regions, as well as the foundations and applications of laser and Fourier-transform based techniques.	CE8 CT1 CT3 CT4 CT6 CT9
Apply the theoretical knowledge of Physical Chemistry I to determine experimentally chemical equilibrium constants, activity coefficients and thermochemical magnitudes.	CE6 CE19 CE20 CE21 CE23 CE27 CE28 CE29 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
New	

Contents	
Topic	
Introduction to group symmetry theory in chemistry	- Symmetry elements and operations. - Symmetry point groups. - Matrix representations. - Irrdeducible Representations. Character tables. - Chemical applications.
Qualitative spects of molecular electronic structure.	- Born-Oppenheimer approximation. - The H2+ molecule. - The MO method for homonucler and heteronuclear diatomic molecules. - The MO method in polyatomic molecules. - The VB method.

Quantitative treatments for the study of the molecular electronic structure.	- Hartree-Fock method. - post-Hartree-Fock methods. - Semiempirical methods. - Calculation of molecular properties
Introduction to Molecular Spectroscopy.	- Radiation-matter interaction: General approach. - Transition dipole moment integral. Selection rules. - Intensity and position of the spectral transitions. - Instrumentation.
Rotational spectroscopy.	- Pure rotation spectra of diatomic molecules. Rigid and elastic rotor models. - Pure rotation spectra of polyatomic molecules. - Pure rotation Raman spectra. - Instrumentation and applications.
Spectroscopy of Vibration-rotation.	- Vibration-rotation spectra of diatomic molecules. Harmonic and anharmonic oscillator models with rotation depending on vibration. - Vibration-rotation spectra of polyatomic molecules. - Vibration-rotation Raman spectroscopy. - Instrumentation and applications.
Electronic spectroscopy.	- Molecular Electronic states. - Vibration-rotation structure: Franck-Condon principle - Chromophore and auxochrome Groups. - Electronic deactivation Processes. - Instrumentation and applications. - Lasers. - Photoelectron Spectroscopy and related techniques.
Spectroscopies of Resonance.	- Introduction to the magnetic resonance. - Chemical shift. - Spin-spin interaction. Coupling Constant. - Electronic spin resonance Spectroscopy.
Practices of Chemical Thermodynamics (six sessions)	- Experimental determination of chemical equilibrium constants employing spectroscopic or potentiometric techniques. - Experimental determination of combustion, dissolution, neutralisation, fusion or vaporisation enthalpies. - Colligative Properties. - Experimental determination of activity coefficients employing potentiometric techniques.
Practices of Quantum Chemistry and Spectroscopy (seven sessions).	- Computational study of the electronic structure of different molecules - Computational Study of conformational isomery. - Computational study of simple chemical processes. - Prediction, theoretical interpretation and resolution of the vibration-rotation spectrum of HCl in gas phase. - Electronic spectroscopy: Spectrum of the I2 molecule in gas phase.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	39	65
Seminars	26	39	65
Laboratory practical	42	0	42
Autonomous problem solving	0	12	12
Essay questions exam	4	8	12
Practices report	0	9	9
Problem and/or exercise solving	4	8	12
Objective questions exam	0	4	4
Laboratory practice	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
Lecturing	They will consist in the presentation of the fundamental aspects of each subject by the teacher, using the material available in the TEM@ platform (diagrams, bulletins of problems, ...). In addition, numerical problems will be proposed for a better understanding of theoretical concepts.
Seminars	The classes of seminar will be mainly work of the student, under the supervision of the professor, and will be used for: - Problems solving, individually or by groups. - Once the student has worked the basic concepts, reinforce those contents of each subject that can present a greater complexity.

Laboratory practical	Completion of laboratory or computational chemistry practices under the supervision of a teacher in an autonomous way. Lab practices will be done by pairs in sessions of 3,5 hours. With advance enough, students will have in the TEM@ platform guide notes for the practices together with all the additional neccessary material. Guide notes will present the essential elements to realise the experimental or computational practices, as well as the fundamental theoretical points and further data treatment. After practice completion, in the terms set by the teacher, it will be necessary to deliver the corresponding report, elaborated following the guidelines given by the teacher.
Autonomous problem solving	For each one of the subjects, some problems or other works to be solved by the student and delivered to the teacher in due time will be proposed.

Personalized assistance

Methodologies	Description
Lecturing	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Seminars	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Laboratory practical	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Autonomous problem solving	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Tests	Description
Essay questions exam	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Practices report	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Problem and/or exercise solving	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Objective questions exam	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Laboratory practice	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).

Assessment

Description	Qualification	Evaluated Competencess

Laboratory practical	This mark comprises the effort and the attitude, the skills and the competitions developed by the student during the realisation of the laboratory practices.	ata 10,0	CE3 CE6 CE8 CE19 CE20 CE21 CE22 CE27 CE28 CT1 CT4 CT5 CT6 CT7 CT8 CT12 CT13 CT14 CT15
Autonomous problem solving	For each one of the subjects or groups of subjects, problems or additional work to be done by the students will be proposed.	ata 3,75	CE3 CE8 CE19 CE20 CE22 CE23 CT1 CT3 CT4 CT5 CT6 CT9 CT12 CT13 CT14 CT15
Essay questions exam	Realisation of one global writing test at the end of the term, in a date set by the Faculty of Chemistry.	como mínimo 33,75	CE3 CE8 CE19 CE20 CE22 CT1 CT3 CT6 CT9 CT12 CT14 CT15

Practices report	Students must present a report for a laboratory practice proposed by the teachers. Students have to take care on format aspects related to the organisation, the correct use of the units, and the correct preparation of graphics and exhibition of the results. It will be also evaluated the critical analysis of results and getting right conclusions. Besides, all the practices will be evaluated by means of oral questions that the students can answer with the help of their laboratory notebook.	ata 5,0	CE3 CE6 CE8 CE19 CE20 CE22 CE23 CE27 CE28 CE29 CT1 CT3 CT4 CT5 CT6 CT8 CT9 CT12 CT14
Problem and/or exercise solving	Realisation of one writing test (liberatory) at the middle of the term, in date set by the Faculty of Chemistry.	ata 33,75	CE3 CE8 CE19 CE20 CE22 CT1 CT3 CT6 CT9 CT12 CT14 CT15
Objective questions exam	For each each subject or group of subjects the student will have the opportunity of answer quiz tests through the TEM@ platform.	ata 3,75	CE3 CE8 CE19 CT3 CT4 CT6 CT7 CT9 CT12 CT14 CT15

Laboratory practice	This written proof will be done in the date fixed by the Faculty of Chemistry and about the contents and skills that the student has to have purchased during the development of the laboratory practices. The questions will be situated, in some cases, in the context of some of the experiences realised by the student and, in others, will be more general. These questions will be used to evaluate the capacity to solve the problems presented.	ata 10,0	CE3 CE6 CE8 CE19 CE21 CE22 CE28 CE29 CT1 CT3 CT4 CT6 CT7 CT9 CT12 CT13 CT14 CT15

Other comments on the Evaluation

The evaluation of the course will take into account the part mentioned above, with distinction between the theoretical and the practical parts of the subject.

Theoretical part:

The evaluation will suppose, in his group (proofs (90%), problems solving (5%), quiz-tests (5%)), 75% of the final qualification of the subject. 2 proofs will be done during the course.

If the student passes the first proof (it will take place around the midle of the 4-months periode, he/she could only answer the questions related to the second part of the subject. Proofs qualification will be the average of the two proofs. When the first proof is repeated the best qualification is the only one to be used for the average,

It is required to pass the subject to obtain in the long proof a minimum qualification of 4,0 on 10,0 points. In the case of not reaching this punctuation the qualification that will reflect in the record will be not larger than 4,0.

Besides, it will be necessary to obtain an average of 2,5 in the theoretical questions of the examinations (short and long proofs). If it did not reach this punctuation the note reflected in the record will not surpass 4,0.

Practical part:

The evaluation will contribute, in his group (practices of laboratory (40%), reports and oral questions(20%) and proof written of practices (40%)), 25% to the final qualification of the matter.

It is indispensable requirement to surpass the matter to obtain in the practical part a minimum qualification of 5,0 on 10 points. In the case of not reaching said punctuation the qualification that will reflect in the record will not be able to surpass 4,0.

The assistance to the practical sessions is compulsory (absences to sessions should be properly justified) and, therefore, is not possible to approve the matter in the case of not to have them realised.

Condition of presented/no presented:

The realisation of the global proof, or of the proof written of practices, or the assistance to five sessions of laboratory, will involve the condition of presented/to and, therefore, the allocation of a qualification.

Second Opportunity:

For the evaluation in the second opportunity, will keep the qualifications and the percentages of the problems/works proposed, of the practices of laboratory and the corresponding reports and of the quiz-tests. In the case to have an equal or upper qualification to 5,0 points in the global proof (long) or the same or upper to 5,0 in the proof written of practices, will keep said qualification (and the percentage) and only will be necessary to realise to another.

Sources of information

Basic Bibliography

Complementary Bibliography

BERTRÁN RUSCA, J.; NÚÑEZ DELGADO, J., """"Química Física"""" (vol. I), 1ª edicion, Editorial Ariel (2002)

BERTRÁN, J.; BRACHANDELL, V.; MORENO, M.; SODUPE, M., """"Química Cuántica"""", 2ª edición, Editorial Síntesis (2002).

ATKINS, P. W.; DE PAULA, J., Química Física, 8ª edición, Editorial Médica Panaméricana

Recommendations

Subjects that are recommended to be taken simultaneously

IT tools and communication in chemistry/V11G200V01401
Numerical methods in chemistry/V11G200V01402
Inorganic chemistry I/V11G200V01404

Subjects that it is recommended to have taken before

Physics 3/V11G200V01301
Physical chemistry I/V11G200V01303

IDENTIFYING DATA				
Inorganic chemistry I				
Subject	Inorganic chemistry I			
Code	V11G200V01404			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	García Bugarín, Mercedes			
Lecturers	Castro Fojo, Jesús Antonio García Bugarín, Mercedes García Fontán, María Soledad García Martínez, Emilia Rodríguez Arguelles, María Carmen			
E-mail	mgarcia@uvigo.es			
Web				
General description	"Machine translation into english of the original teaching guide" In this asignatura studies the chemistry of the elements of the main groups and his compounds. It pretends give an overview of the different types of chemical behaviour and of the existent compounds			

Competencies		
Code		Typology
CE1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.	• know
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	• know
CE9	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: characteristic properties of the elements and their compounds, including group relationships and variations in the periodic table	• know
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	• know
CE14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules	• know
CE20	Evaluate, interpret and synthesize data and chemical information	• Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• Know How
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	• Know How
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work	• Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	• Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	• Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know How
CT3	Learn independently	• Know How
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• Know How
CT7	Apply theoretical knowledge in practice	• Know How
CT8	Teamwork	• Know How
CT9	Work independently	• Know How
CT12	Plan and manage time properly	• Know How
CT13	Make decisions	• Know How
CT14	Analyze and synthesize information and draw conclusions	• Know How
CT15	Evaluate critically and constructively the environment and oneself	• Know How

Learning outcomes	
Learning outcomes	Competences

Distinguish the different chemical behaviour of the elements of the main groups inside each group.	CE1 CE2 CE9 CT1 CT3 CT4 CT9
Choose the general method more adapted for the obtaining of the elements of the main groups from his present compounds in the nature.	CE1 CE2 CE9 CT1 CT3 CT4 CT9
Identify in each group of elements of the main groups those types of singular compounds and of particular importance by his structure or his reactivity.	CE1 CE2 CE9 CE12 CE14 CT1 CT3 CT4 CT9
Deduce the physical properties of a compound from the type of link between his components and his structure.	CE9 CE12 CE14 CE20 CE23 CT1 CT3 CT4 CT9
Relate the physical and chemical properties of the elements of the main groups and of his compounds with his applications.	CE2 CE9 CE12 CE14 CE23 CT1 CT3 CT4 CT9
Carry out in the laboratory the preparation and the study of some physical and chemical properties of elements of the main groups and of his compounds.	CE25 CE26 CE27 CE28 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Contents	
Topic	
1. Hydrogen	Obtaining. Physical and chemical properties. Hydrides: classification and general study of the same. The water.
2. The Nobel gases	General characteristics. Properties and uses. Fluorides of xenon. Combinations of xenon with oxygen.
3. The Halogens	General characteristics. Obtaining, properties and reactivity. Halides. Oxides, oxoácidos and oxosales. Compound interhalógenos and ions polihalogenuro. Pseudohalógenos. Fluorocarbonos.

4. Elements of the group 16	General characteristics. Specific study of the oxygen. Obtaining, properties and reactivity. Peroxide of hydrogen. Sulphur. Obtaining, properties and reactivity. Combinations hydrogenated and halogenadas of the sulphur. Oxides, oxoácidos and oxosales of sulphur.
5. Elements of the group 15	General characteristics. Obtaining, properties and reactivity. Combinations hydrogenated and halogenadas. Oxides, oxoácidos and oxosales of nitrogen and phosphorus. Arsenic and bismuth.
6. Elements of the group 14	General characteristics. Carbon. Obtaining, properties and reactivity. Oxides and carbonates. Carbides. Combinations halogenadas and nitrogenous. Silicon, germanium, tin and lead. Obtaining, properties and reactivity. Hydrides and halides. Oxides. Silicates. Silicones.
7. Elements of the group 13	General characteristics. Boron. Obtaining, properties and reactivity. Hydrides and halides. Composed with nitrogen. Oxides, oxoácidos and oxosales. Aluminium. Obtaining, properties and reactivity. Chemistry in aqueous dissolution of the ion aluminium. Hydrides, halides and oxides. Compounds more important of gallium, Indian and talio.
8. Elements of the group 1	Physical and chemical properties. Reactivity. Obtaining. Compounds more important.
9. Elements of the group 2	Physical and chemical properties. Reactivity. Obtaining. Compounds more important.
Practice 1-2	Study of the chemical properties of the oxides.
Practice 3-4	Obtaining and chemical behaviour of the halogens.
Practice 5-6	Obtaining and reactivity of compounds of the group 16.
Practice 7-8	Obtaining and reactivity of compounds of the group 15.
Practice 9	Obtaining and reactivity of compounds of the group 14.
Practice 10-11	Obtaining and reactivity of compounds of the group 13.
Practice 12	Practice to determine

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	15	41
Problem solving	26	23	49
Laboratory practical	42	6	48
Essay questions exam	4	70	74
Laboratory practice	3	10	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	Exhibition by part of the professor on the subject to develop, doing special emphasis in the most important appearances or of difficult understanding for the student. The professor to will use the platform Tem@ to give information on the matter or on his development.
Problem solving	They will devote two weekly hours to argue and resolve questions on the matter that previously the student will have to work.
Laboratory practical	The experiments will realise along 12 sessions of 3,5 hours each one. The student will have of the scripts of practices as well as of the material of support in the platform tem@ with the end that it can have previous knowledge of the experiments to realise. The student will have to elaborate the fascicle of laboratory during the realisation of the practices.

Personalized assistance

Methodologies	Description
Problem solving	

Assessment

Description	Qualification	Evaluated Competences

Problem solving	It will value the resolution by part of the student of a series of problems and/or exercises proposed in the time/condition established by the professor. The punctuation will be considered if in each one of the eliminatory proofs reaches an equal or upper qualification to 5 points on 10.	15	CE1 CE2 CE9 CE12 CE14 CE23 CT1 CT3 CT4 CT6 CT7 CT9 CT13
Laboratory practical	It is compulsory the assistance to the sessions of laboratory. The professor will realise a follow-up of the experimental work realised by the student in the sessions of laboratory, as well as of the fascicle elaborated (10%). It will realise a proof that will allow to evaluate the competitions and skills purchased by the student (15%). The punctuation will be considered if in each one of the eliminatory proofs reaches an equal or upper qualification to 5 points on 10.	25	CE25 CE26 CE27 CE28 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Essay questions exam	2 Proofs on concrete appearances of the contents explained in class and seminars. Each proof will be able to be eliminatory when the student reach a minimum qualification of 5 points on 10. To be able to approve the matter, the student will have to reach in each one of the eliminatory proofs a minimum qualification of 5 points on 10.	60	CE1 CE2 CE9 CE12 CE14 CE20 CT1 CT6 CT7

Other comments on the Evaluation

The assistance to the theoretical classes, practices of laboratory and seminars is compulsory. The participation of the student in any of the acts of evaluation of the matter will involve the condition of presented and, therefore, the allocation of a qualification. They consider acts of evaluation the assistance to the practical classes of laboratory (three or more) and the realisation of proofs. The students will be able to realise a Final Proof, that will be able to have a value of until a 60 %, in the date of closing of evaluation of the announcement of May-June when they require: - Surpass any of the eliminatory proofs. - Go up the note of the eliminatory proofs that allow him reach the minima required to approve the matter. - Go up the note in the eliminatory proofs to improve the final note of the matter.

Announcement of Julio. The students that do not surpass the matter at the end of the cuatrimestre will have to do a proof written in the period of closing of evaluation of the announcement of July. Said proof will substitute the results of the eliminatory proofs realised along the cuatrimestre and will have a value of until a 60 %. The qualification of resolution of problems and practical of laboratory obtained to along the cuatrimestre keeps .

Sources of information

Basic Bibliography

RAYNER-CANHAM, G., Química Inorgánica Descriptiva, 2.ª Ed, Pearson Education, 2000
SHRIVER & ATKINS, Química Inorgánica, 4º ed., McGraw-Hill, 2008

Complementary Bibliography

ATKINS, P.; OVERTON, T.; ROURKE, J.; WELLER, M. Y ARMSTRONG, F., Inorganic Chemistry, Fifth Edition, Oxford, University Press, 2010
HOUSE, J. E., Inorganic Chemistry, 2ª Ed, Elsevier. Burlinfton, 2013
HOUSECROFT, C.E. Y SHARPE, A. G., Inorganic Chemistry, 3ª Ed, Pearson. Harlow, 2013
HOUSECROFT, C. E. ; A. G. SHARPE., Química Inorgánica, 2.ª Ed (español), Pearson- Prentice Hall, 2006
RAYNER□CANHAM, G., OVERTON, T., Descriptive Inorganic Chemistry, 6ª Ed, W.H. Freeman, 2014

Recommendations

Subjects that are recommended to be taken simultaneously

IT tools and communication in chemistry/V11G200V01401
Numerical methods in chemistry/V11G200V01402
Physical chemistry II/V11G200V01403

IDENTIFYING DATA				
Structural Determination				
Subject	Structural Determination			
Code	V11G200V01501			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Álvarez Rodríguez, Rosana			
Lecturers	Álvarez Rodríguez, Rosana Castro Fojo, Jesús Antonio Vaz Araújo, Belén			
E-mail	rar@uvigo.es			
Web				
General description	The subject devotes to learning the application of the methods used in the structural determination of chemical compounds			

Competencies		
Code		Typology
CB1	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	• know
CB2	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	• Know How
CB3	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	• Know How • Know be
CB4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences	• Know How • Know be
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances	• know • Know How
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	• know • Know How
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	• know • Know How
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• Know How • Know be
CE24	Recognize and analyze new problems and plan strategies to solve them	• Know How • Know be
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know How • Know be
CT3	Learn independently	• Know How • Know be
CT4	Search and manage information from different sources	• Know How • Know be
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT7	Apply theoretical knowledge in practice	• Know How • Know be
CT8	Teamwork	• Know be
CT9	Work independently	• Know How • Know be
CT12	Plan and manage time properly	• Know be
CT13	Make decisions	• Know be
CT14	Analyze and synthesize information and draw conclusions	• Know How • Know be
CT15	Evaluate critically and constructively the environment and oneself	• Know be
CT16	Develop an ethical commitment	• Know be

Learning outcomes	
Learning outcomes	Competences

Describe the fundamental concepts of the methods for structural elucidation	CB1 CE4 CE8 CE12
Analyse the information that the different methods offer on the molecular structure elucidation, and understand their advantages and limitations.	CB2 CB3 CE8 CE12 CE20 CT3 CT4 CT7 CT8 CT9 CT14
Predict the basic features of a given spectrum for a particular compound.	CB2 CB3 CE4 CE8 CE12 CE20 CT3 CT4 CT7 CT9 CT14
Understand the information provided by the different methods of X-ray diffraction.	CB2 CB3 CE4 CE12 CT3 CT4 CT9 CT13 CT14 CT15 CT16
Design the rational process to obtain key structural information of a chemical compound.	CB2 CB3 CE4 CE8 CE24 CT3 CT4 CT7 CT9 CT13 CT14
Determine the molecular structure of a simple compound from the analysis of its spectroscopic data (IR, UV, MS, NMR, etc.).	CB2 CB3 CB4 CE4 CE8 CE12 CE19 CE20 CT1 CT3 CT4 CT5 CT7 CT9 CT12 CT14 CT16
Observe the presence of defects and disorder in solids.	CB1 CE4

Contents	
Topic	
Chapter 1. Obtaining general data of a chemical compound.	Combustion Analysis: empirical formula. Qualitative analysis. Optical Properties.
Chapter 2. Structural determination of crystalline samples.	Applications and limitations of the difractometric techniques in structural determination. Three-dimensional determination of the molecular structure. Defects and disorders in crystalline solids.
Chapter 3. Electronic and photoelectronic spectroscopy.	Determination of the chromophore groups. Effect of conjugation. Study of the valence shell MOs.
Chapter 4. Vibrational Spectroscopy.	Determination of the presence of characteristic functional groups. Other applications in structural determination.
Chapter 5. Mass Spectrometry.	Determination of the molecular mass. Ionisation techniques. Detection methods. Fragmentation reactions. Isotopic patterns. Interpretation of the mass spectra.
Chapter 6. NMR Spectroscopy.	Monodimensional experiments of 1H and 13C Structural information from the chemical shift. Two-dimensional experiments. Homo- and Heteronuclear Correlation spectroscopy. Noe experiments Heteronuclear NMR

Planning	Class hours	Hours outside the classroom	Total hours
Lecturing	13	26	39
Problem solving	24	48	72
Laboratory practice	3	15	18
Essay	1	20	21

*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 theoretical classes will be devoted to the presentations of the basis of the different techniques that are are most relevant for the interpretation of the data from the structural point of view (relationships between spectra and structures).
Problem solving	The classes of small groups will be devoted to solve exercises or problems that allow at the end of each chapter to obtain appropriate information of the corresponding techniques.

Personalized assistance	
Methodologies	Description
Problem solving	Students may consult any doubt with the teaching staff of the subject in mentoring time.
Tests	Description
Essay	Students may consult any doubt with the teaching staff of the subject in mentoring time. In addition, students will be called individually or in small groups for mentoring of the work proposed.

Assessment			
	Description	Qualification	Evaluated Competencess

Problem solving	In the different classes (lectures, seminars) the students will be given handouts with problems and/or exercises that will be used for their evaluation. Learning outcomes: (1). Describe the fundamental concepts of the methods for structural determination. (2). Analyse the information that, on the molecular structure, provide the different methods and understand their main limitations. (3). Predict the basic features of a particular spectrum for a given compound.	20	CB1 CB2 CB3 CE4 CE8 CE12 CE19 CE20 CE24 CT7 CT8 CT13 CT15
Laboratory practice	There will be two short tests of about 2 hour duration in which the students will be asked to obtain structural information from experimental data (spectra and other physical data). The first tests covers chapters 1-3 (10% of qualification), and the second chapter 4 (20% of qualification). Learning outcomes: (1). Analyse the information that, on the molecular structure, provide the different methods and understand their main limitations. (2). Predict the basic features of a particular spectrum for a given compound. (3) Design the basic process to obtain a particular structural information of a compound. (4). Solve the molecular structure of a simple compound from its spectra (UV, IR, MS, NMR, X-Ray, etc). Further, there will be a final test that covers all chapters (30% of qualification)	60	CB1 CB2 CB3 CB4 CE8 CE12 CE19 CE20 CE24 CT3 CT7
Essay	The students will carry out a small project proposed by the professors of multidisciplinary spectroscopic nature. The results will be presented as a written report. Learning outcomes:(1). Solve the molecular structure of a simple compound from its spectra (UV, IR, MS, NMR, X-Ray, etc).	20	CB1 CB2 CB3 CB4 CE4 CE8 CE12 CE19 CE20 CE24 CT1 CT4 CT5 CT9 CT12 CT14 CT16

Other comments on the Evaluation

To pass the course the students must handle the professor the following material:

- A minimum of 80% of the handouts and homework proposed in the seminar classes.

- All the short tests.

- The final report.

To pass the course at the end of the quarter the students will be required to get a minimum of 5 points (on the basis of 10) in the final mark. Besides, it is indispensable to obtain in the evaluation of the different parts of the course the following minima:

- 30% of the total value in each one of the short tests.

- 40% of the total value in the group of the handouts.

- 30% of the total value in the final test.

In the event the minima is not reached, the student record will show the balanced mark of the short tests.

For students that complete less than 20% of the total work scheduled, the records will not show, in agreement with the current legislation and, the quotation NOT PRESENTED. In any case, the presentation to one of the short tests, will imply the qualification of the course.

The students that fail at the end of the quartet will have to pass a final exam at the end of the academic year (June, July). Said proof will replace the results of the final tests. A minimum of 30% of the total value of the exam will be required to pass the course. The qualifications of the handouts and the project report are non-recoverable. In case the minima established in each part is not reached, the qualification will be FAILED. Once the minima is passed a global mark equal or higher than 5.0 (on the basis of 10) will be required to pass the course.

Alternatively, students could choose to be evaluated by performing a single test. To iso, they must communicate it, in writing, to the coordinator of the subject, at the beginning.

Sources of information

Basic Bibliography

Complementary Bibliography

Williams, D.H., Fleming, I., Spectroscopic Methods in Organic Chemistry, 6ª, 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, 5ª, 2014,

Pretsch, Ernö, Structure determination of organic compounds : tables of spectral data, 4a, Springer, 2009, Heidelberg

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

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

Recommendations

Subjects that it is recommended to have taken before

Numerical methods in chemistry/V11G200V01402
Physical chemistry I/V11G200V01303
Physical chemistry II/V11G200V01403
Inorganic chemistry I/V11G200V01404
Organic chemistry I/V11G200V01304

IDENTIFYING DATA

Chemical engineering

Subject	Chemical engineering			
Code	V11G200V01502			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	3rd	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	González de Prado, Begoña			
Lecturers	Canosa Saa, Jose Manuel Deive Herva, Francisco Javier González de Prado, Begoña			
E-mail	bgp@uvigo.es			
Web				
General description	This subject is an introduction to Chemical Engineering, where the knowledge gained in the previous Chemistry degree courses is related to Chemical industry processes. The mail goal is to enable the students to learn the basic knowledge about material and energy balances so that they can applied it to the design of separation processes such as distillation or liquid-liquid extraction. 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. This subject gives the basis to understand other subjects such as Environmental Quemistry, Food Chemistry and Industrial Chemistry.			

Competencies

Code		Typology
CE1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.	• know • Know How
CE16	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles and procedures in chemical engineering	• know • Know How
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• Know How
CE21	Recognize and implement good scientific practices for measurement and experimentation	• know • Know How
CE22	Process and perform computational calculations with chemical information and chemical data	• Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• know • Know How
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	• Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	• Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	• know • Know How
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	• Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• know • Know How
CT3	Learn independently	• Know How
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• know • Know How
CT7	Apply theoretical knowledge in practice	• Know How
CT8	Teamwork	• Know be
CT9	Work independently	• Know be
CT10	Work at a national and international context	• Know be
CT12	Plan and manage time properly	• Know How
CT13	Make decisions	• Know How
CT14	Analyze and synthesize information and draw conclusions	• Know How
CT15	Evaluate critically and constructively the environment and oneself	• Know be

Learning outcomes

Learning outcomes	Competences
Know the different unit systems.	CE1 CE19 CT7
Interpret the flow charts of chemical processes.	CE16 CE19 CE20
Differentiate the steady, non-steady, continuos and batch operations	CE16 CE19 CE20 CT3 CT7 CT9
Know and know how to apply the mass and energy balances in steady or not steady processes, with or without chemical reaction and with recycle, purge and bypass streams	CE16 CE19 CE20 CT3 CT9
Know and know how to apply the mass, energy and momentum conservation laws	CE16 CE19 CE20 CT3 CT7 CT9
Pose and solve the design equations to the ideal chemical reactors.	CE16 CE20 CE23 CT3 CT4 CT5
Differentiate the heat transfer mechanisms	CE16 CE19 CE20 CT3 CT4 CT6 CT7 CT9
Calculate the heat transferred by conduction and convection in simple systems and the heat transferred in shell and tube type heat interchanger.	CE16 CT4
Identify the different operation units and their application.	CE16 CE19 CE20 CT7
Elaborate and interpretate vapour-liquid, liquid-liquid and gas-liquid flow diagrams.	CE21 CE22 CE23 CE25 CE27 CE28 CE29 CT1 CT6 CT8 CT10 CT12 CT13 CT14 CT15

Solve mass balances for flash and batch distillation, liquid-liquid and solid-liquid extraction and absorption.	CE21 CE22 CE23 CE25 CE27 CE28 CE29 CT6 CT8 CT10 CT12 CT13 CT14 CT15
Determine the number of theoretical stages in separation units for simple mixtures.	CE16 CE19 CE20 CT7
Carry out and monitor separation processes in operation units at laboratory level.	CE21 CE22 CE23 CE25 CE27 CE28 CE29 CT1 CT6 CT8 CT12 CT13 CT14 CT15
Determine experimentally some properties of interest from the point of view of transport phenomena: viscosity, coefficients of convection, density.	CE16 CE20 CE21 CE22 CE23 CE25 CE27 CE28 CE29 CT1 CT4 CT5 CT7 CT8 CT10 CT12 CT13 CT14 CT15
Work with continuous and batch chemical reactors at laboratory level.	CE16 CE21 CE22 CE25 CE27 CE28 CE29 CT1 CT4 CT5 CT6 CT7 CT8 CT12 CT13 CT14 CT15

Contents	
Topic	
Subject 1. Introduction to Chemical Engineering	Origin, concept and evolution of the Chemical Engineering. Discontinuous and continuous operation. Stationary and non stationary state. Cocurrent and countercurrent operations. Classification of the unit operations. Systems of units.
Subject 2. Mass and energy balances	General equation of balance. Mass balances in systems without chemical reaction in stationary and non stationary state. Recycle, purge and bypass. Mass balances in systems with chemical reaction in stationary and non stationary state. Energy balances. Energy balances in systems with chemical reaction in stationary state.
Subject 3. Design of ideal reactors	Speed of reaction. Ideal reactors: batch stirred tank reactor, continuos stirred tank reactor and plug flow reactor
Subject 4. Heat transfer	Mechanisms of heat transfer. heat transfer through flat walls, cylindrical and spherical. Heat exchangers.
Subject 5. Distillation	Vapour-liquid equilibria. Phase diagrams for binary mixes. Simple and flash distillation. Multistage distillation
Subject 6. Liquid-liquid extraction	Liquid-liquid equilibrium for binary and ternary systems: binodal curve and distribution coefficients. Liquid-liquid extraction in cocurrent and countercurren contact.
Laboratory sessions	Experimental determination of some properties of interest from the point of view of the design of basic operations: viscosity, coefficients of convection, density. Operation with chemical reactors at lab scale. Experimental determination of phase equilibrium curves. Analysis of the capacity of extraction of several solvents in a process of solid-liquid extraction.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	13	30	43
Problem solving	25	50	75
Laboratory practical	40	3	43
Autonomous problem solving	0	10	10
Presentation	5	5	10
Mentored work	1	10	11
Problem and/or exercise solving	2	8	10
Essay questions exam	3	20	23
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	During these classes (one hour per week) the teacher will explain the most relevant aspects of the subject. The students will have the available documentation on Tem@.
Problem solving	There will be a set of exercises of each subject available for the students. Some of these exercises will be solve in class and other ones will be solved by each student and presented to the teacher in order to be corrected.
Laboratory practical	Laboratory sessions will last 3.5 hours. The experimental procedure will be available for the students and they will have to write a report for each session.
Autonomous problem solving	The students will have to solve some exercises and questions and they will have to present them to the teacher before the deadline.
Presentation	The students will have to make an oral presentation related to the theoretical bases, experimental procedure, obtained results and conclusions for some of their laboratory sessions.
Mentored work	The students will have to write an individual report about one subject related to Chemical Engineering. The teacher will indicate them the main points of the subject that they will have to develop and the recommended literature.

Personalized assistance	
Methodologies	Description
Problem solving	In the assigned hours of tutoring the professor will solve any doubts regarding the subject
Autonomous problem solving	In the assigned hours of tutoring the professor will solve any doubts regarding the subject
Mentored work	In the assigned hours of tutoring the professor will solve any doubts regarding the subject

Assessment

	Description	Qualification	Evaluated Competencess
Laboratory practical	The qualification will depend on the laboratory work and the laboratory report made by the students. Laboratory sessions are mandatory.	10	CE21 CE22 CE23 CE25 CE27 CE28 CE29 CT1 CT6 CT8 CT10 CT12 CT13 CT14 CT15
Presentation	The students will make an oral presentation related to laboratory work.	5	CE16 CE20 CE23 CT4 CT5 CT7 CT8 CT14
Autonomous problem solving	The students will have to deliver, in the terms indicated, the problems proposed of each subject.	5	CE1 CE16 CE19 CE22 CT3 CT7 CT9
Mentored work	The students will realise, and will deliver in the date indicated, an individual work on a subject proposed to the start of course.	5	CE1 CE16 CE20 CE23 CT1 CT3 CT14
Problem and/or exercise solving	They will realise two short exams, one about the subjects 1 and 2 and another one about the subjects 3 and 4.	20	CE1 CE16 CE19 CT1 CT6 CT7 CT9
Essay questions exam	At the end of the course the students have to do an exam related to all the subjets.	55	CE1 CE16 CE19 CT1 CT6 CT7 CT9

Other comments on the Evaluation

Short and long exams. They will realise two short exams along the term. In the final exam, all topics will be evaluated and it is necessary to reach a minimum of 3 out of 10 points to take into account the other elements of evaluation. In case of not reaching the minimum note, the final qualification will be the one obtained in the long exam. Laboratory sessions. The laboratory sessions (lab work and report) and the oral presentation are mandatory and they are 15% of the final qualification. It is indispensable to have a minimum grade of 5 out of 10 points in this section. 50% or more laboratory sessions non-attendance means not to pass the course, independently of the results obtained in the other elements of evaluation. The participation of the student in any of the exams (short exams and long exam), two or more laboratory sessions or the delivery of 20% or more of the works required by the professor, involves the condition of "presented" and the obtention of a qualification. June final exam. A long exam of all the matter that will suppose 75% of the qualification will be done. The students will keep the grades of obtained in laboratory sessions, oral presentation, autonomus exercices and tutored work obtained along the course.

Sources of information

Basic Bibliography

Calleja y otros, Introducción a la Ingeniería Química, Síntesis, 1999,

W.L. McCabe, J.C. Smith y P. Harriot, Operaciones unitarias en Ingeniería Química, McGraw-Hill, 2007,

Complementary Bibliography

R.M. Felder, Principios elementales de los procesos químicos, Limusa Wiley, 2003,

C.J. Geankoplis, Procesos de transporte y principios de procesos de separación, Grupo editorial patria. México, 2007,

José Felipe Izquierdo y otros, Introducción a la Ingeniería Química. Problemas resueltos de balances de materia y energía, Reverté, 2015,

Recommendations

IDENTIFYING DATA				
Analytical chemistry II				
Subject	Analytical chemistry II			
Code	V11G200V01503			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	3rd	1st
Teaching language	Spanish			
Department				
Coordinator	González Romero, Elisa			
Lecturers	González Romero, Elisa Leao Martins, Jose Manuel			
E-mail	eromero@uvigo.es			
Web	http://quimica.uvigo.es/decanatoquimica/guias-docentes.html			
General description	Global knowledge of Analytical Instrumental Techniques and its applications.			

Competencies		
Code		Typology
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances	• know • Know How • Know be
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	• know • Know How • Know be
CE17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management	• know • Know How • Know be
CE18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry	• know • Know How • Know be
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• know • Know How • Know be
CE20	Evaluate, interpret and synthesize data and chemical information	• know • Know How • Know be
CE21	Recognize and implement good scientific practices for measurement and experimentation	• know • Know How • Know be
CE22	Process and perform computational calculations with chemical information and chemical data	• know • Know How • Know be
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• know • Know How • Know be
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	• know • Know How • Know be
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work	• know • Know How • Know be
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	• know • Know How • Know be
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	• know • Know How • Know be
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	• know • Know How • Know be

CT1	Communicate orally and in writing in at least one of the official languages of the University	• know • Know How • Know be
CT3	Learn independently	• know • Know How • Know be
CT4	Search and manage information from different sources	• know • Know How • Know be
CT5	Use information and communication technologies and manage basic computer tools	• know • Know How • Know be
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• know • Know How • Know be
CT7	Apply theoretical knowledge in practice	• know • Know How • Know be
CT8	Teamwork	• know • Know How • Know be
CT9	Work independently	• know • Know How • Know be
CT12	Plan and manage time properly	• know • Know How • Know be
CT13	Make decisions	• know • Know How • Know be
CT14	Analyze and synthesize information and draw conclusions	• know • Know How • Know be
CT15	Evaluate critically and constructively the environment and oneself	• know • Know How • Know be
CT17	Develop concern for environmental aspects and quality management	• know • Know How • Know be

Learning outcomes

Learning outcomes	Competences
Justify the basic principles of the instrumental analysis and his field of application in base to the characteristics of the *analito and of application	CE4 CT1 CT3 CT6 CT9 CT12
Appropiated instrumental technique selection depending the phisycochemicals properties of the analytes.	CE4 CE19 CE20 CE22 CT1 CT4 CT6 CT9 CT12 CT13

Description the quality parameters of an analytical method.	CE4 CE17 CE19 CE29 CT1 CT3 CT4 CT5 CT6 CT9
Adavances in principles of: internal standard, external standard addition, standard solutions preparation, calibration and its applications in different instrumentl equipments.	CE19 CE21 CE25 CE26 CE27 CE28 CE29 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT12 CT13 CT14
Estimation, interpretation and understand the different calibrations parameters of an instrumental method.	CE17 CE19 CE20 CE21 CE26 CE28 CE29 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14
Spectroscopic, electrochemical and separation (chromatographic and electrophoretic) techniques basis and its applications	CE4 CE8 CE18 CE19 CT1 CT3 CT4 CT7 CT8 CT9 CT14
Instrumental equipment description and its functions required for spectroscopic, electrochemical measurements and separations techniques.	CE4 CE8 CE18 CE21 CE26 CE27 CT1 CT3 CT4 CT7 CT9 CT12 CT13

Classify and proposes different applications fields of spectroscopic, electrochemical techniques and separation	CE4 CE8 CE18 CE19 CE23 CT1 CT3 CT4 CT7 CT8 CT9 CT13 CT14
Implementation and application of spectroscopic and electrochemical techniques to carry out the determination of differents analytes	CE4 CE18 CE19 CE21 CE23 CE25 CE26 CE27 CE28 CE29 CT1 CT4 CT5 CT6 CT7 CT8 CT12 CT13 CT14 CT15 CT17
Implementation and application of chromatographic techniques with different detection modes for the separation, identification and quantification of differents analytes	CE4 CE21 CE23 CE25 CE26 CE27 CE28 CE29 CT1 CT4 CT5 CT6 CT7 CT8 CT12 CT13 CT14 CT15 CT17

Contents	
Topic	
General Introduction	Subject (QAII) description
1-Introduction to the instrumental technicians	Introduction Classification of the instrumental techniques Quality parameters Instrumental methodology analysis Calibration Molecular absorption spectrophotometry UV-VIS: Principels, Instrumentation and applications
2- Luminescent techniques	Basic principles Relation between fluorescense intensity and concentration Instrumentation Applications

3- Atomic Absorption Spectrometry	Basic principles Atomization systems, Flame, graphite furnace, hydrides generation and cold steam. Instrumentation Applications
4- Emision Atomic Spectrometry	Basic principles Emisión sources. Flame and plasma. Plasma-Mass coupling Applications
5- Electroanalyticals Techniques	Basic principles Classification Potentiometry: Ion Selective Electrode Voltammetry Conductimetry Coulometry Applications
6- Chromatographic methods	Basic principles Chromatographic modes Gas Chromatography Instrumentation Applications
7- Liquid Chromatography	Liquid chromatography: Normal, reverse phase and ionic Instrumentation Applications
8- Electrophoretic Techniques	Principles High resolution capillary Electrophoresis basic and theory Electrophoretic Techniques Classification Instrumentation Applications

Planning			
	Class hours	Hours outside the classroom	Total hours
Problem solving	26	26	52
Laboratory practical	45.5	7	52.5
Lecturing	26	26	52
Practices report	0	38	38
Problem and/or exercise solving	3.55	12.9575	16.5075
Essay questions exam	3.5	10.5	14
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Problem solving	Following the master classes, seminars be dedicated to solving problems / exercises, which aims are to finding the comprehension level of the students on issues developed. The exercises will be develop in small groups in seminars session followed a general discussion, later the student will have individual proposes exercises to solve individually. The seminars are aimed at strengthening the knowledge acquired in the lectures class, Practical analytical issues and related to the content of the subject will be discussed.
Laboratory practical	The laboratory practical sessions have a fundamental part in the teaching of the subject. On the one hand, they are essential for understanding theoretical concepts; and also allows the students to introduce on analytical methodology practical concepts, as well to understand the norms and rules of scientific work, individual and work group concept in laboratory including report writing.
Lecturing	Lecture sessions will develop during 60 minutes. The teacher provides a global vision of each agenda item, stating the main contents of each. Classes are held interactive way with the students, using online learning materials (Tem @ platform) and adequate literature.

Personalized assistance	
Methodologies	Description
Problem solving	
Laboratory practical	
Tests	Description
Practices report	

Assessment			
	Description	Qualification	Evaluated Competencess
Problem solving	The teacher will monitor the exercises given to students in seminars class. Scientific publication, pratical situations will be discussed in seminars sessions and supervised by the teacher	10	CE4 CE8 CE18 CE29 CT1 CT6
Laboratory practical	The teacher will monitor the experimental work done by students in the lab sessions. It is REQUIRED to attend practical laboratory sessions to pass the course. Students who do not perform laboratory practices are considered FAIL throughout the cycle of evaluation of the course.	15	CE20 CE21 CE25 CE26 CE27 CE28 CT4 CT7 CT8 CT13
Practices report	The student will prepare lab reports, which reflects the work performed in the laboratory. These reports must be submitted by the deadline and will be corrected by the teacher.	10	CE17 CE19 CE20 CE28 CE29 CT1 CT4 CT6 CT7 CT14
Problem and/or exercise solving	The theoretical/practical short test will be used during semester evaluation. This test is not eliminatory and will contribute 10% of the final grade for the course. Labotory test for each student will be made to asses their skills in the development of an experiment. This test is performed at the end of the lab sessions and it contribute 10% to the final score.	20	CE4 CE8 CE18 CE19 CE20 CE21 CE25 CE26 CE27 CE28 CE29 CT1 CT3 CT6 CT7 CT9

Essay questions exam	The exam (the test) will be performed at the end of the semester and contains a theoretical and theoretical-practical aspects. For compensation of subject , students must achieve at least 4.0 minimum score (4.0 minimum score in each part of the test). ATTENTION: 3.0 is the minimal requirement in the final results achieve by the student for each long test corresponding to each teacher participate in the subject in order to carry out the weighting of overall examination. If you do not get this rating, the end result is FAIL	45	CE4 CE8 CE17 CE18 CE19 CT1 CT3 CT6 CT9

Other comments on the Evaluation

Omission of ALL activities proposed for the evaluation of the subject (Not participated all evaluation activities) for the evaluation of the subject will be considered as NOT PRESENTED (NO EVALUATION). Attendance at laboratory practices class is mandatory and eliminatory. If the participation in these activities is less than 80%, TOTAL results in subject evaluation will be FAIL (SUSPENSO); in this case, the final official result will be the value only obtained for laboratory evaluatio.

- July evaluation:
In the second evaluation, the same criteria than in the first one will be applied.

Sources of information

Basic Bibliography

Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Principios de análisis instrumental, 6ª, 2008, Cengage Learning

Satinder Ahuja,Neil D. Jespersen, Modern instrumental analysis, 1ª, Elsevier, 2006, Elsevier

James W. Robinson, Eileen M. Skelly Frame, George M. Frame, Undergraduate instrumental analysis, 7ª, CRC Press, 2014, Marcel Dekker

Complementary Bibliography

Lucas Hernández Hernández, Claudio González Pérez, Introducción al análisis instrumental, 1ª, Ariel Barcelona, 2002, Editorial Ariel

Donald T. Sawyer; William R. Heineman; Janice M. Beebe, Chemistry Experiments for Instrumental Methods, 1ª, Wiley, 1984, Wiley

Rouessac, Annick Rouessac, Chemical Analysis: Modern Instrumentation Methods and Techniques, 6ª, John Wiley & Sons, 2007, Wiley

Recommendations

Subjects that continue the syllabus

Analytical chemistry 3/V11G200V01601

Subjects that are recommended to be taken simultaneously

Structural Determination/V11G200V01501
Chemical engineering/V11G200V01502
Organic chemistry II/V11G200V01504

Subjects that it is recommended to have taken before

Numerical methods in chemistry/V11G200V01402
Analytical chemistry 1/V11G200V01302

IDENTIFYING DATA				
Organic chemistry II				
Subject	Organic chemistry II			
Code	V11G200V01504			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	Spanish			
Department				
Coordinator	Gómez Pacios, María Generosa			
Lecturers	Fall Diop, Yagamare Gómez Pacios, María Generosa			
E-mail	ggomez@uvigo.es			
Web				
General description	Machine translation into english of the original teaching guide The course Organic Chemical II is designed to deepen in the knowledge of the properties and reactivity of functional groups. After the study of nucleophilic substitution and elimination reactions, the reactivity of bi-functional carbonylic compounds will be approached. Finally, the radical and peryciclic reactions will be studied.			

Competencies		
Code		Typology
CB1	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	• know
CB2	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	
CB3	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	• Know How
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	• Know How
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	• know • Know How
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	• know • Know How
CE10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds	• know • Know How
CE11	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: nature and behavior of functional groups in organic molecules	• know • Know How
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	• know • Know How
CE13	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main synthetic routes in organic chemistry, including interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds	• know • Know How
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• know • Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• know • Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• know • Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• know • Know How
CT3	Learn independently	• know • Know How
CT4	Search and manage information from different sources	• know • Know How
CT5	Use information and communication technologies and manage basic computer tools	• know • Know How
CT8	Teamwork	• Know How • Know be
CT9	Work independently	• Know How • Know be

CT12 Plan and manage time properly	• Know How • Know be
CT13 Make decisions	• Know How • Know be
CT14 Analyze and synthesize information and draw conclusions	• Know How

Learning outcomes

Learning outcomes	Competences
Explain the reactivity of the organic compounds through the different mechanisms of reaction: replacement, elimination, addition and addition-elimination.	CB1 CB2 CB3 CB5 CE2 CE10 CE11 CE12 CE13 CT1 CT3 CT4 CT5 CT9 CT12 CT13 CT14
Describe in detail the mechanisms of transformation of the organic compounds using the formalism of arrows.	CE2 CE11 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14
Complete diagrams of reaction of organic compounds adding reactive and/or the conditions of reaction.	CE2 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14
Propose sequences of simple reaction.	CE12 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14

Differentiate, according to the conditions of reaction and the *sustratos used, the mechanisms of replacement *nucleófila *SN1 and *SN2.	CE2 CE11 CE12 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14
Apply the processes of replacement *nucleófila on carbons *sp3 in the obtaining of organic compounds with simple links.	CE2 CE11 CE12 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14
*Predecir The possible competition between the processes of replacement *nucleófila and elimination for a *sustrato given.	CE11 CE12 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14
Apply the reactivity of *enoles and *enolatos.	CE11 CE12 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14
Apply the processes of elimination in the preparation of organic compounds with multiple links.	CE11 CE12 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14

Apply the reactivity of the composed alpha-*dicarbonílicos (*enolización, acidity, *alquilación in alpha, *alquilación in beta, *descarboxilación) in organic synthesis.	CE10 CE11 CE12 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14
Design the synthesis of compounds *bifuncionales using the reaction of condensation *aldólica, the reaction of *Reformatsky and the condensation of *Claisen.	CE11 CE12 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14
Apply the reaction of *Knoevenagel and the procedures of synthesis *acetilacética and synthesis *malónica.	CE11 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14
Design the synthesis of derivatives of the compounds *carbonílicos alpha,beta-*insaturados by means of reactions of addition 1,2 and 1,4.	CE11 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14
Apply the basic reactivity of the organic radicals.	CE2 CE11 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14

Apply the reactions *pericíclicas to the organic synthesis.	CE2 CE11 CE13 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14
(*)Characterize *compuestos organic *sencillos from *sus *datosespectroscópicos.	CE8 CE11 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT8 CT12 CT13 CT14

Contents	
Topic	
1. Nucleophilic substitution reactions	Bimolecular nucleophilic substitutions (SN2). Unimolecular nucleophilic substitutions (SN1). Kinetic, mechanisms, stereochemistry aspects. SN2 and SN1 competition. Transformations of functional groups through SN2 and SN1 processes.
2. Elimination Reactions.	Reactions of elimination. Bimolecular Elimination (E2). Unimolecular Elimination (E1). Base conjugated unimolecular elimination (E1cB). Intramolecular elimination (Ei). Mechanisms. Substitution and elimination competition. Application of elimination reactions in organic synthesis.
3. Oxidation-reduction reactions.	Oxidation-reduction reactions. Oxidation reactions of alcohols. Oxidation reactions of carbonyl compounds. Oxidative rupture of alkenes and alkynes. Reduction of aldehydes and ketones. Reduction of carboxylic acids, esters and nitriles.
5. Radical reactions.	Structure, stability and reactivity of radicals. Halogenation of alkanes. Radical addition of HBr to alkenes. Radical halogenation of allylic and benzilic systems. Polymerization of alkenes.
4. Reactivity in alpha position of carbonyl compounds.	Reactivity in alpha position of carbonyl groups. Enoles and enolates: general reactivity. Reactions of ketones and esters enolate anions. Enolate anion reactions with carbonylic compounds: aldol, Claisen, Dieckmann and Reformatsky reactions.
5. Bifunctional Compounds.	Reactivity of 1,2-Bifunctional compounds: pinacol rearrangement, benzoinic condensation, acyloin condensation, benzyl acid rearrangement, enolization. Reactions of beta-dicarbonyl compounds: malonic synthesis, acetoacetic ester synthesis, Knoevenagel reaction. Reactions of alpha-beta unsaturated carbonyl compounds: reactions with electrophiles, reactions with nucleophiles, carbanion addition (Michael reaction), Robinson annulation.
6. Pericyclic reactions.	General characteristics. Clasification. Electrocyclic reactions. Cycloaddition reactions. Sigmatropic reactions. Diels-Alder reaction. 1,3-Dipolar cycloadditions.

Planning			
	Class hours	Hours outside the classroom	Total hours
Mentored work	2	2	4
Lecturing	24	0	24
Seminars	24	0	24
Problem and/or exercise solving	4	0	4
Essay questions exam	3	8	11
*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	The student, of individual form or in group, will prepare a short exhibition on a subject *realacionado with the matter. This activity includes the research of information, editorial and presentation of the work.
Lecturing	The sessions *magistrales will consist in the exhibition by part of the professor of the fundamental appearances of each subject. Before each session, the student will have to work the material that the professor will facilitate him through the platform FEAR, related with the content that will treat in each session.
Seminars	The students, with the support of the professor, will resolve exercises and questions previously proposed in Bulletins, related with the theoretical contents. A selection of the exercises will be delivered regularly to the professor for his evaluation.

Personalized assistance	
Methodologies	Description
Seminars	The professors will devote a time to attend the needs and queries of the students related with the study and the resolution of exercises on the subjects linked with the matter. The day of the presentation the professors will inform on his time availability for this.
Mentored work	The students will realise a work on a subject that *eligirán of a series proposed by the professors, once finalised, in hours of seminar will expose it and will answer to the questions that formulate him the professors and/or the students. The professors will be able to *asesorar to the student in the election and development of the subject, in the distribution, *busqueda bibliographic and presentation

Assessment			
	Description	Qualification	Evaluated Competencess
Seminars	In the classes of seminar will value the participation and the resolution of the previously proposed problems by the professor. A selection of the exercises will be resolved individually in the classroom and delivered regularly to the professor for his evaluation.	10	CE2 CE8 CE10 CE11 CE12 CE13 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT8 CT9 CT12 CT13 CT14

Mentored work	It will value the preparation and presentation of a work on a subject proposed by the professor related with the theoretical content of the *asignatura.	5	CE2 CE8 CE10 CE11 CE12 CE13 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT9 CT12 CT13 CT14
Problem and/or exercise solving	They will realise two proofs of short answer: the first when finalising the Subject II and the second when finalising the Subject IV. The first will constitute 20% of the total qualification, and the second 15%.	40	CE2 CE8 CE10 CE11 CE12 CE13 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT9 CT12 CT13 CT14
Essay questions exam	It will consist in a global proof on all the contents of the matter. It will be necessary to reach a minimum of 4 points on 10 in this proof to surpass the matter and to take into account the rest of the elements of evaluation. It will realise when finalising he *cuatrimestre.	45	CE2 CE8 CE10 CE11 CE12 CE13 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT9 CT12 CT13 CT14

Other comments on the Evaluation

IMPORTANT NOTES:

1. In the long proof final will evaluate the whole of the *asignatura. It will be necessary to reach in this proof a minimum of 4 points on 10 to surpass the matter and to take into account the rest of the elements of evaluation.

2. A selection of the exercises of the bulletins will be resolved individually in the classroom and delivered regularly to the professor for his evaluation. Those students that by fault of assistance to class, do not deliver a minimum of 80% of these exercises, will not be able to present to the final proof.

CONDITION OF PRESENTED/To: The participation of the student in any one of the proofs written will involve the condition of presented/to and therefore the allocation of qualification.

EVALUATION IN THE ANNOUNCEMENT OF JULIO:

1. Punctuation obtained by the student during the course: Máximo 3.0 points.

It will keep the qualification obtained by the student during the course in works *tutelados (maximum 0.5 points), proofs of short answer (maximum 2.5 points).

2. Proof written: Máximo 7.0 points.

It will realise a proof of long answer on all the contents of the matter to which will assign a maximum of 7.0 points on 10.

Sources of information

Basic Bibliography

Complementary Bibliography

Vollhardt, K.P.C. y Schore, N.E., Química Orgánica, 5ª, Ed. Omega

Wade, L.G., Química Orgánica, 5ª, Ed. Pearson-Prentice-Hall

Yurkanis Bruice, P., Química Orgánica, 5ª, Ed. Perason-Prentice-Hall

Ege, S., Organic Chemistry: Structure and reactivity, 5ª, Ed. Houghton Mifflin Company

Recommendations

Subjects that continue the syllabus

Organic chemistry III/V11G200V01704

Subjects that are recommended to be taken simultaneously

Structural Determination/V11G200V01501
Chemical engineering/V11G200V01502
Analytical chemistry II/V11G200V01503

Subjects that it is recommended to have taken before

Organic chemistry I/V11G200V01304

IDENTIFYING DATA

Analytical chemistry 3

Subject	Analytical chemistry 3			
Code	V11G200V01601			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	Bendicho Hernández, José Carlos			
Lecturers	Bendicho Hernández, José Carlos Lavilla Beltrán, María Isela			
E-mail	bendicho@uvigo.es			
Web	http://faitic.uvigo.es			
General description	"Machine translation into english of the original teaching guide" - This matter provides to the students the knowledge on important and actual aspects on Analytical Chemistry (Chemometrics; Trace Analysis; Automatism and sensors), especially those regarding strategies that have allowed the evolution of the conventional methodologies to improve the quality of the analytical information. Students will be able to complement his training by means of the integration of the knowledge of Analytical Chemistry taken previously, specially the contents in Analytical Chemical II (introduction to the instrumental analysis). This will allow them to tackle the resolution of analytical problems in different areas of interest (environment, feeding, industry, clinic etc.).			

Competencies

Code		Typology
CB1	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	• know
CB2	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	• Know How
CB3	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	• Know How
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances	• know
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	
CE17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management	• know
CE18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry	• know
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• Know How
CE20	Evaluate, interpret and synthesize data and chemical information	
CE22	Process and perform computational calculations with chemical information and chemical data	• Know How
CE24	Recognize and analyze new problems and plan strategies to solve them	• Know How
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know be
CT3	Learn independently	• Know be
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• Know How
CT7	Apply theoretical knowledge in practice	• Know How
CT8	Teamwork	• Know be
CT9	Work independently	• Know be
CT12	Plan and manage time properly	• Know be
CT13	Make decisions	• Know be
CT14	Analyze and synthesize information and draw conclusions	• Know How
CT17	Develop concern for environmental aspects and quality management	• Know be

Learning outcomes

Learning outcomes	Competences
1. Select and apply distinct technical *quimiométricas to the resolution of practical cases and justify the utilisation of the same.	CB1 CB2 CB3 CE17 CE19 CE20 CE22 CT1 CT3 CT5 CT6 CT7 CT9 CT13 CT14 CT17
2. Use the experimental design like tool for the optimisation of an analytical method.	CB1 CE17 CE19 CE22 CT1 CT3 CT5 CT6 CT7 CT9 CT13 CT14
4. Justify the utilisation of the Chemometrics in the quality of the results. Describe how implements a system of quality in a laboratory of control of analytical.	CB1 CB2 CE4 CE17 CE19 CE20 CE29 CT1 CT3 CT5 CT6 CT7 CT8 CT9 CT14 CT17
3. Evaluate and interpret the analytical results of systems *multicomponentes and *multivariables.	CB1 CB2 CB3 CE4 CE17 CE20 CE22 CT1 CT3 CT5 CT6 CT7 CT8 CT9 CT13 CT17

6. Recognise the different methods of treatment of sample as well as evaluate his possibilities in the resolution of diverse analytical problems inside the field of the analysis of trace.	CB1 CB2 CE4 CE19 CE20 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14 CT17
5. Describe the planning of the sampling and the factors that take part in him for the analysis of trace.	CB1 CE4 CE17 CE24 CT1 CT3 CT4 CT6 CT7 CT9 CT12 CT13 CT17
7. Compare and value the different methods of existent extraction in the actuality, like the extraction by fluent *supercríticos, in solid phase, *microextracción, etc.	CB1 CB2 CE4 CE19 CE20 CT1 CT3 CT8 CT9 CT12 CT14 CT17
8. Describe the analytical methodology and instrumentation as well as know the applications of technicians of general use in analysis of trace like the voltammetry of *redisolución *anódica, spectrometry of atomic absorption with atomisation *electrotérmica, spectrometry of masses with source of plasma and the different attachments between the chromatography and the spectrometry of masses.	CB1 CE4 CE8 CE18 CE19 CT1 CT3 CT4 CT8 CT9
9. Classify the different types of automatic systems and *miniaturizados, establishing his advantages and inconvenient, modalities and applications more notable and of immediate future. Justify the automation in the different stages of the analytical process.	CB1 CB2 CE4 CE17 CE20 CT1 CT3 CT4 CT5 CT8 CT9 CT17

10. Explain the foundations of the sensors and *biosensores chemical, as well as his more important applications. Explain and value the importance of the utilisation of the sensors for the fast and reliable obtaining of analytical information.	CB1 CB2 CB3 CE4 CE17 CE20 CT1 CT3 CT4 CT8 CT9 CT12
11. Describe the characteristics of the continuous automatic analysers, discontinuous and *robotizados. Know the phenomena of dispersion in continuous analysers of injection in flow and of sequential injection, as well as the form to characterise them.	CB1 CE4 CE17 CE19 CE20 CT1 CT3 CT4 CT5 CT8 CT9 CT14 CT17
12. Explain the construction of analytical tools in miniature and his applications.	CB1 CE4 CE17 CE19 CT1 CT3 CT4 CT5 CT9 CT12 CT14

Contents	
Topic	
SUBJECT 1. Analysis of trace	Concept and importance of the analysis of trace. Sources of pollution in the laboratory. Experimental methods in analysis of trace. Sampling. Methods of decomposition in analysis of trace inorganic. Methods of extraction in analysis of trace organic. Technicians selected of analysis of trace.
SUBJECT 2. Automation	Automation in the laboratory of analysis: generalities. Automatic analysers. Discontinuous analysers, continuous and robotics. Analysers of injection in flow and segmented flow : characteristics. Phenomena of dispersion. Characteristics of the signal of injection in flow. Technicians of gradient. Analysers of sequential injection. Instrumentation and applications.
SUBJECT 3. Chemical sensors and biosensors	Concept of sensor. Components of a chemical sensor. Classification. Sensors and biosensors. Elements of recognition. Types of *transductores. (Bio)Electrochemical and optical sensors. Applications of interest. Miniaturisation of analytical systems.
SUBJECT 4. Introduction to the Chemometrics	Definition and historical evolution of the Chemometrics. The chemometrics in the different stages of the analytical process. Basic statistical concepts. Parameters that estimate the central value and the dispersion: parametric and no parametric. Properties of the variance and the average. Expression of analytical results.
SUBJECT 5. Basic chemometrics: comparison of analytical results	Test of significance. Proofs of hypothesis: structure of the proofs of hypothesis. Errors type I and II. Probability. Rejection of anomalous results. Parametric tests of comparison of two variances. Parametric tests for comparison of two mean values. Comparison of several mean values by means of one-way ANOVA . Control of the accuracy and precision over time: charts of control. Non-parametric tests.

SUBJECT 6. The quality in the analytical laboratories: qualimetry.	Introduction to qualimetry: quality and chemometrics. Quality and analytical properties: validation of analytical methods. trazability. Generic approximation to the quality. Systems of quality: Norms ISO. Accreditation and certification of the laboratories.

Planning			
	Class hours	Hours outside the classroom	Total hours
Problem solving	13	26	39
Lecturing	26	52	78
Essay questions exam	2	6.5	8.5
Essay questions exam	2	6.5	8.5
Essay questions exam	4	12	16

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

Methodologies	
	Description
Problem solving	In the classes of resolution of problems (in seminar) will reinforce the learning of the *temario explained during the sessions *magistrales, carrying out the resolution of numerical problems and theoretical exercises-practical. The professor will propose, of regular form, different problems/exercises that will be resolved of individual form by the student and delivered for his evaluation.
Lecturing	The professor will develop the contents of the program from the proportionate material to the student through the platform FEAR. In the sessions *magistrales, the professor will present the fundamental appearances of the matter that will have to complement by means of the bibliography recommended.

Personalized assistance	
Methodologies	Description
Lecturing	The professor will resolve the doubts of personalised way on any one of the activities proposed (masterclasses, seminars, works *tutelados, resolution of problems/exercises and proofs). To such end, the professor will inform the available schedule in the presentation of the matter.
Problem solving	The professor will resolve the doubts of personalised way on any one of the activities proposed (master classes, seminars, resolution of problems/exercises and proofs). To such end, the professor will inform the available schedule in the presentation of the matter.

Assessment			
	Description	Qualification	Evaluated Competencess
Problem solving	In classes of seminar, the teacher will resolve part of the problems/exercises, leaving others to be resolved by the student. It will be necessary to obtain a minimum punctuation of 3 on 10 points for the qualification of this activity can add to the rest of elements of evaluation.	10	CB1 CB2 CB3 CE4 CE8 CE17 CE18 CE19 CE20 CE22 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT14

Essay questions exam	Compulsory FINAL EXAMINATION. It will consist in a global proof of the course that will include questions of short answer, problems and ask type test. It will be necessary to obtain 3 points on 10 in this examination so that the qualification can add to the one of the rest of elements of evaluation.	50	CB1 CB2 CB3 CE4 CE8 CE17 CE18 CE19 CE20 CE22 CE24 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14 CT17
Essay questions exam	It will effect a first SHORT PROOF on the subjects 1, 2 and 3, roughly to half of the course. The short proof will be able to consist in questions of short answer, problems and ask type test. The presentation to this proof *inhabilita to the student to obtain the qualification of no presented.	20	CB1 CB2 CB3 CE4 CE8 CE17 CE18 CE19 CE20 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14 CT17

Essay questions exam	It will effect a second SHORT PROOF on the subjects 4, 5 and 6 to the end of the *cuatrimestre. The short proof will be able to consist in questions of short answer, problems and ask type test. The presentation to this proof *inhabilita to the student to obtain the qualification of no presented.	20	CB1 CB2 CB3 CE4 CE17 CE19 CE20 CE22 CE24 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14

Other comments on the Evaluation

To surpass the matter, the student can opt by one of the two following types of evaluation (to choose to principle of the course):

CONTINUOUS EVALUATION
The participation of the student in any one of the two proofs of short answer programmed during the course, it *inhabilita to obtain the qualification of NO PRESENTED. To surpass the short proofs as well as the final examination, will be necessary that exist a balance in the qualifications of the theoretical part and the one of problems. The qualification in the first edition of the announcement will be integrated by the qualifications obtained in the classes of resolution of problems (*entregables) (1 point), short proofs (4 points) and final examination (5 points).

Qualification in the 2ª edition of the announcement (Julio):
The qualification in this announcement will be formed by two components:

1. Punctuations obtained by the student during the course (4 points). The weighting of the problems resolved in seminars (*entregables) will be of 0.5 points and the ones of the two short proofs of 3.5 points

2. Final examination of the contents of the matter (6 points).
This proof will include questions of short answer, problems and ask type test. It will be necessary that exist a balance in the qualifications of the theoretical part (ask type test and questions of short answer) and the one of problems to surpass the matter.

ONLY EVALUATION:
The student will be evaluated by means of an only final examination (10 points) that it will be able to include questions of short answer, problems and ask type test. It will be necessary that exist a balance in the qualifications of the theoretical part (questions of short answer and ask type test) and the one of problems to surpass the matter. The election in this way of evaluation has to communicate to the professor in a time limit of a month from the beginning of the *cuatrimestre through a form that will enable in the platform TEMA. Once chosen the way of evaluation (continuous or only) will not allow changes between both systems. In case that the student do not manifest in this regard, will understand that it follows the way of continuous evaluation.

Sources of information

Basic Bibliography

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C. Cámara, Análisis químico de trazas, Síntesis, 2011,
Valcárcel, Automatización y miniaturización en Química Analítica, Springer, 2000,

Complementary Bibliography

S. Mitra, Sample preparation techniques in analytical chemistry, Wiley, 2003,
B.R. Eggins, Chemical sensors and biosensors, Wiley, 2002,
L. Hernández, Introducción al análisis instrumental, Ariel, 2002,
K.A. Rubinson, Análisis Instrumental, Prentice-Hall, 2000,
Skoog, Principios de Análisis Instrumental, McGraw-Hill, 2001,
Kellner, Analytical Chemistry, Wiley-VCH, 2004,
M. Valcárcel, M.D. Luque de Castro, Flow-injection analysis. Principles and applications, Ellis Horwood, 1987,

Recommendations

Subjects that it is recommended to have taken before

Analytical chemistry 1/V11G200V01302
Analytical chemistry II/V11G200V01503

IDENTIFYING DATA				
Biological chemistry				
Subject	Biological chemistry			
Code	V11G200V01602			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	Teijeira Bautista, Marta			
Lecturers	Diego González, Lara Pérez Cid, Benita Romero Rivas, Vanesa Teijeira Bautista, Marta			
E-mail	qomaca@uvigo.es			
Web				
General description	Introductory course of Biochemistry, global and integrated knowledge of the molecular mechanisms responsible of biological processes.			

Competencies		
Code		Typology
CB1	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	• know
CB2	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	• Know How
CB3	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	• know
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	• know
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances	• know
CE15	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: chemistry of biological molecules and their processes	• know
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• Know How
CE21	Recognize and implement good scientific practices for measurement and experimentation	• Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• know
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	• know
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work	• Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	• Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	• Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know be
CT3	Learn independently	• Know be
CT4	Search and manage information from different sources	• Know be
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT7	Apply theoretical knowledge in practice	• Know How
CT8	Teamwork	• Know be
CT9	Work independently	• Know be
CT12	Plan and manage time properly	• Know be
CT13	Make decisions	• know
CT14	Analyze and synthesize information and draw conclusions	• Know How
CT15	Evaluate critically and constructively the environment and oneself	• Know How

Learning outcomes	
Learning outcomes	Competences

Identify and recognise the structure of the distinct types of *biomoléculas and represent them properly, recognise his properties and his chemical reactivity.	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Recognise the distinct biological activities of the diverse types of *biomoléculas	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Define the kinetical enzymatic of reactions *catalizadas by enzymes as well as his general mechanisms. Recognise the distinct types of inhibition of the enzymatic activity and his quantification	CB1 CB3 CE4 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Relate the vitamins with the corresponding *coenzimas of enzymatic reactions	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Explain he concept of *Bioenergética. Reason conceptually the importance of him attachment of the processes *endergónicos and *exergónicos in the biological systems	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Enumerate the main structural appearances of the ATP that determine his paper in the transfer of energy. Describe the cycle of the ATP.	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Distinguish the metabolic roads of the *biomoléculas, as well as his interrelationships and regulation	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Explain the foundations of the current technicians of *proteómica and molecular biology in relation with the isolation, separation, purification, determination, identification and manipulation of proteins and nucleic acids	CB1 CB2 CB3 CE4 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Apply experimentally some basic technicians in Biochemistry. Justify the application of the distinct instrumental technicians in the analysis of *biomoléculas	CB1 CB2 CB3 CE4 CE15 CE19 CE21 CE23 CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Distinguish the main operations involved in the commercial production of *biomoléculas, as well as his foundations. Recognise the possible practical applications of *biomoléculas, with special emphasis in the characteristic operational conditions	CB1 CB2 CB3 CB5 CE15 CE21 CE23 CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Distinguish and pose analytical protocols of application of the previously mentioned technicians to the analysis of *biomoléculas in diverse areas (clinical, pharmaceutical, *biomédica, etc.)	CB1 CB2 CB3 CB5 CE4 CE15 CE19 CE21 CE23 CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Contents	
Topic	
1.Biomolecules	Structure and structure-function relationship of biomolecules: proteins, carbohydrates, lipids and nucleic acids.
2.Biocatalisis	Structure and function of enzymes. Enzymatic reactions. Enzymatic kinetics.
3.Vitamins and coenzymes	Structure and function of vitamins and coenzymes in metabolic reactions.
4.Metabolism of glucides	Degradative Metabolism of glucides: glycolysis. Metabolic crossroad of pyruvate. Degradative Oxidation of acetil-CoA. Respiratory chain and oxidative phosphorylation. Oxidative Route of the pentoses phosphate. Gluconeogénesis. Metabolism of glycogen.
5. Metabolism of lipids	Degradation of lipids: oxidation of fatty acids. Biosynthesis of fatty acids.
6. Metabolism of proteins	Proteolisis. Degradation of amino acids. Destination of the ion ammonium. Biosynthesis of amino acids.
7.Metabolism of nucleotides	Degradation of nucleic acids and nucleotides. Biosynthesis of nucleotides.
8.Experimental methods in Biochemistry	Techniques for synthesis and isolation of biomolecules. Separation, determination and identification of proteins. Determination and quantification of lipids. Determination and quantification of glycogen. Evaluation of the enzymatic activity. Effect of the temperature and inhibition. Polymerase chain reaction. Use of restriction enzymes.

Planning	Class hours	Hours outside the classroom	Total hours
Seminars	13	19.5	32.5
Laboratory practical	45.5	68.25	113.75
Problem solving	3	3	6
Lecturing	26	26	52
Essay questions exam	4	6	10
Laboratory practice	2.3	3.45	5.75
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
Seminars	This teaching activity will be dedicated to the resolution of some problems or proposed exercises related to the subject. In these classes you can collect questions or short problems to track the progress of the students.
Laboratory practical	They will propose questions practise, to resolve in the laboratory.
Problem solving	Activity in which they formulate problems and/or exercises related with the matter. The student has to develop the suitable or correct solutions by means of the realisation of routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results.
Lecturing	Exhibition by the professor of the contents on the matter object of study, theoretical bases and/or guidelines of a work, exercise or project to develop by the student.

Personalized assistance	
Methodologies	Description
Lecturing	Throughout the teaching period students can consult all kinds of questions related to the subject. These consultations will be addressed both in tutorials and seminars.
Seminars	Throughout the teaching period students can consult all kinds of questions related to the subject. These consultations will be addressed both in tutorials and seminars.
Laboratory practical	The professor will resolve the doubts of the students for the good development of the activities proposed

Assessment

	Description	Qualification	Evaluated Competencess
Seminars	Students attitude and participation in seminar classes will be valued. Short questions and hand-made problems will be also proposed to track students' progress. Grading in this section will be only considered if students reach a mark equal or above 5/10 in the written exams.	10	CE4 CE15 CE19 CE23 CT3 CT4 CT8 CT12 CT14 CT15
Laboratory practical	The attendance to the practices and the application of the instrumental techniques learned will be valued by means of the resolution of proposed questions as well as the delivery of a practice report. Grading in this section will be only considered if students reach a mark equal or above 5/10 in the written exams.	30	CB1 CB2 CB3 CB5 CE15 CE19 CE21 CE25 CE26 CE27 CE28 CT3 CT7 CT9 CT12 CT13 CT14
Essay questions exam	There will be two written tests during the semester on the subject taught until then in the lectures and seminars. This exam will be eliminatory of matter in the final test if students reach a mark equal or above 5/10. Those students not reaching this mark will have to repeat this part of the examination in the final written test.	hasta el 60	CB1 CB3 CE4 CE15 CT1 CT3 CT4 CT9 CT12 CT14
Essay questions exam	A final written test will be proposed to evaluate the adquired competences.	hasta el 60	CB1 CB3 CE4 CE15 CT1 CT3 CT4 CT9 CT12 CT14

Other comments on the Evaluation

The final grade of the matter will be calculated taking into account the evaluation of the seminars (10%), the laboratory practices (30%) and the written tests (60%), for those students that reach an equal or upper punctuation to 5 points on 10

in the written tests. If that score is not reached, the grade of the matter will correspond to the value of the final written test. The short written tests may have eliminatory character, as long as they reach the minimum value each of 5/10, subtracting its percentage corresponding to the value of the final written test.

Attendance at laboratory practices is mandatory. The lack of assistance, even if justified, will penalize the evaluation of the same. An attendance lower than 75% of the practical sessions supposes the qualification of suspense in the matter.

The participation in the evaluation activities throughout the semester or in some of the assessment tests involve the condition of presented and therefore the student will be graded.

Assessment in July: The same rules are applied. If 75% of the laboratory sessions have been completed, the minimum grade has not been obtained, a laboratory exam may be carried out in July.

Sources of information

Basic Bibliography

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Susan R. Mikkelsen, Eduardo Cortón, Bioanalytical Chemistry, 1ª, Wiley-Interscience, 2004, New Jersey

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Recommendations

Subjects that it is recommended to have taken before

Analytical chemistry 1/V11G200V01302
Organic chemistry I/V11G200V01304
Organic chemistry II/V11G200V01504

IDENTIFYING DATA				
Physical chemistry III				
Subject	Physical chemistry III			
Code	V11G200V01603			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	3rd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Bravo Díaz, Carlos Daniel			
Lecturers	Bravo Díaz, Carlos Daniel Gómez Graña, Sergio Losada Barreiro, Sonia Tojo Suárez, María Concepción			
E-mail	cbravo@uvigo.es			
Web	http://faitic.uvigo.es/			
General description	The matter provides training in applications of Physical Chemistry of great importance, like Chemical Kinetics, including Catálisis, surface phenomena, Macromolecules and Colloids as well as some foundations of Electrochemistry.			

Competencies		
Code		Typology
CE7	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: kinetics of change, including catalysis and reaction mechanisms	• know • Know How
CE14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules	• know • Know How
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• know • Know How
CE21	Recognize and implement good scientific practices for measurement and experimentation	• Know How
CE22	Process and perform computational calculations with chemical information and chemical data	• Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• know • Know How
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work	• Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	• Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	• Know How
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	• Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know How
CT3	Learn independently	• Know How • Know be
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• Know How
CT7	Apply theoretical knowledge in practice	• Know How
CT8	Teamwork	• Know be
CT9	Work independently	• Know be
CT14	Analyze and synthesize information and draw conclusions	• Know How
CT15	Evaluate critically and constructively the environment and oneself	• Know be

Learning outcomes	
Learning outcomes	Competences

Explain the hypotheses, the consequences and the fundamental results of the Molecular Kinetical Theory of the gases	CE7 CE14 CE19 CE23 CT1 CT3 CT4 CT9
Describe the general mechanism of the process of transport and *particularizarlo for the transport of distinct physical properties. Comprise the origin of the ionic conductivity. Know apply this knowledge to the determination of thermodynamic parameters like constants of balance, coefficients of activity or others like molar conductivities limit.	CE7 CE14 CE19 CE23 CT1 CT3 CT4 CT9
Define with precision, all the basic concepts in Kinetical Chemical, and know the distinct methods of analysis of data to obtain equations of speed.	CE7 CE19 CE23 CT1 CT3 CT4 CT9
Establish the kinetical behaviour of complex reactions and apply the most usual approximations in kinetical chemical. Obtain equations of speed of complex processes from the corresponding mechanisms. Distinguish between complexes of Arrhenius and van't Hoff and know realise a kinetical treatment-formal general for both cases.	CE7 CE14 CE19 CT1 CT3 CT4 CT9
Describe the foundation of the distinct experimental technicians available for the kinetical study of the chemical reactions.	CE20 CE27 CE28 CT1 CT3 CT4 CT9
Be able to carry out the analysis of kinetical data, including the ones of complex reactions and relate the same with the mechanisms of reaction.	CE7 CE19 CE27 CT1 CT3 CT4 CT7 CT9
Explain the fundamental hypotheses of the distinct theories on the chemical change, as well as the results and the limitations of each one of them (Theory of Collisions and Theory of the State of Transition and know apply them like tool in the analysis of kinetical results).	CE7 CE14 CE19 CT1 CT3 CT4 CT9
Describe the distinct types of *catálisis, explain the mechanism of the reactions *catalizadas and apply it to concrete cases. Know *particularizar said kinetical treatment-formal to the distinct types of *catálisis	CE7 CE19 CT1 CT3 CT4 CT9
Know the basic structure of the *interfase energised and his applications to the study of the stability of the colloids and of the processes in the *interfases *electródicas.	CE7 CE14 CE19 CT1 CT3 CT4 CT9

Explain the principles that govern the phenomena of adsorption on solid surfaces and distinguish the types. Comprise the origin of the distinct isotherms of adsorption and know apply them to concrete problems.	CE14 CE19 CT1 CT3 CT4 CT9
Explain the nature and structure of the macromolecules in dissolution and the most representative models for his description.	CE14 CE19 CT1 CT3 CT4 CT9
Describe with clarity the nature and the distinct types of systems *coloidales. Comprise the basic appearances of the thermodynamic treatment of the macromolecular dissolutions.	CE14 CE19 CT1 CT3 CT4 CT9
Describe the foundation of the experimental technicians more important for the determination of the structure of *macromoleculas and systems *coloidales.	CE14 CE27 CT1 CT3 CT4 CT9
Describe the structure and explain the causes of the stability of the systems *coloidales as well as recognise his chemical importance.	CE14 CE19 CT1 CT3 CT4 CT9
Know the basic appearances of the structure of the *interfase *electródica, the origin of the distinct types of *sobrepotencial and his application.	CE7 CE14 CE19 CT1 CT3 CT4 CT9
Apply the distinct basic technicians in the field of the kinetical for the determination, between others, of equations of speed and energies of activation. Determine experimentally properties associated to the phenomena of transport and superficial and the structure of the macromolecules and systems *coloidales.	CE19 CE20 CE21 CE22 CE26 CE27 CE28 CE29 CT1 CT4 CT5 CT6 CT7 CT8 CT9 CT14 CT15

Contents	
Topic	
(*)Phenomena of transport	(*)Kinetical theory of the gases. Phenomena of transport no electrical. Phenomena of electrical transport: conductivity
(*)Phenomena of surface	(*)Superficial tension. Structure of the solid surfaces. Adsorption on solid surfaces. *Fisisorción And *quimisorción: models. The *interfase energised.
(*)Kinetical formal	(*)Speed of reaction and equations of speed. Analysis of data. Kinetical analysis of complex reactions. Mechanisms. Influence of the temperature in the speed of reaction.
(*)Experimental methods in Kinetical Chemical	(*)Transformation of the equations of speed. Conventional technicians. Experimental technicians for the study of fast reactions.
(*)Theoretical interpretation of the speed of reaction.	(*)Theory of collisions for reactions *bimoleculares. Theory of the state of transition.

(*)Macromolecules.	(*)Structure of the macromolecules. Structural models. Characterisation of macromolecules.
(*)Colloids.	(*)Classification of the systems *coloidales. Synthesis and characterisation of colloids. Stability of systems *coloidales.
(*)*Catálisis.	(*)General mechanism of the *catálisis. *Catálisis *homogénea. *Catálisis Heterogeneous.
(*)Kinetical *electródica.	(*)Stages of a process *electródico. *Sobrepotenciales. *Sobrepotencial Of transfer of load. *Sobrepotencial Of diffusion. *Sobrepotenciales Of reaction and crystallisation. Experimental technicians.
(*)Practical.	(*)Experiences of Kinetical Chemical including *Catálisi, Phenomena of Transport, Electrochemical Macromolecules and Colloids.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	0	26
Seminars	13	65	78
Laboratory practical	45.5	32.5	78
Problem and/or exercise solving	1	5	6
Problem and/or exercise solving	1	5	6
Essay questions exam	3	15	18
Practices report	0	6	6
Problem and/or exercise solving	0	7	7

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

Methodologies

	Description
Lecturing	Lesson by the method *expositivo *desarrolada in a classroom. They can pose simple exercises *directamentamente related *on the explanation.
Seminars	Approach, analysis and discussion of problems and questions of some complexity.
Laboratory practical	Realization under the supervision of Professor (but of autonomous way) of laboratory practises related whith the matter.

Personalized assistance

Methodologies	Description
Lecturing	Resolution of doubts on the proportionate explanations in classes.
Seminars	Resolution of doubts on the proportionate explanations in classes.
Laboratory practical	Those questions of students that may arise during the realization of laboratory practices or the corresponding reports will be resolved individually in the teacher tutoring schedule.
Tests	Description
Practices report	Those questions of students that may arise during the realization of laboratory practices or the corresponding reports will be resolved individually in the teacher tutoring schedule.
Problem and/or exercise solving	Doubts and questions of problems and/or questions provided in classes.

Assessment

	Description	Qualification	Evaluated Competencess
Seminars	Presentation and discussion of exercises prior to the seminar will be evaluated	4	CE7 CE14 CE19 CE23 CT1 CT6 CT7 CT14

Laboratory practical	It is scored here along with the effort and the attitude, the skills and the competences developed by the student during the accomplishment of the different practices. Attendance at practice sessions is mandatory and, therefore, it is not possible to pass the subject in case it has not taken place.	15	CE19 CE20 CE21 CE22 CE23 CE26 CE27 CE28 CE29
Problem and/or exercise solving	Evaluation of acquired knowledge up to date with a small exam (questions, problems)	18	CE7 CE14 CE19 CE23 CT1 CT7
Problem and/or exercise solving	Evaluation of acquired knowledge up to date with a small exam (questions, problems)	18	CE7 CE14 CE19 CE23 CT1 CT7
Essay questions exam	Final exam. Evaluation of the acquired knowledge: questions and problems	40	CE7 CE14 CE19 CE23 CE28 CT1 CT7
Practices report	The presentation and quality of the experimental data obtained in experiments will be evaluated. Reports will necessarily include some discussion on the reported data.	5	CE19 CE20 CE21 CE22 CE23 CE28 CE29

Other comments on the Evaluation

- **The assistance to masterclasses, seminars and the realisation of the practices and the delivery of the corresponding reports is compulsory**.

The notes of the seminars and practical of laboratory will keep for the second evaluation. Under special circumstances, students may be required to make a special work to improve the grades obtained.

The minimum note of the "official" (long) exam will be of 3.8 (in scale 0-10, 1.52 in scale 0-4) and of 3.0 (scale 0-10) in the short ones, so that the final grade will be an average (with the corresponding percentage) of the punctuations of all sections. To pass the topic, the global grade has to be, of course, equal to or higher than 5.0. There is not minimum punctuations in other sections, but presentation and discussion of exercises during the seminars is highly relevant and will be considered important.

Sources of information

Basic Bibliography

Complementary Bibliography

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P.W. ATKINS y J. DE PAULA, Physical Chemistry, 10ª, 2014
T. ENGEL y P.J. REID, Physical Chemistry, 3ª, 2014
K. J. LAIDLER, Chemical Kinetics, 3ª, 1987
A. HORTA, Macromoléculas (2 vols), 2ª, 1984
S. SENENT, Química Física II, 3ª, 2000
J. Bertrán y J. Núñez (coords.), Química Física (2 vols), 1ª, 2002

Recommendations

Subjects that are recommended to be taken simultaneously

Analytical chemistry 3/V11G200V01601
Inorganic chemistry II/V11G200V01604

Subjects that it is recommended to have taken before

Physical chemistry I/V11G200V01303
Physical chemistry II/V11G200V01403

IDENTIFYING DATA				
Inorganic chemistry II				
Subject	Inorganic chemistry II			
Code	V11G200V01604			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Vázquez López, Ezequiel Manuel			
Lecturers	Carballo Rial, Rosa Vázquez López, Ezequiel Manuel			
E-mail	ezequiel@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This matter presents the most relevant aspects of the Chemistry of the Transition Metals as well as an important class of derivatives known as coordination compounds.			

Competencies		
Code		Typology
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	• know
CE7	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: kinetics of change, including catalysis and reaction mechanisms	• Know How
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	• know • Know How
CE9	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: characteristic properties of the elements and their compounds, including group relationships and variations in the periodic table	• know • Know How
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	• know • Know How
CE14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules	

Learning outcomes	
Learning outcomes	Competences
Classify ligands and coordination compounds, as well as recognize the presence of isomers.	CE12
Define the global and steps thermodynamic stability constants of one complex and describe the chelate, macrocyclic and cryptate effects	CE2 CE14
Deduce the spectroscopic terms for stable electronic configurations of the transition metals in a coordination compound	CE9
Construct and interpret a qualitative energy diagram of molecular orbitals in octahedral complexes	CE12 CE14
Interpret the electronic spectra of octahedral, tetrahedral and square planar complexes of transition metals and rationalize their magnetic behavior	CE8 CE14
Describe the different mechanisms of substitution and rationalize the various products obtained in substitution reactions in octahedral and square planar complex.	CE7
Describe how you can get metals from their natural resources	CE9
Being able to differentiate the behavior between the elements of the first transition series and the second and third.	CE9
Predicting the reactivity of the metal oxides, halides and of those of the coordination compounds based on the bond and on the oxidation state of the metal.	CE9
Rationalize the thermodynamic stability of coordination compounds, depending on the oxidation state of the metal and the type of ligand.	CE9 CE12 CE14

Contents
Topic

Subject 1: Introduction to the Chemistry of the transition metals.	Physical properties. Electronic configuration. Multielectrons Systems. Microstates and spectroscopic terms. Reactivity and characteristic properties. General methods of obtention and purification of metals
Subject 2: Coordination Chemistry.	Numbers and geometry of coordination. Ligand types. Isomerism in metal complexes. Nomenclature.
Subject 3: Bond in coordination compounds (I): Crystal field theory	Theory of crystal field. Complexes of weak and strong field. Tetrahedric and square-plane complexes.
Subject 4: Chemistry of the group 3 and 4 metals.	Obtention methods and uses. Usual oxidation numbers. Representative compounds of titanium: halides, oxides and mixed oxides. Coordination compounds.
Subject 5: Chemistry of the group 5 metals.	Obtention methods and uses. Usual oxidation numbers. Representative compounds of vanadium: halides, oxides and mixed oxides. Coordination compounds.
Subject 6: Bond in coordination compounds (II).	Molecular orbital theory in octahedral complexes. Metal-ligand interaction.
Subject 7: Spectroscopic and magnetic properties of the complexes.	Energetic states. Rules of selection. General characteristics of the electronic spectra. Magnetic behavior
Subject 8: Thermodynamic properties of the coordination compounds.	Stability constants and affecting factors them. Chelate, macrocycle and crystate effects.
Subject 9: Reaction mechanisms in coordination compounds.	Reactions of substitution in octahedral and square-plane complexes. Processes of electronic transfer
Subject 10: Chemistry of the group 6 metals.	Production methods and uses. Usual oxidation numbers. Representative compounds of chromium: halides, oxides and oxoanions. Coordination compounds.
Subject 11: Chemistry of the group 7 metals.	Production methods and uses. Usual oxidation numbers. Representative compounds of manganese: halides, oxides and oxoanions. Coordination compounds. Bioinorganic chemistry of manganese and technetium.
Subject 12: Chemistry of the group 8 metals.	Production methods and uses. Usual oxidation numbers. Representative compounds of iron: halides, oxides and oxoanions. Coordination compounds. Bioinorganic chemistry of iron.
Subject 13: Chemistry of the group 9 metals.	Production methods and uses. Usual oxidation numbers. Representative compounds of cobalt: halides, oxides and oxoanions. Coordination compounds. Bioinorganic chemistry of cobalt.
Subject 14: Chemistry of the group 10 metals.	Production methods and uses. Usual oxidation numbers. Representative compounds of nickel: halides, oxides and oxoanions. Coordination compounds. Bioinorganic chemistry of platinum.
Subject 15: Chemistry of the group 11 metals. .	Production methods and uses. Usual oxidation numbers. Representative compounds of copper: halides, oxides and oxoanions. Coordination compounds. Bioinorganic chemistry of copper and gold.
Subject 16: Chemistry of the group 12 metals.	Production methods and uses. Usual oxidation numbers. Representative compounds of zinc and mercury: halides, oxides and oxoanions. Coordination compounds. Bioinorganic chemistry of the elements of the group.

Planning

	Class hours	Hours outside the classroom	Total hours

Seminars	26	26	52
Lecturing	26	39	65
Problem and/or exercise solving	2	2	4
Problem and/or exercise solving	0	21	21
Essay questions exam	4	4	8

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

Methodologies

	Description
Seminars	Seminar classes will be devoted to the resolution of case studies related to the subject as well as the resolution of questions or issues that arise in the development of each topic. Beheld also hold seminars that address issues not taught in other courses but necessary for the progress of the course.
Lecturing	The lectures will be devoted to presenting the fundamental aspects.

Personalized assistance

Methodologies	Description
Lecturing	Throughout the educational period students can consult any doubts on the matter tutorials or previous appointment.
Seminars	Throughout the educational period students can consult any doubts on the matter tutorials or previous appointment.

Assessment

	Description	Qualification	Evaluated Competencess
Lecturing	In the lectures they may ask students to solve simple issues that will have to deliver at that time and will serve for the evaluation. The score will be considered only if the test is long reaches a score of 3 or above on 10 points.	5	CE2 CE7 CE8 CE12
Seminars	In the lectures they may ask students to solve simple issues that will have to deliver at that time and will serve for the evaluation. The score will be considered only if the test is long reaches a score of 3 or above on 10 points.	10	CE2 CE7 CE8 CE12 CE14
Problem and/or exercise solving	There will be two short tests throughout the school period of 1-2 hours each. The score will be considered only if the test is long reaches a score greater than or equal to 3 points out of 10.	30	CE2 CE7 CE8 CE9 CE12 CE14
Problem and/or exercise solving	Throughout the course they ask students to do exercises to perform such work. The solutions must be submitted in a timely manner previously established. It is possible that the teacher ask the student to defend his response delivered before proceeding with the assessment. The score will be considered only if the test is long reaches a score greater than or equal to 3 points out of 10.	15	CE2 CE7 CE8 CE9 CE12 CE14
Essay questions exam	There will be a test at the end of the semester in which students must resolve all issues related to the presented contents.	40	CE2 CE7 CE8 CE9 CE12 CE14

Other comments on the Evaluation

Conditions to opt the continuous evaluation:

- Attendance at lectures and seminars is mandatory.The student has to mandatorily assist it all the class and seminars.

- To pass the course the professor must have time and form of a minimum of 80% of the exercises proposed in the various activities and presences. It is also mandatory for the student to present all written tests planned to pass the course.

- The no fulfillment of the conditions involves the loss of the right to the continuous evaluation

Development of continuous evaluation:

- The competencies of the subject relating to the competencies of the degree (A1-A3, A5, A10, A12 and A20) will be assessed explicitly in classroom exercises and written tests. The transferable skills will be evaluated implicitly by the qualification of the exercises (B2, B3 and B4).

- Will need a score greater than or equal to 30% of the total value in each of written tests (short and final) and the sum total of the qualifications of the deliverables to the final qualification note the rest of the elements of evaluation (exercises and short tests). Failure to achieve any of the minimum, in the act appear the result of the tests and weighted exercises in which qualified reached criterion.

- Students who fail the course at the end of the semester will take a written test in the closing period of evaluation in the final month of July. This test will be worth 40% of the mark and replace the test results at the end of the semester. The qualification of the exercises (classroom activities) and short tests are not recoverable.

In the case of not achieving the conditions for continuous evaluation, it/the student will be able to presented the a proof at the end of the semester where will owe to resolve questions related with all the specific skills of the subject. In each question or question, the kind of skill being evaluated will be identify. This proof will be different in extension to the realized by those that opt by continuous evaluation. In this case:

1.- It will be necessary to obtain a minimum of 3 points on 10 of average in the evaluation of each specific competition to surpass the subject.

2.- It will be necessary to obtain an equal global qualification or upper to 5 on 10 in this proof to surpass the subject and, in any case previous qualifications obtained during the semester will be not considered.

3.- The qualification will not be affected by the normalization applied to be upper to 7 points.

Sources of information
Basic Bibliography
Complementary Bibliography
Housecroft, C.E. e Sharpe, A.G., Inorganic chemistry, 3º Ed.,
Winter, Mark J., D-block chemistry, Oxford : Oxford University Press, 1994,
Housecroft, Catherine E., The Heavier d-block metals : aspects of inorganic and coordination chemistry, Oxford : Oxford University Press, 1999,
Atkins, Peter, Inorganic Chemistry, Oxford : Oxford University Press, 2010,
Housecroft, C.E. e Sharpe, A. G., Inorganic chemistry, 4º ed.,

Recommendations
Subjects that continue the syllabus
Materials chemistry/V11G200V01702
Inorganic chemistry III/V11G200V01703

Subjects that it is recommended to have taken before
Physical chemistry I/V11G200V01303
Physical chemistry II/V11G200V01403
Inorganic chemistry I/V11G200V01404

IDENTIFYING DATA				
Project				
Subject	Project			
Code	V11G200V01701			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	Spanish			
Department				
Coordinator	Canosa Saa, Jose Manuel			
Lecturers	Canosa Saa, Jose Manuel Díez Sarabia, Aida María Fernández Requejo, Patricia			
E-mail	jcanosa@uvigo.es			
Web				
General description	"Machine translation into english of the original teaching guide" The main aim of this subject is to give the students the methodology, direction, management and organisation of projects in the field of the Chemistry. With the knowledge in Chemistry, Chemical Engineering and other affine matters, the student has to be able to develop a Project in Chemistry. At the end of the course the student has to be able to draft, schedule, execute and direct industrial projects in the field of the Chemistry			

Competencies		
Code		Typology
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• know • Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• know • Know How
CE22	Process and perform computational calculations with chemical information and chemical data	• Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• Know How
CE24	Recognize and analyze new problems and plan strategies to solve them	• know • Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know How
CT3	Learn independently	• Know How
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• know • Know How
CT7	Apply theoretical knowledge in practice	• know • Know How
CT8	Teamwork	• Know How
CT9	Work independently	• Know How
CT12	Plan and manage time properly	• Know How
CT13	Make decisions	• Know How
CT14	Analyze and synthesize information and draw conclusions	• Know How
CT15	Evaluate critically and constructively the environment and oneself	• Know How • Know be
CT16	Develop an ethical commitment	• Know be
CT17	Develop concern for environmental aspects and quality management	• Know be
CT18	Generate new ideas and show initiative	• Know How

Learning outcomes	
Learning outcomes	Competences

Evaluate the feasibility of the realisation of a project related with the competitions of a chemist	CE20 CE23 CE24 CT1 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15 CT16
*Recopilar And analyse the necessary information for the realisation of the project in Chemistry, including normative appearances and of market	CE20 CE22 CE23 CE24 CT4 CT5 CT8 CT9 CT12 CT13 CT14 CT15 CT16
Organise and manage the diverse stages of realisation of a project in Chemistry	CE20 CE23 CE24 CT3 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15 CT16 CT17 CT18
Define the suitable scope of a project, taking into account technical appearances, economic, geographic and environmental	CE19 CE20 CE22 CE23 CE24 CT1 CT3 CT4 CT6 CT7 CT8 CT9 CT13 CT14 CT17 CT18
Realise the calculations associated to the development of a project	CE19 CE20 CE22 CT3 CT7 CT8 CT9 CT12 CT14

Estimate the costs and potential profitability of a project	CE19 CE20 CE22 CT3 CT6 CT7 CT9 CT14 CT15
Analyse the environmental implications of a project, and propose preventive measures and of improvement if it was necessary	CE19 CE20 CE22 CE24 CT1 CT7 CT8 CT9 CT12 CT14 CT16 CT17
Evaluate the potential impact (environmental, socioeconomic) of a project	CE19 CE20 CE23 CE24 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT15 CT16 CT17 CT18
Elaborate technical reports very structured and drafted and present the same using the audiovisual means more suitable	CE20 CE23 CE24 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT18

Contents	
Topic	
Subject 1. The projects in chemistry	Professional competitions of the chemists. Definition and aims of a Project. *Caracteristicas. Stages and classification of a Project. Organisation. Norms, regulations and legislation
Subject 2. Design of a project	*Analisis Preliminary of feasibility and alternative Study of market Size of the project Location Approach of a project
Subject 3. Engineering of the project	Development of a project, stages, calculations, diagrams of flow and balances. Teams

Subject 4. Economic evaluation of a project	Investment. Costs of production and management Profitabilities Analysis of risk
Subject 5. Environmental evaluation of a project	Preventive Measured pollution and/or of correction Waste Cycle of Life
Subject 6. Documentation of a project	Memory Methods Norms

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	13	22	35
Seminars	22	58	80
Problem solving	2	7	9
Presentation	2	5	7
Objective questions exam	0	4	4
Essay questions exam	3	8	11
Essay	0	4	4
*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 sessions *magistrales are theoretical classes to all the group in 13 weeks and of an hour of length (13 *x 1 *h/*sem). They will consist in the exhibition by part of the professor of the most fundamental appearances of each subject, taking like base the available documentation in the platform FEAR. The students will have to work, before each session, the material that provides him the professor related with the content that will treat in each subject.
Seminars	They will give to groups reduced, in 13 weeks (13 *x 2 *h/*sem). The students, with the support of the professor, will realise concrete projects (total or partial) of industrial installations, applying the knowledges purchased in the career. They will use computer programs of simulation to build and design the projects realised. It will realise in the classroom of computing.
Problem solving	In each subject, that was necessary, will put to disposal of the students a bulletin of problems. Some of these problems will resolve in class and others will have to be resolved by the students of individual form and deliver them so that they are corrected by the professor.
Presentation	The students of individual form or in group, will have to realise a short exhibition on the results obtained, a discussion of the results together with the conclusions of the project developed along the course

Personalized assistance	
Methodologies	Description
Lecturing	It will give them to know to the students, to principle of course, the schedules of *tutorías in which they will resolve the doubts that exist regarding the theory, problems and works.
Problem solving	It will give them to know to the students, to principle of course, the schedules of *tutorías in which they will resolve the doubts that exist regarding the theory, problems and works.
Seminars	It will give them to know to the students, to principle of course, the schedules of *tutorías in which they will resolve the doubts that exist regarding the theory, problems and works.
Presentation	It will give them to know to the students, to principle of course, the schedules of *tutorías in which they will resolve the doubts that exist regarding the theory, problems and works.
Tests	Description
Objective questions exam	It will give them to know to the students, to principle of course, the schedules of *tutorías in which they will resolve the doubts that exist regarding the theory, problems and works.
Essay questions exam	It will give them to know to the students, to principle of course, the schedules of *tutorías in which they will resolve the doubts that exist regarding the theory, problems and works.
Essay	It will give them to know to the students, to principle of course, the schedules of *tutorías in which they will resolve the doubts that exist regarding the theory, problems and works.

Assessment		
	Description	QualificationEvaluated Competencess

Problem solving	The students will have to deliver, in the terms indicated, the problems proposed	5	CE19 CE20 CE22 CE24 CT3 CT4 CT6 CT7 CT8 CT9 CT12 CT14 CT15 CT18
Presentation	The students will realise an exhibition of the project realised	10	CE23 CT1 CT3 CT5 CT8 CT9 CT12 CT14
Objective questions exam	They will realise two test type test along the course. One when finalising the two first subjects and the another when finalising the subject 3. The length of the same will be between 20 minutes and 1 hour	10	CE19 CT3 CT7 CT9 CT12 CT14
Essay questions exam	It will realise a long proof of all the matter of the *asignatura	35	CE19 CT3 CT7 CT9 CT12 CT14
Essay	The students will realise and will deliver in the dates indicated, all the parts of the project that proposes him to principle of course	40	CE20 CE22 CE24 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15 CT16 CT17 CT18

Other comments on the Evaluation

FIRST ANNOUNCEMENT&*nbsp;To
surpass the *asignatura is compulsory to obtain, like minimum 50% of
the qualification assigned to the total realisation of the project (project, seminars and
presentation/exhibition), being necessary, besides reach like minimum a 3
on 10 points in the final proof to take into account the other elements of
evaluation.CONDITION
OF PRESENTED: The participation of the student in any one of the proofs
written, the delivery of some work, or the assistance to two or&*nbsp; more sessions of seminar &*nbsp;it will involve the condition of presented and therefore
the allocation of a qualification&*nbsp;SECOND ANNOUNCEMENTIn this
announcement the students will have to present to those parts of the *asignatura that have not been surpassed previously.Ethical commitmentit expects that the present student a suitable ethical behaviour. In case to detect a no ethical behaviour (copy, plagiarism, utilisation of unauthorised electronic devices, for example), will consider that the student does not gather the necessary requirements to surpass the matter.

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 gestíon de proyectos para ingenierios 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 continue the syllabus

Industrial chemistry/V11G200V01904

Subjects that it is recommended to have taken before

Chemical engineering/V11G200V01502

IDENTIFYING DATA				
Materials chemistry				
Subject	Materials chemistry			
Code	V11G200V01702			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Bolaño García, Sandra			
Lecturers	Bolaño García, Sandra Tojo Suárez, María Concepción			
E-mail	bgs@uvigo.es			
Web				
General description	Structure, properties and application of the different types of materials.			

Competencies		
Code		Typology
CE5	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Characteristics of the different states of matter and the theories used to describe them	• know
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	• know
CE18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry	• know
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know How
CT3	Learn independently	• Know How
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT7	Apply theoretical knowledge in practice	• know • Know How
CT8	Teamwork	• Know How • Know be
CT9	Work independently	• Know How
CT12	Plan and manage time properly	• Know How
CT13	Make decisions	• Know How
CT14	Analyze and synthesize information and draw conclusions	• Know How
CT15	Evaluate critically and constructively the environment and oneself	• Know How

Learning outcomes	
Learning outcomes	Competences
Analyse the characteristics of metals and alloys through essays of traction and compression.	CE5 CE19 CE20 CT1 CT7 CT9
Differentiate between electrical and ionic conductivity. Distinguish the intrinsic semiconductors of the extrinsic.	CE5 CE19 CE20 CT1 CT7 CT9
Differentiate between the cooperative magnetism and the no cooperative.	CE5 CE19 CE20 CT1 CT9

Recognise hard magnetic materials and soft from his cycle of histéresis.	CE5 CE19 CE20 CT1 CT9
Recognise the types of superconductivity and his relation with the nature of the material.	CE5 CE19 CE20 CT1 CT9
Describe the optical properties of the metals and no metals.	CE5 CE19 CT1 CT9
Describe the applications of the optical phenomena more important.	CE5 CE19 CT1 CT9
Explain the thermal properties more important of the materials.	CE5 CE19 CE20 CT1 CT9
Analyse and describe the characteristics of the alloys in function of his diagrams of phases.	CE5 CE19 CE20 CT1 CT7 CT9 CT12 CT13 CT14
Describe the properties of the different ceramic materials and polymers.	CE5 CE20 CT1 CT7 CT9
Describe the general characteristics of the compound materials.	CE20 CE23 CT1 CT3 CT4 CT5 CT8 CT12 CT14 CT15
Analyse the corrosion of metals and ceramic and the degradation of the polymers.	CE18 CT1 CT8 CT14
Justify and enter the need of new materials and nanomaterials.	CE20 CE23 CT1 CT3 CT4 CT5 CT8 CT12 CT14 CT15

Describe the basic processes for the obtaining of nanomaterials.	CE5 CE20 CE23 CT1 CT3 CT4 CT7 CT8 CT9 CT13 CT15
Tackle the basic technicians of study of the surfaces of the materials.	CE8 CE23 CT1 CT3 CT4 CT5 CT8 CT12 CT14 CT15

Contents	
Topic	
Subject 1. Introduction	Historical perspective of the development of the materials. Relation between structure and properties. Classification of the materials. Need of new materials.
Subject 2. Properties of the materials.	Mechanical properties. Electrical properties. Magnetic properties. Optical properties. Thermal properties.
Subject 3. Metallic materials and alloys.	Diagrams of phase. Thermal treatment of the metallic alloys. ferric Alloys. Steels. No-Ferric Alloys. Alloys with memory of form.
Subject 4. Ceramic materials.	Usual structures. Sillicates. Carbon. Imperfections. Glasses. Clays. Refractory.
Subject 5. Material polymers.	Structures of the polymers. Mechanical and thermomechanical characteristics. Thermoplastic and thermostable polymers. Applications and forming of the polymers.
Subject 6. Compound materials.	General characteristics. Classification. Materials reinforced with: particles, fibres and structural compounds.
Subject 7. Degradation of materials.	Metallic oxidation and passivation. Methods of protection against the corrosion. Methods of self-reparation.
Subject 8. New materials and nanomaterials.	Nanoscience and nanotechnology. Methods of preparation. Properties to nanoscale.
Subject 9. Characterisation of materials.	Electronic microscopy, fotoelectrónic spectroscopy.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	26	45	71
Seminars	13	32	45
Problem and/or exercise solving	4	30	34
*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 students will receive 26 hours of magistral classes in an only group, that will devote to the presentation of the fundamental appearances of each subject. The platform of ¨teledocencia¨ will use to provide the supplementary material related with the matter.
Seminars	They will devote to the resolution of doubts or questions that arise in the development of each subject, to the exhibition by part of the students of subjects related with the matter, as well as to the resolution of exercises and exposed problems by the professor.

Personalized assistance	
Methodologies	Description
Seminars	During all the educational period the students will be able to consult all type of doubts related with the matter in the tutorial hours.

Assessment			
	Description	Qualification	Evaluated Competencess
Seminars	In addition to resolving practical exercises that allow to the students 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 to continuous evaluation of the students. This process of continous evaluation will make through the resolution of exercises and/or problems related with the contents of the matter, as well as the resolution of exposed short questions by the professor/to that the students will have to deliver for his evaluation. Also it can carry out by means of the preparation and exhibition by part of the students of subjects related with the matter.	40	CE5 CE8 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Problem and/or exercise solving	To the long of the quadrimester will make two short proofs for the evaluation of the competitions purchased in the matter. The first of them will cover the subjects 1-5 and will suppose 36% of the final note. The second will cover the subjects 6-9 and will suppose 24% of the final note. To surpass the matter is necessary to reach a minimum of 40% in each one of the short proofs.	60	CE5 CE8 CE18 CE19 CE20 CT1 CT7 CT12 CT13

Other comments on the Evaluation

Observations: The participation in any of the proofs of 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 grade of each one) to be able to take into account the other elements of evaluation.

Evaluation of July: The students that do not pass one or the two short proofs done during the quadrimester will have to present those proofs. This proof substitute to the results obtained in the/s short proof/s done to the long of the quadrimester. The final grade could be he highest obtained when comparing the final examination grade and the weighted examination note with the continuous evaluation.

Sources of information

Basic Bibliography

Complementary Bibliography

Callister, W.D., Rethwisch, D.G., Materials Science and Engineering, Wiley, 2015

Callister, W.D., Rethwisch, D.G., Introducción a la Ciencia e Ingeniería de los Materiales, Reverté (trad. 9ºed), 2016

Kirkland, A.I., Hutchison, J.L., Nanocharacterisation, RSC, Cambridge, 2007

Levine, I.N., Fisicoquímica, McGraw-Hill / Interamericana de España, S. A., 2014

Singh, S. C, Hoboken J., Nanomaterials, John Wiley & Sons, 2012

Smart, L.E. Moore, E.A., Solid State Chemistry. An introduction, Taylor & Francis, 4ªed, 2012

Vollath, D., Nanomaterials : an introduction to synthesis, properties and application, Wiley-VCH, 2013

West, A.R.., West, A.R.. Solid state chemistry and its applications, John Wiley & Sons., 2014

Recommendations

Subjects that are recommended to be taken simultaneously

Inorganic chemistry III/V11G200V01703

Subjects that it is recommended to have taken before

IDENTIFYING DATA				
Inorganic chemistry III				
Subject	Inorganic chemistry III			
Code	V11G200V01703			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	4th	1st
Teaching language	Spanish			
Department				
Coordinator	Bravo Bernárdez, Jorge			
Lecturers	Bolaño García, Sandra Bravo Bernárdez, Jorge Carballo Rial, Rosa García Fontán, María Soledad Pérez Lourido, Paulo Antonio Valencia Matarranz, Laura María			
E-mail	jbravo@uvigo.gal			
Web				
General description	The first part of the subject centres in the structural study and the structure/properties relationship as well as the main methods of preparation of inorganic solids that represent an important contribution to the field of material science. The second part of the subject devotes to the study of the organometallic compounds. It will be developed the basic aspects referred to the obtaining, description of the bonding, spectroscopic characterisation, reactivity and applications of these compounds. In the laboratory will be realised experiences of synthesis and characterisation of coordination compounds, organometallic compounds and inorganic solids.			

Competencies		
Code		Typology
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	• Know How
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	• know
CE10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds	• know
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	• know
CE14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules	• know
CE20	Evaluate, interpret and synthesize data and chemical information	• Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• Know How
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	• Know How
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work	• Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	• Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	• Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• know
CT3	Learn independently	• know
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• Know How
CT7	Apply theoretical knowledge in practice	• know
CT8	Teamwork	• Know be
CT9	Work independently	• Know be
CT12	Plan and manage time properly	• Know How
CT13	Make decisions	• Know be
CT14	Analyze and synthesize information and draw conclusions	• know
CT15	Evaluate critically and constructively the environment and oneself	• Know be

Learning outcomes	
Learning outcomes	Competences
Recognise and predict the main structural types of solids and their implications in the chemical and physical properties.	CB5 CE12 CE14 CT1 CT3 CT4 CT5 CT9 CT14
Enumerate and recognise the types of defects in crystals and their effects on the properties of the solid.	CB5 CE12 CE14 CT1 CT3 CT4 CT5 CT9 CT14
Define solid electrolytes, recognising their general characteristics and applications.	CE2 CE12 CE14 CT1 CT3 CT4 CT14
Identify non-stoichiometric compounds.	CE2 CE12 CE20 CT1 CT3 CT4 CT9 CT14
Recognise the effect of the addition of impurities on the colour and the optical properties of some inorganic solids.	CB5 CE2 CE12 CE14 CE20 CT1 CT3 CT4 CT9 CT14
Identify the main methods of preparation of inorganic solids.	CE2 CE14 CE20 CT1 CT3 CT4 CT14
Describe methodologies for crystallogenesis	CE2 CT1 CT3 CT4
Define organometallic compound . Describe the bonding between a metal and the different types of common ligands.	CE10 CE12 CE14 CE23 CT1 CT3 CT4 CT5 CT9 CT14

Rationalise the information that usual spectroscopyc techniques provide for the characterisation of the different types of organometallic compounds.	CE10 CE12 CE14 CE20 CE23 CT1 CT3 CT4 CT5 CT9 CT14
Identify the main types of organometallic reactions .	CE2 CE10 CE23 CT1 CT3 CT4 CT5 CT14
Describe the products of the most important reactions of carbonyl, olefin, carbene and cyclopentadiene complexes.	CE2 CE10 CE14 CE20 CE23 CT1 CT3 CT4 CT5 CT9 CT14
Describe the bases of the isolobal analogy. Apply the Wade's rules for metallic clusters.	CE10 CE12 CE14 CE20 CE23 CT1 CT3 CT4 CT5 CT9 CT14
Describe some important catalytic cycles.	CE2 CE10 CE14 CE20 CE23 CT1 CT3 CT4 CT5 CT9 CT14

Carry out in the laboratory the preparation, characterisation and the study of some physical and chemical properties of the metals and their compounds.	CE2 CE10 CE14 CE20 CE25 CE26 CE27 CE28 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Contents	
Topic	
Subject 1. Organometallic chemistry of the main groups elements.	Introduction. Synthesis, properties and applications of the organometallic compounds of Li, Mg, B and Al.
Subject 2. Organometallic chemistry of the transition metals (I)	Introduction. Types of ligands. Bonding. Characterisation.
Subject 3. Organometallic chemistry of the transition metals (II)	Types of organometallic reactions: substitution, oxidative addition, reductive elimination, insertion, reactions of coordinated ligands, etc.
Subject 4. Organometallic chemistry of the transition metals (III)	Reactivity of organometallic compounds: carbonyl, olefin, carbene, and cyclopentadiene complexes.
Subject 5. Organometallic catalysis.	Introduction. Olefin metathesis. Alkene hydrogenation. Carbonylation of methanol. Hydroformylation of alkenes.
Subject 6. Metallic clusters	Introduction. Types. Structure. Properties.
Subject 7. Inorganic solids: introduction and bases.	Technological importance of the inorganic solids. Classification of solids. Polymorphism, pseudomorphism, polytypism. Formulation of inorganic solids incorporating structural information.
Subject 8. Structural rationalization in inorganic solids.	Sphere packing. Linear, planar, and theoretical densities and packing factors. Interstitial sites in crystal structures. Determining principles of the structure of the solids. Main solid structures.
Subject 9. Defects and no stoichiometry in the solids.	Types of defects. Ionic conductivity. Solid electrolytes. Non- stoichiometric compounds. Solids of different dimensionality. Diffusion.
Subject 10. Methods of preparation of solids.	Ceramic methods. Microwave methods. Sol-gel method. Precursor method. Hydrotermal methods. Chemical vapor deposition and chemical vapor transport (CVD and CVT), etc.
Practices of the chemistry of the coordination compounds (5 sessions)	Preparation and characterisation of some coordination compounds.
Practices of organometallic chemistry (4 sessions)	Preparation and characterisation of some organometallic compounds.
Practices of inorganic solids (4 sessions)	Preparation and study of the properties of some inorganic solids.

Planning			
	Class hours	Hours outside the classroom	Total hours
Seminars	13	42	55
Laboratory practical	45.5	20.5	66
Lecturing	26	50	76
Problem and/or exercise solving	4	24	28
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Seminars	They will devote to the resolution of doubts or questions that arise in the development of each subject, to the exhibition by part of the students of any of the subjects related with the matter, and/or to the resolution of questions, exercises and problems proposed by the professor.
Laboratory practical	They will realise practices of laboratory in which they will apply the theoretical knowledges adquired. The practices will be realised in 13 sessions of 3,5 hours each and the students will have to reflect and interpret the facts observed in the corresponding notebook lab.

Lecturing	The students, in an only group, will receive 26 one-hour lectures in which the professor will give to know the most important aspects of each subject.

Personalized assistance

Methodologies	Description
Seminars	The students will be able to consult all type of doubts related with the matter in the scheduled tutorials.
Laboratory practical	The students will be able to consult all type of doubts related with the matter in the scheduled tutorials.

Assessment

	Description	Qualification	Evaluated Competencess
Seminars	In addition to resolving practical exercises that allow the students to settle the knowledges on the subjects developed in the lectures, and to resolve all the exposed doubts, the classes of seminar will be used to carry out the students continuous evaluation. This process of continuous evaluation will be done through the resolution of exercises related with the contents of the matter as well as the resolution of short questions proposed by the professor. Also it will be able to carry out by means of the preparation and presentation by the students of subjects related with the subject.	25	CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT14
Laboratory practical	They are compulsory and will value the realisation of the practices of laboratory in which it refers so much to the fulfillment of the experimental aim foreseen how to the interpretation of the observed phenomena. The students have to do an examination at the end of each one of the three blocks of the experiments. Those students who have passed the practices during the previous course may request not to repeat them in the current course, maintaining the grade obtained.	20	CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Problem and/or exercise solving	The students will realise two 2-hours written proofs.	55	CB5 CE2 CE10 CE12 CE14 CE20 CT1 CT14

Other comments on the Evaluation

Observations: The participation in any of the proofs of planned evaluation and the assistance to two or more sessions of laboratory will involve the condition of presented and, therefore, the allocation of a qualification in the record of the matter. It will be necessary to obtain a minimum of 4 points on 10 in the qualification of each one of the planned short proofs to be able to take into account, in the final qualification, the remaining elements of evaluation. In the evaluation of July the

students will have to do a written proof that will consist of two parts that will correspond with the items evaluated in the two short proofs realised during the course. It will not be necessary to realise the part of the proof that, in the corresponding short proof, obtained an equal or upper qualification to 4 on 10, keeping the qualification obtained. This proof will have a value of 55% of the qualification and will substitute to the results of the short proofs. 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 as final qualification of the matter.

Sources of information

Basic Bibliography

C. E. Housecroft y A. G. Sharpe., Inorganic Chemistry, 4, Pearson, 2012,

Complementary Bibliography

A. R. West, Solid State Chemistry and its applications, 2, Wiley, 2014, USA
L. Smart, E. Moore, Solid State Chemistry. An introduction, 4, CRC, 2012,
G. O. Spessard, G. L. Miessler, Organometallic chemistry, 2, Oxford University Press, 2010,
R. H. Cabtree, The organometallic chemistry of the transition metals, 6, Wiley, 2014, USA

Recommendations

Subjects that it is recommended to have taken before

Inorganic chemistry I/V11G200V01404
Organic chemistry I/V11G200V01304
Inorganic chemistry II/V11G200V01604
Organic chemistry II/V11G200V01504

IDENTIFYING DATA				
Organic chemistry III				
Subject	Organic chemistry III			
Code	V11G200V01704			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	4th	1st
Teaching language	Spanish			
Department				
Coordinator	Rodríguez de Lera, Angel			
Lecturers	Álvarez Rodríguez, Rosana Fall Diop, Yagamare Rodríguez de Lera, Angel Tojo Suárez, Emilia			
E-mail	qolera@uvigo.es			
Web				
General description	This subject will integrate all the previous knowledge of Organic Chemistry, in particular regarding organic synthesis and his consequences in the creation of new stereogenic elements. For this, will use the tools of rethrosynthetic analysis , paying particular attention to the analysis of synthetic proposals that take place with selectivity (chemo-, regio- and stereoselectivity).			

Competencies		
Code		Typology
CB1	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	• know
CB2	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	• Know How
CB4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences	• Know be
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	• Know How
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	• know
CE10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds	• know
CE11	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: nature and behavior of functional groups in organic molecules	• know
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	• know
CE13	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main synthetic routes in organic chemistry, including interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds	• know
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• Know be
CE24	Recognize and analyze new problems and plan strategies to solve them	• Know How
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	• Know How
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work	• Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	• Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	• Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know be
CT3	Learn independently	• Know be
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT7	Apply theoretical knowledge in practice	• Know How
CT8	Teamwork	• Know be
CT9	Work independently	• Know be
CT13	Make decisions	• Know be

CT14 Analyze and synthesize information and draw conclusions	• Know be
CT15 Evaluate critically and constructively the environment and oneself	• Know be
CT18 Generate new ideas and show initiative	• know

Learning outcomes

Learning outcomes	Competences
1. Recognise structural elements in organic molecules.	CB2 CE2 CE11 CE12 CE13 CE23 CE24 CT1 CT3 CT7 CT9 CT13 CT14 CT18
2. Propose retrosynthetic sequences of target molecules.	CB1 CB2 CB5 CE2 CE11 CE12 CE13 CE24 CT1 CT3 CT4 CT5 CT7 CT9 CT13 CT18
3. Analyse alternative retrosynthetic proposals.	CB1 CB2 CB5 CE2 CE10 CE11 CE12 CE13 CE20 CE24 CT1 CT3 CT4 CT5 CT7 CT9 CT13 CT18

4. Design synthetic sequences to target molecules.	CB1 CB2 CB5 CE2 CE10 CE11 CE12 CE13 CE20 CT1 CT3 CT4 CT5 CT7 CT9 CT13 CT18
5. Value the use of structure-simplifying reactions.	CB1 CB2 CB5 CE2 CE10 CE11 CE12 CE13 CE20 CE24 CT1 CT3 CT4 CT7 CT9 CT13 CT14 CT18
6. Recognise relationships between functional groups of target molecules.	CB1 CB2 CB5 CE2 CE10 CE11 CE12 CE13 CE20 CE24 CT1 CT3 CT4 CT7 CT9 CT13 CT18

7. Use properly the functional groups interconversions.	CB1 CB2 CB5 CE2 CE10 CE11 CE12 CE13 CE20 CE24 CT1 CT3 CT4 CT5 CT7 CT9 CT13 CT14 CT18
8. Propose synthesis of carbocyclic and heterocyclic compounds.	CB1 CB2 CB5 CE2 CE10 CE11 CE12 CE13 CE20 CE24 CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT7 CT9 CT13 CT14 CT18
9. Know the reactivity of heterocyclic compounds.	CB1 CB2 CB5 CE2 CE10 CE11 CE12 CE13 CE20 CE24 CE26 CE27 CE28 CT1 CT3 CT4 CT7 CT9 CT13 CT14 CT18

10. Know the reactions that can provide selectivity (chemo-, regio- and stereoselectivity) in chemical transformations.	CB1 CB2 CB5 CE2 CE10 CE11 CE12 CE13 CE19 CE20 CE24 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT13 CT14 CT18
11. Handle appropriately the disconnections between unsaturated fragments.	CB1 CB2 CB5 CE2 CE10 CE11 CE12 CE13 CE20 CE24 CT1 CT3 CT4 CT5 CT7 CT9 CT13 CT14 CT18
12. Evaluate and propose the use of protective groups in organic synthesis.	CB1 CB2 CB5 CE2 CE10 CE11 CE12 CE13 CE20 CE24 CT1 CT3 CT4 CT7 CT9 CT13 CT14 CT18
13. Recognise and value the importance of organic synthesis in the advancement of society.	CB2 CB4 CB5 CE23 CT15

Contents

Topic

1. THE DESIGN OF ORGANIC SYNTHESIS. RETROSINTHETIC ANALYSIS	1.1. Introduction to target-oriented synthesis. 1.2. Rethrosynthetic analysis. The synthon approach. Transforms and rethrons. Strategic disconnections. The synthesis tree. i. Preliminary evaluation. ii. Simplifying transforms. iii. Powerful transforms. iv. Interconversion, addition and removal of functional groups. 1.3. Computer-based synthetic strategies.
2. CRITERIA OF SELECTION OF DISCONNECTIONS	2.1. One- and two-group C-X disconnections (1,n). i. Synthons snd synthetic equivalents. ii. Alternate polarities. iii. Inversion of polarity. iv. Functional groups interconversions. v. Addition and removal of functional groups. 2.2. One- and two-group C-C disconnections (1,n). i. One-group C-C disconnections. ii. (1,n) C-C disconnections of difuncionalized compounds. 2.3. Tactics of skeletal transformations. Rearrangements and fragmentations.
3. FUNCTIONAL GROUPS INTERCONVERSIONS	3.1. Interconversion of functional groups by substitution, addition and elimination. 3.2. Oxidation reactions. i. Transition metals (*Cr and *Mn). ii. Methods based in the generation of "activated DMSO". iii. Hypervalent iodine reagents. iv. Olefin epoxidation and dihydroxylation. 3.3. Reduction reactions.
4. CHEMOSELECTIVITY. PROTECTIVE GROUPS IN ORGANIC SYNTHESIS	4.1. Strategies for the selection of protective groups: orthogonal or of modulated sensitivity . 4.2. Description of protective groups. i. Sensitive to acids or bases. ii. Sensitive to fluoride. iii. Sensitive to reduction and oxidation reagents . iv. Other protective groups.
5. STEREOCHEMICAL STRATEGIES . STEREOSELECTIVITY	5.1. Description of Stereochemistry. i. Symmetry and chirality. Stereogenic units. ii. Topicity. iii. Relative configuration. Descriptors. 5.2. *Stereochemistry in chemical reactions. i. Product selectivity. ii. Simple- and induced-distereoselectivity. 5.3. Disconnections based in chiral fragments.
6. DISCONNECTIONS OF UNSATURATED COMPOUNDS	6.1. Stereoselective olefin synthesis . i. Carbanions stabilised by phosphorous: Wittig and HWE reactions. ii. Carbanions stabilised by silicon: Peterson reaction. iii. Carbanions stabilised by sulphur: Julia reaction. iv. Claisen rearrangement. v. Olefin metathesis. 6.2. Palladium-catalyzed reactions. i. Heck reaction. ii. Stille, Negishi and Suzuki cross-coupling.
7. FORMATION AND REACTIVITY OF CYCLIC COMPOUNDS. TOPOLOGICAL STRATEGIES	7.1. Formation of saturated carbocyclic and heterocyclic compounds. i. Cyclization reactions. The Thorpe-Ingold effect. ii. Baldwin Rules. iii. Formation of carbocyclic compounds. 7.2. Formation of heterocyclic compounds. i. (3+2) Cycloadditions. ii. Condensation of dicarbonyl compounds. 7.3. Properties and reactivity of aromatic heterocyclic compounds. 7.4. Topological strategies in Retrosynthetic Analysis.
LAB EXPERIMENT 1. Preparation of a-D-glucopyranoside pentaacetate	One session
LAB EXPERIMENT 2. Preparation of b-D-glucopyranoside pentaacetate	Two sessions
LAB EXPERIMENT 3. Reactivity of dimethylsulfoxonium methylide with conjugated and nonconjugated carbonyl compounds: synthesis of epoxides and cyclopropanes.	One session

LAB EXPERIMENT 4. Microwave-assisted Diels-Alder reaction	One session
LAB EXPERIMENT 5. Preparation of an Ionic Liquid. Application in the synthesis of coumarines	Two sessions
LAB EXPERIMENT 6. Suzuki reaction in water	One session
LAB EXPERIMENT 8. Total synthesis of a natural product: caffeic acid phenethyl ester (CAPE)	Four sessions

Planning			
	Class hours	Hours outside the classroom	Total hours
Seminars	26	49	75
Laboratory practical	45.5	32.5	78
Lecturing	13	17	30
Problem and/or exercise solving	3	27	30
Essay questions exam	2	10	12

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

Methodologies	
	Description
Seminars	In this activity, which is scheduled to take place twice a week, the most complex topics of the subject will be discussed, and the exercises and problems previously proposed by the teaching staff will be solved.
Laboratory practical	Each student will plan and execute the corresponding lab experiments in sessions lasting 3.5 hours. The students will be provided with the explanation of the lab session by the teaching staff. All the observations, calculations and notes for every experiment will be collected in a lab notebook, which will also include the discussion of the questions posed in the experiment description as well as the spectroscopic characterization of the synthesized compounds.
Lecturing	The teaching staff will explain the general contents of the course paying particular attention to those considered key topics and of the greater difficulty. In anticipation of each master session, all the handouts and presentations will be made available in the TEMA teaching platform for downloading by the students.

Personalized assistance	
Methodologies	Description
Lecturing	The teaching staff will devote the necessary time to solve the requests and questions raised by the students related to the course syllabus, informing beforehand about his/her availability.
Seminars	The teaching staff will devote the necessary time to solve the requests and questions raised by the students related to the course syllabus, informing beforehand about his/her availability.
Laboratory practical	The teaching staff will devote the necessary time to solve the requests and questions raised by the students related to the laboratory practice, paticularly in the lab sessions and beforhand.
Tests	Description
Problem and/or exercise solving	The teaching staff will devote the necessary time to solve the requests and questions raised by the students related to the short answer tests, informing beforehand about his/her availability. In addition, short answer test exams from previous years will be solved in seminars before the official tests take place.
Essay questions exam	The teaching staff will devote the necessary time to solve the requests and questions raised by the students related to the long answer tests, informing beforehand about his/her availability. In addition, long answer test exams from previous years will be solved in seminars before the official tests take place.

Assessment		
	Description	QualificationEvaluated Competencess

Seminars	The resolution of problems and questions posed in the seminar classes, as well as the homework carried out by the students in those tasks of personal work entrusted by the teachers will be valued. Results of the learning: All the indicated, since the seminars will take place along the course.	20	CB1 CB2 CB4 CB5 CE2 CE10 CE11 CE12 CE13 CE19 CE20 CE23 CE24 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT13 CT14 CT15 CT18
Laboratory practical	1.- The work carried out in the laboratory: the assistance to each one of the sessions is compulsory. The attitude and skill of the student in the laboratory and the interpretation of the mechanisms and spectra will be valued. 2.- The laboratory notebook. 3.- Written exam: it will consist on theoretical and practical questions related to the lab experiments. It will take place in the official dates established by the Faculty. To pass the lab course it is mandatory to have passed each one of the three parts evaluated. Those students who passed the lab course in the academic year 2014-2015 are entitled to keep that grade in the present academic year. In the extraordinary exam the student will answer the written examination and will deliver a new laboratory notebook if required, keeping the qualifications obtained during the course in the others parts of the subject. Results of the learning: 1. Recognise structural elements in the organic molecules. 2. Design alternative synthetic sequences. 3. Handle reactions of functional groups interconversions. 4. Propose synthesis of carbo- and heterocyclic molecules. 5. Recognise selective reactions. 6. Recognise the importance of organic synthesis to the advancement of society.	30	CB1 CB2 CB4 CE25 CE26 CE27 CE28

Problem and/or exercise solving	A short answer exam will be carried out (10%). Results of the learning: 1. Recognise structural elements of organic molecules. 2. Propose retrosynthetic sequences. 3. Analyse alternative retrosynthetic proposals. 4. Value the use of structurally-simplifying reactions. 5. Recognise relationships between functional groups. 6. Use properly functional groups interconversion reactions.	10	CB1 CB2 CB5 CE2 CE10 CE11 CE12 CE13 CE20 CE24 CT1 CT3 CT4 CT5 CT7 CT9 CT13 CT14 CT18
Essay questions exam	A global proof for the evaluation of the competitions acquired in the subject. For passing the subject the students will have to obtain a minimum of 50% in the written proofs (short and long answer). Therefore, the qualification of the remaining parts will only be added when the grade obtained in overall written proofs is equal or higher than two and a half points. Results of the learning: 1. Recognise structural elements of organic molecules. 2. Propose retrosynthetic sequences. 3. Analyse alternative retrosynthetic proposals. 4. Value the use of structurally-simplifying reactions. 5. Recognise relationships between functional groups. 6. Use properly functional groups interconversion reactions. 7. Design synthetic sequences. 8. Propose synthesis of carbo- and heterocyclic molecules. 9. Know the reactivity of heterocyclic compounds. 10. Know selective reactions. 11. Propose disconnections in unsaturated compounds. 12. Know the use of protective groups in organic synthesis.	40	CB1 CB2 CB4 CB5 CE2 CE10 CE11 CE12 CE13 CE19 CE20 CE23 CE24 CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT13 CT14 CT15 CT18

Other comments on the Evaluation

The participation of the students in any of the acts of evaluation of the subject will involve that they purchase the condition of "presented" and, therefore, they will have assigned a qualification. Acts of evaluation are considered the assistance to the classes of laboratory (three or but sessions), the realisation of the written exams and the handling of a minimum of 25% of

the homework assigned by the teaching staff.

Evaluation of the July call:

>1) Grade obtained by the students during the course: maximum of 4 points, divided in the qualification obtained by the students along the course in the resolution of the problems, homework, etc (maximum of 1 point) and the realisation of the laboratory exams (maximum of 3 points).

2) Work carried out by the students: maximum of 1,5 points

for the resolution and handling of the exercises proposed by the teaching staff after the evaluation of January, that will be oriented to the acquisition of the necessary knowledge to pass the matter. This work will be handled in advance to the official date of the exam.

3) Written Tests: maximum of 4,5 points, which will evaluate the knowledge of the matter.

Sources of information
Basic Bibliography
Complementary Bibliography
Warren, S.; Wyatt, P., Organic Synthesis: The Disconnection Approach, 2nd, Wiley, 2008, Chichester
Wyatt, P.; Warren, S., Organic Synthesis: Strategy and Control, 1st, Wiley, 2008, Chichester
Zweifel, G. S.; Nantz, M. H., Modern Organic Synthesis: An Introduction, 1st, W H Freeman, 2007, New York
Clayden, J.; Greeves, N.; Warren, S., Organic Chemistry, 2nd, Oxford University Press, 2012, Oxford
Starkey, L. S., Introduction to strategies for organic synthesis, 1st, Wiley, 2012, Chichester

Recommendations
Subjects that continue the syllabus
Pharmaceutical chemistry/V11G200V01903

Subjects that it is recommended to have taken before
Organic chemistry I/V11G200V01304
Structural Determination/V11G200V01501
Organic chemistry II/V11G200V01504

IDENTIFYING DATA				
Food chemistry				
Subject	Food chemistry			
Code	V11G200V01901			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	2nd
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Environmental chemistry				
Subject	Environmental chemistry			
Code	V11G200V01902			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish English			
Department				
Coordinator	González Romero, Elisa			
Lecturers	González Romero, Elisa Tojo Suárez, María Concepción			
E-mail	eromero@uvigo.es			
Web				
General description	Global knowledge of the chemical processes involved in the environment, analysis of pollutants, control of quality, treatment and management of the pollution. Evaluation of the environmental impact			

Competencies		
Code		Typology
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances	
CE17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management	
CE18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry	
CT1	Communicate orally and in writing in at least one of the official languages of the University	
CT3	Learn independently	
CT4	Search and manage information from different sources	
CT5	Use information and communication technologies and manage basic computer tools	
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	
CT7	Apply theoretical knowledge in practice	
CT8	Teamwork	
CT9	Work independently	
CT10	Work at a national and international context	
CT12	Plan and manage time properly	
CT13	Make decisions	
CT14	Analyze and synthesize information and draw conclusions	
CT15	Evaluate critically and constructively the environment and oneself	
CT16	Develop an ethical commitment	
CT17	Develop concern for environmental aspects and quality management	

Learning outcomes	
Learning outcomes	Competences

Describe the main chemical processes that occur in each layer of the atmosphere. Describe the mechanisms of production and destruction of ozone. Explain the greenhouse effect	CE2 CE17 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT15 CT16 CT17
Describe the composition and properties of the natural waters	CE2 CE17 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT15 CT16 CT17
Explain the exchange of matter between the distinct environmental compartments. Time of residence	CE2 CE17 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT15 CT16 CT17
Explain the main causes of the corrosion and how minimise it	CE2 CE18 CT3 CT4 CT5 CT6 CT7 CT9 CT10 CT14 CT16 CT17

Identify the main pollutants present in the natural media and the main pollutants according to the different environmental rules	CE2 CE4 CE17 CT3 CT4 CT5 CT6 CT7 CT9 CT10 CT13 CT14 CT16 CT17
Recognise the different types of chemical reactions that experience the pollutants in the natural medias	CE2 CE4 CE17 CT3 CT4 CT5 CT6 CT7 CT10 CT14 CT16 CT17
Estimate the harmful effects for the environment of the diverse types of pollutants	CE2 CE4 CE17 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT13 CT14 CT16 CT17
Describe the sampling, pre-treatment and preparation of sample for the analysis of environmental pollutants	CE4 CE17 CT3 CT4 CT5 CT6 CT7 CT8 CT10 CT13 CT14 CT16 CT17
Select the appropriate analytical techniques and the concrete methods for its determination in the atmosphere, waters, floors, sediments and biota	CE4 CE17 CT3 CT4 CT5 CT6 CT7 CT8 CT10 CT13 CT14 CT15 CT16 CT17

Describe the main available technologies for the treatment of the pollution and evaluate its applicability in diverse cases	CE4 CT1 CT4 CT5 CT6 CT7 CT8 CT10 CT12 CT13 CT14 CT15 CT16 CT17
Know the fundamental methodologies for the evaluation of the environmental impact and the rule related	CE4 CE17 CT1 CT4 CT5 CT6 CT7 CT8 CT10 CT12 CT13 CT14 CT15 CT16 CT17

Contents	
Topic	
1.- The matter and its cycles	Generalities
2.- Chemical processes in the atmosphere	Photochemical processes. Chemistry of the layer of ozone. Greenhouse effect .
3.- Chemical processes in the hydrosphere	Salinity and alkalinity. Transfer of matter between environmental compartments. Interface Atmosphere-water. Exchange of gases. Interface Sediment-water
4.- Electrochemical processes in the environment	Corrosion
5.- Environmental Pollutants	Classification. Natural transformations of the pollutants.
6.- Analysis of pollutants	Analytical methodology: sampling and treatment of sample, techniques and methods in the determination of pollutants. Applications in atmosphere, waters, floors, sediments and biota
7.- Quality Control in the laboratories of environmental analysis	Generalities
8.- Quality Assurance of the pollution	Generalities
9.- Evaluation of the environmental impact	Systems of environmental management

Planning			
	Class hours	Hours outside the classroom	Total hours
Seminars	10	25	35
Presentation	4	14	18
Scientific events	3	4.5	7.5
Workshops	0	12	12
Lecturing	22	33	55
Problem and/or exercise solving	2	9	11
Essay questions exam	2	9.5	11.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Seminars	The aim that pursues in the seminars is to settle the knowledges and expand the competitions purchased in the masterclasses, giving practical and representative examples of the fundamental concepts that collect in each subject.

Presentation	Each student will choose, to the start of the course, a subject of which suggest , or another if it is of interest for him, but always related with the program of the Environmental Chemical matter, and will realise a diagram and synthesis of the work to be exposed in a maximum time of 10 min, in which it will include a practical example extracted of one or several scientific articles. The aims to cover are: introduction and/or practical in the bibliographic research, preparation and presentation of the scientific work, comparison of results between different technical, evaluation of the environmental impact, etc... Previous to the exhibition, the student/to will deliver, in a dossier with his name and title of the exhibition, a copy of all the articles consulted and of the presentation of the same. The assistance to the exhibitions is compulsory and any of the questions formulated during his development can fall in the examinations
Scientific events	They include other less conventional activities inside the program of the matter, like the assistance to conferences, webinars of the ACS, "workshops" or congresses that celebrate in the own University, what will allow to the student expand his horizons and begin to go in in contact with other realities further of the faculty, obtaining information at first hand through representatives of companies, of professors of other universities -and, even, of other countries - that will orient them on other opportunities and will promote the mobility of these students. Of this form, pretends transmit to the student the multiple possibilities that can him present in the future, showing him a fan of labour possibilities. These events are subject to the programmings extra-academic of the different centres in the own University, but in any moment overlap with activities programmed previously and, in his case, would look for other alternatives.
Workshops	They would form part of the seminars in which the students will have to resolve by himself same, under the supervision of the professor but with a greater autonomy, real practical suppositions of chemical processes, detection of possible pollutants in which they derive, the environmental impact that produce and design strategies for his control
Lecturing	The masterclasses (55 min) pretend to give a global and real vision of the chemical processes that produce in the environment, the interaction between the different compartmentalized means, the pollutants present and those that generate , the most appropriate methodology for his analysis and his environmental control. Each one of the subjects will go documented with scientific articles, whose contents will serve to settle and expand the knowledges purchased in the theoretical classes, and of representative examples of the fundamental concepts that collect each subject. The methodology education-learning will be centred in the student, by what the classes will be headed to motivate a high participation by part of these in the classroom. The platform *Tem@ will be the resource that allow to the student the communication with the professor and his mates, through a virtual application, at the same time to be the source of information of immediate access for them. In her they will be able to find the basic information and documentation on the matter that gives , the diary of activities, the exercises to realise and the qualifications.

Personalized assistance

Methodologies	Description
Seminars	In the seminars and in the workshops will do a follow-up of the personal work that was realising the student in this moment, related with the matter. They realised experiments of classroom, useful for the problems resolution, including the oral exposition and other complementary works that propose, in function of the evolution of the student in the process of learning
Workshops	In the seminars and in the workshops will do a follow-up of the personal work that was realising the student in this moment, related with the matter. They realised experiments of classroom, useful for the problems resolution, including the oral exposition and other complementary works that propose, in function of the evolution of the student in the process of learning

Assessment

	Description	Qualification	Evaluated Competencess
Presentation	The presentations and other activities associated (ACS Webinars, conferences and Meeting/Symposiums) until arriving to the defence of the work.	20	CE17 CT1 CT3 CT4 CT5 CT8 CT9 CT10 CT14 CT16 CT17

Problem and/or exercise solving	They will realise two short proofs of one or two hours of length, C1 and C2, along the quatrimester in which it gives the matter and whose dates will be fixed in the chronogram to the start of the course. They are not eliminatory.	30	CE2 CE4 CE18 CT1 CT3 CT6 CT7 CT12 CT13 CT14 CT15 CT16
Essay questions exam	The long proof (divided into 2 parts) will have until three hours and in her will go in all the subjects given of the matter and the activities associated to them. A minimum of 4 in each part is required to be compensated by both parties	50	CE2 CE4 CE18 CT1 CT3 CT6 CT7 CT12 CT13 CT14 CT15 CT16

Other comments on the Evaluation

All the partial qualifications will allow to make the final qualification, valuing the attitude of participation and the interest showed by the student along the course. Due to the fact that each one of the subjects will go documented with scientific articles, some question extracted of them will be able to form part of the short proofs and/or long and in the second announcement.

It considers no-presented (NP) not assisting to 25% of the face-to-face hours and/or not realising any of the proofs (short or long) neither participate in the activities programmed. In the moment in that any of the parts have qualification, in records will appear said qualification obtained, although it have not realised any another proof or activity programmed.

In the second announcement, the students will have the opportunity to recover 50% of the matter. This proof contemplates the same contents that require for the long proof and will keep the qualifications of the others sections evaluated along the course.

To achieve approve the matter, the students will have to surpass 50% of all and each one of the proofs and activities program of the matter.

Sources of information

Basic Bibliography

Complementary Bibliography

P.W. ATKINS, Química Física, Omega

I.N. LEVINE, Fisicoquímica, Mc Graw Hill Interamericana

Stanley E. Manahan, Environmental Chemistry, 9, CRC Press

Roger N. Reeve, Introduction to Environmental Analysis, Wiley

F. W. Fifield y P. J. Haines (Editores), Environmental Analytical Chemistry, 2, Wiley-Blackwell

Frank M. Dunnivant, Environmental Laboratory Exercises for Instrumental Analysis and Environmental Chemistry, Wiley

Chunlong Zhang, Fundamentals of Environmental Sampling and Analysis, Wiley

J. P. RILEY y G. SKIRROW, Chemical Oceanography, Academic Press

ISI WEB OF KNOWLEDGE, Thomson Reuters

Scifinder, CAS-ACS

Environmental Sciences Category, RSC, ACS y otras

Colin Baird y Michael Cann, QUIMICA AMBIENTAL, 2ª edición, REVERTÉ ISBN: 978-84-291-7915-6

Recommendations
Subjects that continue the syllabus
Final Year Dissertation/V11G200V01991
Subjects that are recommended to be taken simultaneously
Industrial chemistry/V11G200V01904
Final Year Dissertation/V11G200V01991
Subjects that it is recommended to have taken before
Analytical chemistry 1/V11G200V01302
Physical chemistry I/V11G200V01303
Physical chemistry II/V11G200V01403
Analytical chemistry II/V11G200V01503
Analytical chemistry 3/V11G200V01601
Physical chemistry III/V11G200V01603

IDENTIFYING DATA				
Pharmaceutical chemistry				
Subject	Pharmaceutical chemistry			
Code	V11G200V01903			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Terán Moldes, María del Carmen			
Lecturers	Terán Moldes, María del Carmen			
E-mail	mcteran@uvigo.es			
Web				
General description	The subject is allocated to contribute to the students basic knowledges on Pharmaceutical Chemistry, an interdisciplinar science that is among different disciplines of chemical and biological content, whose aim is the study of the bioactive compounds and in particular its discovery, development, identification and mechanism of action at molecular level.			

Competencies		
Code		Typology
CB1	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	• know
CB3	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	• know
CB4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences	• Know How
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	• Know be
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• Know How
CE20	Evaluate, interpret and synthesize data and chemical information	• know
CE22	Process and perform computational calculations with chemical information and chemical data	• Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know How
CT3	Learn independently	• Know be
CT4	Search and manage information from different sources	• Know How
CT5	Use information and communication technologies and manage basic computer tools	• Know How
CT7	Apply theoretical knowledge in practice	• know
CT8	Teamwork	• Know How
CT9	Work independently	• Know How
CT10	Work at a national and international context	• Know How
CT12	Plan and manage time properly	• Know be
CT13	Make decisions	• Know How
CT14	Analyze and synthesize information and draw conclusions	• know
CT15	Evaluate critically and constructively the environment and oneself	• Know be
CT16	Develop an ethical commitment	• Know be
CT17	Develop concern for environmental aspects and quality management	• Know be

Learning outcomes	
Learning outcomes	Competences
Diferenciate and understand the concepts: drug, active principle, medicine and pharmacological target	CB4 CE20 CE23 CT1 CT4 CT5 CT14

Differentiate the types of receptors, as well as an agonist drug from an antagonist.	CB4 CB5 CE20 CE23 CT1 CT3 CT4 CT5 CT7 CT9 CT13 CT14
Relate the physicochemical properties of drugs with their pharmacokinetics.	CB1 CB3 CB5 CE19 CE20 CE22 CE23 CT1 CT3 CT5 CT7 CT8 CT14
Differentiate the pharmacomodulation techniques.	CB3 CB5 CE19 CE20 CE23 CT1 CT4 CT5 CT7 CT8
Differentiate a chemoterapeutic from a pharmacodynamic agent	CB3 CB4 CB5 CE19 CE20 CE23 CT1 CT3 CT4 CT7 CT9
Familiarise with the most recent tools in drug design: combinatorial chemistry and computer-aided drug design (QSAR and docking methods)	CB3 CB5 CE19 CE20 CE22 CE23 CT1 CT3 CT4 CT5 CT8 CT12 CT13 CT15 CT16

Describe the methods of structural analysis involved in drug design and differentiate the type of information that they provide	CB3 CB5 CE19 CE20 CE22 CE23 CT1 CT3 CT5 CT7 CT9 CT14 CT15
Identify the different forms of drug administration and their fundamentals.	CB1 CB3 CB4 CB5 CE19 CE20 CE23 CT1 CT3 CT4 CT9 CT14
Identify the formulation and composition variables in the preparation of suspensions and emulsions, and describe their characteristic properties, as well as and the instability phenomena	CB3 CB5 CE19 CE20 CE23 CT1 CT3 CT9 CT13 CT14
Recognise the main stages of fermentative and enzymatic processes applied to the drug production, including production and purification steps	CB3 CB5 CE19 CE20 CE22 CE23 CT1 CT3 CT4 CT7 CT8 CT12 CT14 CT15
Apply the basic principles of safety and pollution control in operations and processes oriented to drug production	CB3 CB5 CE19 CE20 CE23 CT1 CT3 CT5 CT8 CT10 CT13 CT16 CT17

Explain the sampling, pretreatment and sample preparation, as well as the appropriate instrumental techniques for the analysis of prime matters, bioactive compounds and pharmaceutical formulations in the biological media	CB3 CB5 CE19 CE20 CE22 CE23 CT1 CT3 CT8 CT13 CT14

Contents	
Topic	
Subject 1. Introduction: general aspects of Pharmaceutical Chemistry	Definitions, aims and scope of the Pharmaceutical Chemistry. Nomeclature of drugs and classification systems. Chemotherapeutic and pharmacodynamic agents
Subject 2. Drug targets	Types of drug targets. Drug-target interactions. Nucleic Acids, enzymes and proteins as drug targets.
Subject 3. Receptors as drug targets	Types of receptors. Agonist, antagonist and inverse agonist drugs. Measure and expression of pharrmacological effect. Drug tolerance and tachyphylaxis
Subject 4. Pharmacokinetic and related aspects	Absorption and transport through biological membranes, the Lipinski rules, bioavailabilty. Metabolism, prodrugs. Excretion. ways of drug administration and pharmaceutical forms.
Subject 5. Discovery, design and development of drugs	Strategies for lead discovery, serendipity, systematic screening, rational design. Pharmacomodulation. Patents. preclinical and clinical trials.
Subject 6. Strategies for drug design	Molecular modeling, indirect methods (QSAR, pharmacophore design), direct methods (docking).
Subject 7. Preparation, analysis and purification of drugs	Production in the pharmaceutical industry. fermentative processes. Drug processing.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	26	52	78
Seminars	13	39	52
Studies excursion	3	3	6
Problem and/or exercise solving	1	3	4
Essay questions exam	2	8	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	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 Tem@ platform, will make available to the student the material that will be used in these sessions. Students should previously check and complete this material by using the recommended literature. In addition, periodic controls will be carried out to follow the study and understanding of the subject. These tests will be performed during some master sessions which will be determined in advance
Seminars	They will devote time to discuss the most complicated aspects of the treated subjects, to use programs of molecular modeling which will allow to work with several biomolecules cocrystallized with different ligands, as well as to present works, researchs or summaries carried out by the students and related with the content of the subject.
Studies excursion	The students will visit a company of the pharmaceutical sector, in which it will be able to appreciate the process of production in all its phases. After the visit the students will have to answer, in schedule of class, to a test related with this visit.

Personalized assistance	
Methodologies	Description
Seminars	Time devoted by the teachers to attend the needs and queries of the students related with the study of the subject and developed activities. The teachers will inform in the presentation of the subject about the available schedule.

Assessment			
	Description	Qualification	Evaluated Competencess
Lecturing	Contents developed in the program study will be evaluated by means of verbal or written questions formulated in the theoretical sessions. The written questions will be referents to the content treated in the previous two or three weeks.	5	CB1 CB3 CE19 CE23 CT14 CT15 CT16
Seminars	Attendance and participation in the sessions, exercices and questions resolution, as well as the presentation of reports, summaries and works, will be qualified	20	CB1 CB3 CB4 CB5 CE19 CE20 CE22 CE23 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT16
Studies excursion	Attendance and active participation in the visit, as well as the results of the test will be qualified.	10	CB3 CE20 CT14 CT15 CT17
Problem and/or exercise solving	A short exam (one hour long) will be carried out at week ten. In this exam will enter the subject explained until that moment.	15	CB1 CB3 CB5 CE19 CE20 CT7 CT12 CT13 CT14
Essay questions exam	A global exam will be carried on closing date of evaluation in order to analyze the adquired competencies	50	CB1 CB3 CB5 CE19 CE20 CT7 CT12 CT13 CT14

Other comments on the Evaluation

Participation of students in any of the evaluation parts, such as attendance to seminars (four or more) or the performace of written exams, will involve the condition of presented and therefore the obtaining of a qualification. 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 in the global exam, as well as in seminars and study visit.

Evaluation in the July Call

1. Mark obtained by the students during the academic course: maximum 3.5 points

Marks obtained from verbal or written questions formulated in the theoretical sessions (maximun 0.5 point), visit test (maximun 1 point) and seminars (maximum 2 points) will be preserved.

2. Work carried out by the students: maximum 1.5 points

Finished the evaluation process of June, teachers will propose to the students who have not pass the subject to perform an individual work in order to adquire the competencies of which they will be evaluated in July. This work should be presented and defended before the exam.

The students will perform a written exam similar to June in which they will obtain a maximum of 5 points

Sources of information

Basic Bibliography

Complementary Bibliography

A. Delgado C. Minguillón y J. Juglar, Introducción a la Química Terapéutica, 2ª Edición 2003, Diaz de Santos
G. L. Patrick, An introduction to Medicinal Chemistry, 6th Edition 2017, Oxford University Press
C. G. Wermuth, 4. The Practice of Medicinal Chemistry, 4th Edition 2015, Academic Press Elsevier
R. Renneberg, Biotecnología para principiantes, 2004, Reverté

Recommendations

Subjects that it is recommended to have taken before

IT tools and communication in chemistry/V11G200V01401
Physical chemistry I/V11G200V01303
Physical chemistry II/V11G200V01403
Organic chemistry I/V11G200V01304
Structural Determination/V11G200V01501
Chemical engineering/V11G200V01502
Analytical chemistry II/V11G200V01503
Biological chemistry/V11G200V01602
Organic chemistry II/V11G200V01504
Organic chemistry III/V11G200V01704

IDENTIFYING DATA				
Industrial chemistry				
Subject	Industrial chemistry			
Code	V11G200V01904			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Deive Herva, Francisco Javier			
Lecturers	Gago Martínez, Ana			
E-mail	deive@uvigo.es			
Web				
General description	Chemical industry represents one of the most booming sectors in the economy of many countries, being the basis for many other industries like metallurgic, petrochemical, food and electronic ones. Similarly, recent advances on high efficient materials, electronic devices, medical applications, together with new environmental and agricultural technologies are fostered by continuous improvements and innovations in each stage of the process design. Therefore, this subject is devoted to provide the student with a comprehensive approach of Industrial Chemistry, going from the construction and understanding of process flowsheets diagrams of chemical processes with socio-economic interest, to the performance of quality principles underlying them.			

Competencies		
Code		Typology
CE16	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles and procedures in chemical engineering	• know • Know How • Know be
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	• know • Know How • Know be
CE20	Evaluate, interpret and synthesize data and chemical information	• know • Know How • Know be
CE22	Process and perform computational calculations with chemical information and chemical data	• know • Know How • Know be
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	• know • Know How • Know be
CT1	Communicate orally and in writing in at least one of the official languages of the University	• know • Know How • Know be
CT3	Learn independently	• know • Know How • Know be
CT4	Search and manage information from different sources	• know • Know How • Know be
CT5	Use information and communication technologies and manage basic computer tools	• know • Know How • Know be
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• know • Know How • Know be
CT7	Apply theoretical knowledge in practice	• know • Know How • Know be
CT8	Teamwork	• know • Know How • Know be
CT9	Work independently	• know • Know How • Know be

CT10 Work at a national and international context	• know • Know How • Know be
CT12 Plan and manage time properly	• know • Know How • Know be
CT13 Make decisions	• know • Know How • Know be
CT14 Analyze and synthesize information and draw conclusions	• know • Know How • Know be
CT15 Evaluate critically and constructively the environment and oneself	• know • Know How • Know be

Learning outcomes

Learning outcomes	Competences
(*)To acquire habilities on process flowsheet diagrams interpretation and design on the basis of real processes.	CE16 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT15
(*) To identify generic systems for quality management in laboratories and to know the required essential doccumentation	CE16 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT15

(*)To establish analytical methodology suitable for warranting the quality of raw materials and products, as well as the pollution derived from the industrial process.	CE16 CE19 CE20 CE22 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT15
(*)To integrate automatized and miniaturized systems on the control of industrial processes.	CE16 CE19 CE22 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT15
(*)To acquire the ability of designing a process for the production of biofuels or biocatalysts at laboratory scale, on the basis of the process flowsheet diagrams.	CE16 CE19 CE20 CE22 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT15
To understand the role of bioengineering as an environmentally sustainable alternative to obtain products with commercial interest	CE16 CE19 CE20 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT15

(*)To evaluate the economic viability of industrial processes by using basic tools such as the Net Present Value, the Internal Rate of Return of the Return of Investment	CE20 CE22 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT14 CT15
New	CE16 CE19 CE20 CT4 CT5 CT7 CT8 CT9
New	CE16 CE20 CT4 CT8 CT9 CT10 CT12 CT13

Contents	
Topic	
Subject 1. Introduction to processes in Industrial Chemistry	General aspects of chemical processes. Characteristics and sectorial sctructure of chemical industry. Facts and figures of spanish and european chemical industry. Process flowsheet diagrams
Subject 2.- Economy of industrial processes.	Preparation of budget. Analysis of costs and profits. Criteria of economic feasibility: Net Present Value, Internal Rate of Return, Time of return.
Subject 3.- Biotecnological Processes.	Fundamental stages of biotechnological processes. Pretreatment of raw materials. Types of bioreactors. Product recovery and downstream strategies. Processes for the production of biofuels. Food biotechnology
Subject 5.- Petrochemistry.	Oil reserves, types and composition. Crude refining. Types of refineries: basic structure. General flowsheet of a petrochemical refinery. Crude fractionation. Thermal cracking: coking unit. Catalytic cracking, reactors, etc. Catalytic reforming. Desulfurization.
Subject 4.- Biofuels	Energy concerns and current regulations. Raw materials. Processes for the production of biofuels. Alternatives for conventional processes
Subject 7.- Basic elements and principles of quality.	Introduction to the control of quality. Implementation of systems of quality. Tools of quality. International Standards - ISO. Quality manual. Control of Processes quality (prime Matters, transformation and final product)

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	26	52	78
Problem solving	5	13	18
Mentored work	5	10	15
Presentation	3	6	9
Studies excursion	3	6	9
Problem and/or exercise solving	1	4	5
Essay questions exam	2	14	16
*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 describe the general aspects of the program in a structured way, highlighting the fundamentals and aspects involving greater difficulties for the student. The lecturer will deliver (by means of the online platform "TEMA") all the material required for a proper understanding of the subject. The student is encouraged to work on that material and consult relevant literature to acquire a deeper knowledge.
Problem solving	After each subject, the most relevant aspects will be tackled by means of problem and questions solving.
Mentored work	The students will carry out a work focused on the design of a process for producing some product with industrial interest, taking into account the knowledge acquired during the master sessions.
Presentation	The students have to defend their tutored works in front of a jury made up of lecturers from the departments of Chemical Engineering or Analytical Chemistry and/or professionals from chemical industries
Studies excursion	Different outdoor studies will be carried out throughout the course, in order to get a deeper insight into the processes explained during the master sessions. Priority will be given to top companies of our socioeconomic environment.

Personalized assistance

Methodologies	Description
Lecturing	During tutoring hours, the students can ask the lecturers about any aspect of the subject. In the same way, students can communicate with the teachers via E-mail or Tema platform. The lecturers will show their availability for tutoring on the first day.
Problem solving	During tutoring hours, the students can ask the lecturers about any aspect of the subject. In the same way, students can communicate with the teachers via E-mail or Tema platform. The lecturers will show their availability for tutoring on the first day.
Mentored work	During tutoring hours, the students can ask the lecturers about any aspect of the subject. In the same way, students can communicate with the teachers via E-mail or Tema platform. The lecturers will show their availability for tutoring on the first day.
Presentation	During tutoring hours, the students can ask the lecturers about any aspect of the subject. In the same way, students can communicate with the teachers via E-mail or Tema platform. The lecturers will show their availability for tutoring on the first day.
Studies excursion	During tutoring hours, the students can ask the lecturers about any aspect of the subject. In the same way, students can communicate with the teachers via E-mail or Tema platform. The lecturers will show their availability for tutoring on the first day.

Assessment

	Description	Qualification	Evaluated Competencess
Problem solving	Different troubleshooting will be solved by the students at the framework of their tutored works	10	CE16 CE19 CE22 CT3 CT5 CT6 CT7 CT9 CT14

Mentored work	A work focused on the design of an industrially relevant process flowsheet diagram will be carried out during the term.	20	CE16 CE20 CE22 CE23 CT1 CT4 CT5 CT6 CT7 CT8 CT10 CT12 CT13 CT14 CT15
Presentation	The tutored works will be defended against a jury composed of lecturers from the Departments of Chemical Engineering and Analytical Chemistry and/or professionals from the chemical industry.	10	CE16 CE23 CT1 CT5 CT8 CT12 CT13 CT14
Studies excursion	The students must unavoidably attend the outdoor studies in order to get a deper insight into the processes tackled during the master sessions. A report about questions on the plants will be doned by them after each visit.	5	CE20 CE22 CT7 CT8 CT14 CT15
Problem and/or exercise solving	Short tests will be performed in the middel and at the end of the course. Students will be encouraged to relate new ideas with their own views, and to solve problems based on the new knowledge acquired	10	CE16 CE19 CE20 CE22 CE23 CT3 CT7 CT9 CT12 CT13 CT14
Essay questions exam	A final long answer test will be done at the end of the course, and the students will have to have a minimum of 5 out of 10 to pass the course.	45	CE16 CE19 CE20 CE22 CE23 CT3 CT7 CT12 CT13 CT14

Other comments on the Evaluation

In order to pass the subject, at least 5 points out of 10 should be achived in each of the evaluted activities. It is expected that the students show an ethical behaviour concerning plagiarism, use of unauthorized electronic devices or suitable team work. Otherwise, the student will be rated with 0 (fail).
 Evaluation in July
 The activities that have been obtained a mark higher than 5 will be maintaned.

Sources of information

Basic Bibliography

M.M Camps, Los Biocombustibles, Mundi-Prensa, 2002

M. Díaz, Ingeniería de bioprocesos, Paraninfo, 2012

J. Happel, Economía de los procesos químicos, Reverté, 1981

M.A. Ramos Carpio, Refino de petróleo, gas natural y petroquímica, Fomento Innovación Industrial, 1997

Complementary Bibliography

G.T. Austin, Manual de Procesos Químicos en la Industria, McGraw Hill, 1993

J.H.Gary, Refino de petróleo: tecnología y economía, Reverté, 1980

A. Vian Ortuño, Introducción a la Química Industrial, Reverté, 1996

G. Ramis Ramos et al., Quimiometría, Sintesis, 2001

W. Wegscheider, Quality in Chemical Measurements, Training Concepts and Teaching Materials, Springer, 2001

D. Hoyle, ISO 9000 Quality Systems Handbook, Elsevier, 2009

J.M. de Juana, Energias renovables para el desarrollo, Thompson, 2003

Recommendations

Subjects that it is recommended to have taken before

Chemical engineering/V11G200V01502

IDENTIFYING DATA				
Sustainable chemistry				
Subject	Sustainable chemistry			
Code	V11G200V01905			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	2nd
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Internships: Internships in companies				
Subject	Internships: Internships in companies			
Code	V11G200V01981			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	García Bugarín, Mercedes Pérez Juste, Ignacio			
Lecturers	García Bugarín, Mercedes			
E-mail	mgarcia@uvigo.es uviqpipj@uvigo.es			
Web	http://quimica.uvigo.es/index.php/practicas-en-empresas.html			
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.			

Competencies		
Code		Typology
CB1	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	• know
CB2	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	• Know How
CB3	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	• Know How • Know be
CB4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences	• Know How • Know be
CE20	Evaluate, interpret and synthesize data and chemical information	• know • Know How
CE24	Recognize and analyze new problems and plan strategies to solve them	• Know How • Know be
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	• Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	• Know How • Know be
CT2	Communicate at a basic level in English in the field of chemistry	• Know How • Know be
CT3	Learn independently	• know
CT4	Search and manage information from different sources	• know • Know How
CT5	Use information and communication technologies and manage basic computer tools	• know • Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	• know • Know How
CT7	Apply theoretical knowledge in practice	• Know How
CT8	Teamwork	• Know be
CT9	Work independently	• Know be
CT10	Work at a national and international context	• Know be
CT11	Adapt to new situations	• Know be
CT12	Plan and manage time properly	• Know How
CT13	Make decisions	• Know How
CT14	Analyze and synthesize information and draw conclusions	• Know How
CT15	Evaluate critically and constructively the environment and oneself	• Know be
CT16	Develop an ethical commitment	
CT17	Develop concern for environmental aspects and quality management	• Know be
CT18	Generate new ideas and show initiative	• Know be

Learning outcomes	
Learning outcomes	Competences
Contrast the attitudes and the theoretical-practical compentences acquired.	CB1 CB2 CB3 CB4 CE20 CE24 CE25 CT1 CT2 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT11 CT12 CT13 CT14 CT15 CT16 CT17 CT18
Perform tasks to test the critical and reflexive capacity.	CB1 CB2 CB3 CB4 CE20 CE24 CE25 CT1 CT2 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT11 CT12 CT13 CT14 CT15 CT16 CT17 CT18

Take decisions and put in practice the capacity of analysis and synthesis in the resolution of practical problems.	CB1 CB2 CB3 CB4 CE20 CE24 CE25 CT1 CT2 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT11 CT12 CT13 CT14 CT15 CT16 CT17 CT18

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
External practices	0	120	120
Report of 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
External practices	(*)Os estudantes desenvolven actividades nun contexto relacionado co exercicio dunha profesión, durante un período determinado, realizando as funcións asignadas e previstas na proposta de prácticas.

Personalized assistance	
Methodologies	Description
External practices	
Tests	Description
Report of external practices	

Assessment			
	Description	Qualification	Evaluated Competencess
External 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 external practices	At the end of the internship period, the students will have to present to the 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 tutors will make the global evaluation of the external practices considering:

(70%) The report made by the company tutor (D5 form of the University of Vigo) 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 (see section 3 of article 8 of the Normative 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. Mminimum 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.

The grade of the written memory will be included in the *Observaciones/Sugerencias* section of the D7 form filled by the academic tutor.

(10%) The assessment of the academic tutor (D7 form of the University of Vigo) of the aptitude and attitude showed by the student during the development of the activities made.

* The academic tutor will reflect the result of the global evaluation in the D8 form of the University of Vigo.

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

IDENTIFYING DATA				
Final Year Dissertation				
Subject	Final Year Dissertation			
Code	V11G200V01991			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	18	Mandatory	4th	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Pérez Juste, Ignacio			
Lecturers	Pérez Juste, Ignacio			
E-mail	uviqpipj@uvigo.es			
Web	http://quimica.uvigo.es/traballo-fin-de-grao.html			
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.			

Competencies		
Code		Typology
CB1	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	• know
CB2	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	• Know How
CB3	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	• Know How
CB4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences	• Know How
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	• Know be
CE1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.	
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	
CE3	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: principles of quantum mechanics and its application in the description of the structure and properties of atoms and molecules	
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances	
CE5	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Characteristics of the different states of matter and the theories used to describe them	
CE6	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: principles of thermodynamics and their applications in chemistry	
CE7	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: kinetics of change, including catalysis and reaction mechanisms	
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	
CE9	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: characteristic properties of the elements and their compounds, including group relationships and variations in the periodic table	
CE10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds	
CE11	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: nature and behavior of functional groups in organic molecules	
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	

CE13	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main synthetic routes in organic chemistry, including interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds
CE14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules
CE15	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: chemistry of biological molecules and their processes
CE16	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles and procedures in chemical engineering
CE17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management
CE18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
CE20	Evaluate, interpret and synthesize data and chemical information
CE21	Recognize and implement good scientific practices for measurement and experimentation
CE22	Process and perform computational calculations with chemical information and chemical data
CE23	Present oral and written scientific material and scientific arguments to a specialized audience
CE24	Recognize and analyze new problems and plan strategies to solve them
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy
CT1	Communicate orally and in writing in at least one of the official languages of the University
CT2	Communicate at a basic level in English in the field of chemistry
CT3	Learn independently
CT4	Search and manage information from different sources
CT5	Use information and communication technologies and manage basic computer tools
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
CT7	Apply theoretical knowledge in practice
CT8	Teamwork
CT9	Work independently
CT10	Work at a national and international context
CT11	Adapt to new situations
CT12	Plan and manage time properly
CT13	Make decisions
CT14	Analyze and synthesize information and draw conclusions
CT15	Evaluate critically and constructively the environment and oneself
CT16	Develop an ethical commitment
CT17	Develop concern for environmental aspects and quality management
CT18	Generate new ideas and show initiative

Learning outcomes

Learning outcomes	Competences

(*)Todos os da titulación	CB1 CB2 CB3 CB4 CB5 CE1 CE2 CE3 CE4 CE5 CE6 CE7 CE8 CE9 CE10 CE11 CE12 CE13 CE14 CE15 CE16 CE17 CE18 CE19 CE20 CE21 CE22 CE23 CE24 CE25 CE26 CE27 CE28 CE29 CT1 CT2 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT11 CT12 CT13 CT14 CT15 CT16 CT17 CT18

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	(*)Trabajo individual que cada estudiante realizará de forma autónoma bajo la supervisión de uno o dos tutores. La asignación del tema de trabajo se hará de acuerdo con la Normativa del TFG de la Facultad de Química.

Personalized assistance

Methodologies	Description
Mentored work	

Assessment

	Description	Qualification	Evaluated Competencess

Mentored work	30	CB1 CB2 CB3 CB4 CB5 CE1 CE2 CE3 CE4 CE5 CE6 CE7 CE8 CE9 CE10 CE11 CE12 CE13 CE14 CE15 CE16 CE17 CE18 CE19 CE20 CE21 CE22 CE23 CE24 CE25 CE26 CE27 CE28 CE29 CT1 CT2 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT11 CT12 CT13 CT14 CT15 CT16 CT17 CT18

Presentation	70	CB1
		CB2
		CB3
		CB4
		CB5
		CE1
		CE2
		CE3
		CE4
		CE5
		CE6
		CE7
		CE8
		CE9
		CE10
		CE11
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		CT17
		CT18

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 platform Tem@ and/or in the web page of the faculty.

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Subjects that are recommended to be taken simultaneously

Environmental chemistry/V11G200V01902
Pharmaceutical chemistry/V11G200V01903
Industrial chemistry/V11G200V01904