(*)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 4th

Code	Name	Quadmester	Total Cr.
V11G200V01701	Project	1st	6
V11G200V01702	Materials chemistry	1st	6
V11G200V01703	Inorganic chemistry III	1st	9
V11G200V01704	Organic chemistry III	1st	9
V11G200V01902	Environmental chemistry	2nd	6
V11G200V01903	Pharmaceutical chemistry	2nd	6
V11G200V01904	Industrial chemistry	2nd	6

V11G200V01981	Internships: Internships in companies	2nd	6
V11G200V01991	Final Year Dissertation	2nd	18

IDENTIFYING DATA				
Project				
Subject	Project			
Code	V11G200V01701			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	Spanish			
Department	Chemical Engineering			
Coordinator	González de Prado, Begoña			
Lecturers	González de Prado, Begoña Morandeira Conde, Lois Rodríguez López, Lorena			
E-mail	bgp@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	
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C22	Process and perform computational calculations with chemical information and chemical data
C23	Present oral and written scientific material and scientific arguments to a specialized audience
C24	Recognize and analyze new problems and plan strategies to solve them
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself
D16	Develop an ethical commitment
D17	Develop concern for environmental aspects and quality management
D18	Generate new ideas and show initiative

Learning outcomes		
Expected results from this subject	Training and Learning Results	
Evaluate the feasibility of the realisation of a project related with the competitions of a chemist	C20 C23 C24	D1 D4 D5 D7 D8 D9 D12 D13 D14 D15 D16

*Recopilar And analyse the necessary information for the realisation of the project in Chemistry, including normative appearances and of market	C20 C22 C23 C24	D4 D5 D8 D9 D12 D13 D14 D15 D16
Organise and manage the diverse stages of realisation of a project in Chemistry	C20 C23 C24	D3 D5 D7 D8 D9 D12 D13 D14 D15 D16 D17 D18
Define the suitable scope of a project, taking into account technical appearances, economic, geographic and environmental	C19 C20 C22 C23 C24	D1 D3 D4 D6 D7 D8 D9 D13 D14 D17 D18
Realise the calculations associated to the development of a project	C19 C20 C22	D3 D7 D8 D9 D12 D14
Estimate the costs and potential profitability of a project	C19 C20 C22	D3 D6 D7 D9 D14 D15
Analyse the environmental implications of a project, and propose preventive measures and of improvement if it was necessary	C19 C20 C22 C24	D1 D7 D8 D9 D12 D14 D16 D17
Evaluate the potential impact (environmental, socioeconomic) of a project	C19 C20 C23 C24	D1 D3 D4 D5 D7 D8 D9 D12 D13 D15 D16 D17 D18

Elaborate technical reports very structured and drafted and present the same using the audiovisual means more suitable	C20 C23 C24	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D18

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 attention	
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	Qualification	Training and Learning	Results
Problem solving	The students will have to deliver, in the terms indicated, the problems proposed	5	C19 C20 C22 C24	D3 D4 D6 D7 D8 D9 D12 D14 D15 D18
Presentation	The students will realise an exhibition of the project realised	10	C23	D1 D3 D5 D8 D9 D12 D14
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	C19	D3 D7 D9 D12 D14
Essay questions exam	It will realise a long proof of all the matter of the *asignatura	35	C19	D3 D7 D9 D12 D14

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	C20 C22 C24	D1 D3 D4 D5 D6 D7 D8 D9 D12 D13 D14 D15 D16 D17 D18

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	Choose	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	Spanish Galician English			
Department	Physical Chemistry Inorganic Chemistry			
Coordinator	Pastoriza Santos, Isabel			
Lecturers	Bolaño García, Sandra Pastoriza Santos, Isabel			
E-mail	pastoriza@uvigo.es			
Web				
General description	Structure, properties and application of the different types of materials.			

Competencies	
Code	
C5	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
C8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy
C18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C23	Present oral and written scientific material and scientific arguments to a specialized audience
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself

Learning outcomes		
Expected results from this subject	Training and Learning Results	
Analyse the characteristics of metals and alloys through essays of traction and compression.	C5 C19 C20	D1 D7 D9
Differentiate between electrical and ionic conductivity. Distinguish the intrinsic semiconductors of the extrinsic.	C5 C19 C20	D1 D7 D9
Differentiate between the cooperative magnetism and the no cooperative.	C5 C19 C20	D1 D9
Recognise hard magnetic materials and soft from his cycle of histéresis.	C5 C19 C20	D1 D9
Recognise the types of superconductivity and his relation with the nature of the material.	C5 C19 C20	D1 D9
Describe the optical properties of the metals and no metals.	C5 C19	D1 D9

Describe the applications of the optical phenomena more important.	C5 C19	D1 D9
Explain the thermal properties more important of the materials.	C5 C19 C20	D1 D9
Analyse and describe the characteristics of the alloys in function of his diagrams of phases.	C5 C19 C20	D1 D7 D9 D12 D13 D14
Describe the properties of the different ceramic materials and polymers.	C5 C20	D1 D7 D9
Describe the general characteristics of the compound materials.	C20 C23	D1 D3 D4 D5 D8 D12 D14 D15
Analyse the corrosion of metals and ceramic and the degradation of the polymers.	C18	D1 D8 D14
Justify and enter the need of new materials and nanomaterials.	C20 C23	D1 D3 D4 D5 D8 D12 D14 D15
Describe the basic processes for the obtaining of nanomaterials.	C5 C20 C23	D1 D3 D4 D7 D8 D9 D13 D15
Tackle the basic technicians of study of the surfaces of the materials.	C8 C23	D1 D3 D4 D5 D8 D12 D14 D15

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: mechanics, electrical, magnetic, optical and thermal.	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
Short answer tests	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 attention

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	Training and Learning Results	
Seminars	In addition to resolving practical exercises that allow to the students settle the knowledges on the subjects developed in the classes of theory, and to resolve all the exposed doubts, the classes of seminar will use also to carry out to continuous evaluation of the students. This process of continuous evaluation will realise 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 that the students will have to deliver for his evaluation. Also will carry out by means of the preparation and exhibition by part of the students of subjects related with the matter.	40	C5 C8 C19 C20 C23	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15
Short answer tests	Along the cuatrimestre will realise 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	C5 C8 C18 C19 C20	D1 D7 D12 D13

Other comments on the Evaluation

Observations: it is compulsory the assistance to all the planned activities that carry evaluation. The participation in 20% of the activities of evaluation of the seminars along the cuatrimestre, or in any of the short proofs of planned evaluation, will involve the condition of presented and thus, the qualification in the record of the matter. It will be necessary to surpass the two short proofs (obtain a minimum of 40% of the note of each one) to be able to take into account the other elements of evaluation.

July Evaluation: the students that do not surpass one or the two short proofs that realise during the cuatrimestre, will have to present to the corresponding part in the announcement of Julio. This proof will substitute to the results obtained in the tests shorts realised along the cuatrimestre. They will keep the note of the remaining elements of evaluation of the cuatrimestre.

Sources of information

Basic Bibliography

Complementary Bibliography

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

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

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

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

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

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

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

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

Recommendations

Subjects that are recommended to be taken simultaneously

Inorganic chemistry III/V11G200V01703

Subjects that it is recommended to have taken before

Physical chemistry III/V11G200V01603

IDENTIFYING DATA				
Inorganic chemistry III				
Subject	Inorganic chemistry III			
Code	V11G200V01703			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Mandatory	4th	1st
Teaching language	Spanish			
Department	Inorganic Chemistry			
Coordinator	Pérez Lourido, Paulo Antonio			
Lecturers	Bolaño García, Sandra Bravo Bernárdez, Jorge Carballo Rial, Rosa García Fontán, María Soledad Pérez Lourido, Paulo Antonio Valencia Matarranz, Laura María			
E-mail	paulo@uvigo.es			
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	
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
C2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics
C10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds
C12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry
C14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules
C20	Evaluate, interpret and synthesize data and chemical information
C23	Present oral and written scientific material and scientific arguments to a specialized audience
C25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use
C26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work
C27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way
C28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself

Learning outcomes			
Expected results from this subject		Training and Learning Results	
Recognise and predict the main structural types of solids and their implications in the chemical and physical properties.	A5	C12 C14	D1 D3 D4 D5 D9 D14
Enumerate and recognise the types of defects in crystals and their effects on the properties of the solid.	A5	C12 C14	D1 D3 D4 D5 D9 D14
(*)			
Define solid electrolytes, recognising their general characteristics and applications.		C2 C12 C14	D1 D3 D4 D14
Identify non-stoichiometric compounds.		C2 C12 C20	D1 D3 D4 D9 D14
Recognise the effect of the addition of impurities on the colour and the optical properties of some inorganic solids.	A5	C2 C12 C14 C20	D1 D3 D4 D9 D14
Identify the main methods of preparation of inorganic solids.		C2 C14 C20	D1 D3 D4 D14
Describe methodologies for crystallogenesis		C2	D1 D3 D4
Define organometallic compound . Describe the bonding between a metal and the different types of common ligands.		C10 C12 C14 C23	D1 D3 D4 D5 D9 D14
Rationalise the information that usual spectroscopyc techniques provide for the characterisation of the different types of organometallic compounds.		C10 C12 C14 C20 C23	D1 D3 D4 D5 D9 D14
Identify the main types of organometallic reactions .		C2 C10 C23	D1 D3 D4 D5 D14
Describe the products of the most important reactions of carbonyl, olefin, carbene and cyclopentadiene complexes.		C2 C10 C14 C20 C23	D1 D3 D4 D5 D9 D14
Describe the bases of the isolobal analogy. Apply the Wade's rules for metallic clusters.		C10 C12 C14 C20 C23	D1 D3 D4 D5 D9 D14

Describe some important catalytic cycles.	C2 C10 C14 C20 C23	D1 D3 D4 D5 D9 D14
Carry out in the laboratory the preparation, characterisation and the study of some physical and chemical properties of the metals and their compounds.	C2 C10 C14 C20 C25 C26 C27 C28	D4 D5 D6 D7 D8 D9 D12 D13 D14 D15

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 practices	45.5	20.5	66
Lecturing	26	50	76
Short answer tests	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 practices	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 attention

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

Assessment

	Description	Qualification	Training and Learning	Results
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.	30	C20 C23	D1 D3 D4 D5 D6 D7 D8 D9 D14
Laboratory practices	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 and the correct fulfillment of the laboratory notebook. It will be possible that the students have to do an examination.	25	C25 C26 C27 C28	D1 D3 D4 D5 D6 D7 D8 D9 D12 D13 D14 D15
Short answer tests	The students will realise two 2-hours written proofs.	45	A5 C2 C10 C12 C14 C20	D1 D14

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 45% 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
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

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	Choose	Year	Quadmester
	9	Mandatory	4th	1st
Teaching language	Spanish			
Department	Organic Chemistry			
Coordinator	Álvarez Rodríguez, Rosana			
Lecturers	Álvarez Rodríguez, Rosana Fall Diop, Yagamare Rodríguez de Lera, Angel Tojo Suárez, Emilia			
E-mail	rar@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	
A1	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
A2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
C2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics
C10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds
C11	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: nature and behavior of functional groups in organic molecules
C12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry
C13	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
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C23	Present oral and written scientific material and scientific arguments to a specialized audience
C24	Recognize and analyze new problems and plan strategies to solve them
C25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use
C26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work
C27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way
C28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D13	Make decisions

D14 Analyze and synthesize information and draw conclusions

D15 Evaluate critically and constructively the environment and oneself

D18 Generate new ideas and show initiative

Learning outcomes

Expected results from this subject	Training and Learning Results		
1. Recognise structural elements in organic molecules.	A2	C2	D1
		C11	D3
		C12	D7
		C13	D9
		C23	D13
		C24	D14
			D18
2. Propose retrosynthetic sequences of target molecules.	A1	C2	D1
	A2	C11	D3
	A5	C12	D4
		C13	D5
		C24	D7
			D9
			D13
			D18
3. Analyse alternative retrosynthetic proposals.	A1	C2	D1
	A2	C10	D3
	A5	C11	D4
		C12	D5
		C13	D7
		C20	D9
		C24	D13
			D18
4. Design synthetic sequences to target molecules.	A1	C2	D1
	A2	C10	D3
	A5	C11	D4
		C12	D5
		C13	D7
		C20	D9
			D13
			D18
5. Value the use of structure-simplifying reactions.	A1	C2	D1
	A2	C10	D3
	A5	C11	D4
		C12	D7
		C13	D9
		C20	D13
		C24	D14
			D18
6. Recognise relationships between functional groups of target molecules.	A1	C2	D1
	A2	C10	D3
	A5	C11	D4
		C12	D7
		C13	D9
		C20	D13
		C24	D18
7. Use properly the functional groups interconversions.	A1	C2	D1
	A2	C10	D3
	A5	C11	D4
		C12	D5
		C13	D7
		C20	D9
		C24	D13
			D14
			D18

8. Propose synthesis of carbocyclic and heterocyclic compounds.	A1 A2 A5	C2 C10 C11 C12 C13 C20 C24 C25 C26 C27 C28	D1 D3 D4 D7 D9 D13 D14 D18
9. Know the reactivity of heterocyclic compounds.	A1 A2 A5	C2 C10 C11 C12 C13 C20 C24 C26 C27 C28	D1 D3 D4 D7 D9 D13 D14 D18
10. Know the reactions that can provide selectivity (chemo-, regio- and stereoselectivity) in chemical transformations.	A1 A2 A5	C2 C10 C11 C12 C13 C19 C20 C24	D1 D3 D4 D5 D7 D8 D9 D13 D14 D18
11. Handle appropriately the disconnections between unsaturated fragments.	A1 A2 A5	C2 C10 C11 C12 C13 C20 C24	D1 D3 D4 D5 D7 D9 D13 D14 D18
12. Evaluate and propose the use of protective groups in organic synthesis.	A1 A2 A5	C2 C10 C11 C12 C13 C20 C24	D1 D3 D4 D7 D9 D13 D14 D18
13. Recognise and value the importance of organic synthesis in the advancement of society.	A2 A4 A5	C23	D15

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 practices	45.5	32.5	78
Lecturing	13	17	30
Short answer tests	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 practices	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 attention	
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 practices	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**
Short answer tests	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	Qualification	Training and Learning Results		
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	A1 A2 A4 A5	C2 C10 C11 C12 C13 C19 C20 C23 C24	D1 D3 D4 D5 D7 D8 D9 D13 D14 D15 D18

Laboratory practices	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	A1 A2 A4	C25 C26 C27 C28	
Short answer tests	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	A1 A2 A5	C2 C10 C11 C12 C13 C20 C24	D1 D3 D4 D5 D7 D9 D13 D14 D18
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	A1 A2 A4 A5	C2 C10 C11 C12 C13 C19 C20 C23 C24 C25 C26 C27 C28	D1 D3 D4 D5 D7 D8 D9 D13 D14 D15 D18

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
Wyatt, P.; Warren, S., **Organic Synthesis: Strategy and Control**, 1st, Wiley, 2008
Zweifel, G. S.; Nantz, M. H., **Modern Organic Synthesis: An Introduction**, 1st, W H Freeman, 2007
Clayden, J.; Greeves, N.; Warren, S., **Organic Chemistry**, 2nd, Oxford University Press, 2012
Starkey, L. S., **Introduction to strategies for organic synthesis**, 1st, Wiley, 2012

Recommendations
Subjects that continue the syllabus
Pharmaceutical chemistry/V11G200V01903

Subjects that it is recommended to have taken before
Chemistry, physics and biology: Integrated laboratory 1/V11G200V01103
Chemistry, physics and geology: Integrated laboratory 2/V11G200V01202
Organic chemistry I/V11G200V01304
Structural Determination/V11G200V01501
Organic chemistry II/V11G200V01504

IDENTIFYING DATA				
Environmental chemistry				
Subject	Environmental chemistry			
Code	V11G200V01902			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish English			
Department	Analytical and Food Chemistry Physical Chemistry			
Coordinator	González Romero, Elisa			
Lecturers	González Romero, Elisa Pérez Juste, Jorge			
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	
C2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics
C4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances
C17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management
C18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D10	Work at a national and international context
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself
D16	Develop an ethical commitment
D17	Develop concern for environmental aspects and quality management

Learning outcomes	
Expected results from this subject	Training and Learning Results

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	C2 C17	D1 D3 D4 D5 D6 D7 D8 D9 D10 D12 D13 D14 D15 D16 D17
Describe the composition and properties of the natural waters	C2 C17	D1 D3 D4 D5 D6 D7 D8 D9 D10 D12 D13 D14 D15 D16 D17
Explain the exchange of matter between the distinct environmental compartments. Time of residence	C2 C17	D1 D3 D4 D5 D6 D7 D8 D9 D10 D12 D13 D14 D15 D16 D17
Explain the main causes of the corrosion and how minimise it	C2 C18	D3 D4 D5 D6 D7 D9 D10 D14 D16 D17
Identify the main pollutants present in the natural media and the main pollutants according to the different environmental rules	C2 C4 C17	D3 D4 D5 D6 D7 D9 D10 D13 D14 D16 D17

Recognise the different types of chemical reactions that experience the pollutants in the natural medias	C2 C4 C17	D3 D4 D5 D6 D7 D10 D14 D16 D17
Estimate the harmful effects for the environment of the diverse types of pollutants	C2 C4 C17	D3 D4 D5 D6 D7 D8 D9 D10 D13 D14 D16 D17
Describe the sampling, pre-treatment and preparation of sample for the analysis of environmental pollutants	C4 C17	D3 D4 D5 D6 D7 D8 D10 D13 D14 D16 D17
Select the appropriate analytical techniques and the concrete methods for its determination in the atmosphere, waters, floors, sediments and biota	C4 C17	D3 D4 D5 D6 D7 D8 D10 D13 D14 D15 D16 D17
Describe the main available technologies for the treatment of the pollution and evaluate its applicability in diverse cases	C4	D1 D4 D5 D6 D7 D8 D10 D12 D13 D14 D15 D16 D17

Know the fundamental methodologies for the evaluation of the environmental impact and the rule related	C4 C17	D1 D4 D5 D6 D7 D8 D10 D12 D13 D14 D15 D16 D17

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
Short answer tests	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 attention

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	Training and Learning Results	
Presentation	The presentations and other activities associated (ACS Webinars, conferences and Meeting/Symposiums) until arriving to the defence of the work.	20	C17	D1 D3 D4 D5 D8 D9 D10 D14 D16 D17
Short answer tests	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	C2 C4 C18	D1 D3 D6 D7 D12 D13 D14 D15 D16

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	C2 C4 C18	D1 D3 D6 D7 D12 D13 D14 D15 D16

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**,

I.N. LEVINE, **Fisicoquímica**,

Stanley E. Manahan, **Environmental Chemistry**, 9,

Roger N. Reeve, **Introduction to Environmental Analysis**,

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

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

Chunlong Zhang, **Fundamentals of Environmental Sampling and Analysis**,

J. P. RILEY y G. SKIRROW, **Chemical Oceanography**,

ISI WEB OF KNOWLEDGE,

Scifinder,

Environmental Sciences Category,

Colin Baird y Michael Cann, **QUIMICA AMBIENTAL**, 2ª edición,

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	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish			
Department	Chemical Engineering Organic Chemistry			
Coordinator	Terán Moldes, María del Carmen			
Lecturers	Álvarez Álvarez, María Salomé Terán Moldes, María del Carmen			
E-mail	mcteran@uvigo.es			
Web				
General description	The matter 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	
A1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C22	Process and perform computational calculations with chemical information and chemical data
C23	Present oral and written scientific material and scientific arguments to a specialized audience
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D10	Work at a national and international context
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself
D16	Develop an ethical commitment
D17	Develop concern for environmental aspects and quality management

Learning outcomes			
Expected results from this subject	Training and Learning Results		
Diferenciate and understand the concepts: drug, active principle, medicine and pharmacological target	A4	C20 C23	D1 D4 D5 D14

Differentiate the types of receptors, as well as an agonist drug from an antagonist.	A4 A5	C20 C23	D1 D3 D4 D5 D7 D9 D13 D14
Relate the physical chemical properties of drugs with their pharmacokinetics.	A1 A3 A5	C19 C20 C22 C23	D1 D3 D5 D7 D8 D14
Differentiate the pharmacomodulation techniques.	A3 A5	C19 C20 C23	D1 D4 D5 D7 D8
Differentiate a chemoterapeutic from a pharmacodynamic agent	A3 A4 A5	C19 C20 C23	D1 D3 D4 D7 D9
Familiarise with the most recent tools in drug design: combinatorial chemistry and computer-aided drug design (QSAR and docking methods)	A3 A5	C19 C20 C22 C23	D1 D3 D4 D5 D8 D12 D13 D15 D16
Describe the methods of structural analysis involved in drug design and differentiate the type of information that they provide	A3 A5	C19 C20 C22 C23	D1 D3 D5 D7 D9 D14 D15
Identify the different forms of drug administration and their fundamentals.	A1 A3 A4 A5	C19 C20 C23	D1 D3 D4 D9 D14
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	A3 A5	C19 C20 C23	D1 D3 D9 D13 D14
Recognise the main stages of fermentative and enzymatic processes applied to the drug production, including production and purification steps	A3 A5	C19 C20 C22 C23	D1 D3 D4 D7 D8 D12 D14 D15
Apply the basic principles of safety and pollution control in operations and processes oriented to drug production	A3 A5	C19 C20 C23	D1 D3 D5 D8 D10 D13 D16 D17

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	A3 A5	C19 C20 C22 C23	D1 D3 D8 D13 D14

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. Chemical development.
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
Short answer tests	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 attention	
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	Training and Learning Results

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	A1 A3	C19 C23	D14 D15 D16
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	A1 A3 A4 A5	C19 C20 C22 C23	D1 D3 D4 D5 D7 D8 D9 D10 D12 D13 D14 D16
Studies excursion	Attendance and active participation in the visit, as well as the results of the test will be qualified.	10	A3	C20	D14 D15 D17
Short answer tests	A short exam (one hour long) will be carried out at week nine. In this exam will enter the subject explained until that moment.	15	A1 A3 A5	C19 C20	D7 D12 D13 D14
Essay questions exam	A global exam will be carried on closing date of evaluation in order to analyze the adquired competencies	50	A1 A3 A5	C19 C20	D7 D12 D13 D14

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,

G. L. Patrick, **An introduction to Medicinal Chemistry**, 6th Edition 2017,

C. G. Wermuth, **4. The Practice of Medicinal Chemistry**, 4th Edition 2015,

R. Renneberg, **Biotecnología para principiantes**, 2004,

Recommendations

Subjects that it is recommended to have taken before

Biology: Biology/V11G200V01101
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	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish			
Department	Chemical Engineering Analytical and Food Chemistry			
Coordinator	Rodríguez Rodríguez, Ana María			
Lecturers	Álvarez Álvarez, María Salomé Deive Herva, Francisco Javier Gago Martínez, Ana Rodríguez Rodríguez, Ana María			
E-mail	aroguez@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	
C16	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles and procedures in chemical engineering
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C22	Process and perform computational calculations with chemical information and chemical data
C23	Present oral and written scientific material and scientific arguments to a specialized audience
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D10	Work at a national and international context
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself

Learning outcomes	
Expected results from this subject	Training and Learning Results

(*)To acquire habilities on process flowsheet diagrams interpretation and design on the basis of real processes.	C16 C20 C23	D1 D3 D4 D5 D6 D7 D8 D9 D10 D12 D13 D14 D15
(*) To identify generic systems for quality management in laboratories and to know the required essential doccumentation	C16 C19 C20 C23	D1 D3 D4 D5 D6 D7 D8 D9 D10 D12 D13 D14 D15
(*)To establish analytical methodology suitable for warranting the quality of raw materials and products, as well as the pollution derived from the industrial process.	C16 C19 C20 C22 C23	D1 D3 D4 D5 D6 D7 D8 D9 D10 D12 D13 D14 D15
(*)To integrate automatized and miniaturized systems on the control of industrial processes.	C16 C19 C22 C23	D1 D3 D4 D5 D6 D7 D8 D9 D10 D12 D13 D14 D15
(*)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.	C16 C19 C20 C22 C23	D1 D3 D4 D5 D6 D7 D8 D9 D10 D12 D13 D14 D15

To understand the role of bioengineering as an environmentally sustainable alternative to obtain products with commercial interest	C16 C19 C20	D1 D3 D4 D5 D6 D7 D8 D9 D10 D12 D13 D14 D15
(*)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	C20 C22 C23	D1 D3 D4 D5 D6 D7 D8 D14 D15
New	C16 C19 C20	D4 D5 D7 D8 D9
New	C16 C20	D4 D8 D9 D10 D12 D13

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 Current Value, Internal Tax of Performance, 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
Supervised work	5	10	15
Presentation	3	6	9
Studies excursion	3	6	9
Short answer tests	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	Presentation of the general aspects of the program, focusing on the fundamental aspects with more difficulties to be understood by the students. The lecturer will give the basic material by Tema platform in order to get the students familiarized with te topic prior to the presentation in class.
Problem solving	After each subject, the most relevant aspects will be tackled by means of problem and questions solving.
Supervised 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 attention	
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.
Supervised 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	Training and Learning Results	
Problem solving	Different troubleshooting will be solved by the students at the framework of their tutored works	10	C16 C19 C22	D3 D5 D6 D7 D9 D14
Supervised work	A work focused on the design of an industrially relevant process flowsheet diagram will be carried out during the term.	20	C16 C20 C22 C23	D1 D4 D5 D6 D7 D8 D10 D12 D13 D14 D15
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	C16 C23	D1 D5 D8 D12 D13 D14
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	C20 C22	D7 D8 D14 D15

Short answer tests	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	C16 C19 C20 C22 C23	D3 D7 D9 D12 D13 D14
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	C16 C19 C20 C22 C23	D3 D7 D12 D13 D14

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,

M. Díaz, **Ingeniería de bioprocesos**, Paraninfo,

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

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

Complementary Bibliography

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

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

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

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

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

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

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

Recommendations

Subjects that it is recommended to have taken before

Chemical engineering/V11G200V01502

IDENTIFYING DATA				
Internships: Internships in companies				
Subject	Internships: Internships in companies			
Code	V11G200V01981			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish Galician			
Department	Physical Chemistry Inorganic Chemistry			
Coordinator	García Bugarín, Mercedes Pérez Juste, Ignacio			
Lecturers	García Bugarín, Mercedes Pérez Juste, Ignacio			
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	
A1	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
A2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
C20	Evaluate, interpret and synthesize data and chemical information
C24	Recognize and analyze new problems and plan strategies to solve them
C25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use
D1	Communicate orally and in writing in at least one of the official languages of the University
D2	Communicate at a basic level in English in the field of chemistry
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D10	Work at a national and international context
D11	Adapt to new situations
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself
D16	Develop an ethical commitment
D17	Develop concern for environmental aspects and quality management
D18	Generate new ideas and show initiative

Learning outcomes	
Expected results from this subject	Training and Learning Results

Contrast the attitudes and the theoretical-practical compentences acquired.	A1 A2 A3 A4	C20 C24 C25	D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15 D16 D17 D18
Perform tasks to test the critical and reflexive capacity.	A1 A2 A3 A4	C20 C24 C25	D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15 D16 D17 D18
Take decisions and put in practice the capacity of analysis and synthesis in the resolution of practical problems.	A1 A2 A3 A4	C20 C24 C25	D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15 D16 D17 D18

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 attention

Methodologies	**Description**
External practices	
Tests	**Description**
Report of external practices	

Assessment

	Description	Qualification	Training and Learning Results
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.

(10%) The assessment of the academic tutor 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 D7 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	Choose	Year	Quadmester
	18	Mandatory	4th	2nd
Teaching language	Spanish Galician English			
Department	Physical Chemistry			
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	
A1	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
A2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
C1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.
C2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics
C3	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
C4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances
C5	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
C6	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: principles of thermodynamics and their applications in chemistry
C7	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: kinetics of change, including catalysis and reaction mechanisms
C8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy
C9	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
C10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds
C11	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: nature and behavior of functional groups in organic molecules
C12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry
C13	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

C14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules
C15	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: chemistry of biological molecules and their processes
C16	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles and procedures in chemical engineering
C17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management
C18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C21	Recognize and implement good scientific practices for measurement and experimentation
C22	Process and perform computational calculations with chemical information and chemical data
C23	Present oral and written scientific material and scientific arguments to a specialized audience
C24	Recognize and analyze new problems and plan strategies to solve them
C25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use
C26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work
C27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way
C28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory
C29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy
D1	Communicate orally and in writing in at least one of the official languages of the University
D2	Communicate at a basic level in English in the field of chemistry
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D10	Work at a national and international context
D11	Adapt to new situations
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself
D16	Develop an ethical commitment
D17	Develop concern for environmental aspects and quality management
D18	Generate new ideas and show initiative

Learning outcomes

Expected results from this subject	Training and Learning Results

(*)Todos os da titulación	A1	C1	D1
	A2	C2	D2
	A3	C3	D3
	A4	C4	D4
	A5	C5	D5
		C6	D6
		C7	D7
		C8	D8
		C9	D9
		C10	D10
		C11	D11
		C12	D12
		C13	D13
		C14	D14
		C15	D15
		C16	D16
		C17	D17
		C18	D18
		C19	
		C20	
		C21	
		C22	
		C23	
		C24	
		C25	
		C26	
		C27	
		C28	
		C29	

Contents

Topic
(*)Dado o seu carácter especial, a materia non ten contidos propios.

Planning

	Class hours	Hours outside the classroom	Total hours
Supervised 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
Supervised 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 attention

Methodologies	Description
Supervised work	

Assessment

	Description	Qualification	Training and Learning Results

Supervised work	30	A1 A2 A3 A4 A5	C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29	D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15 D16 D17 D18
Presentation	70	A1 A2 A3 A4 A5	C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29	D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15 D16 D17 D18

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