

## (\*)Facultade de Química

### Presentation

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



### Degrees given in the Faculty

Degree in Chemistry

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

### Web page

Information about the Faculty of Chemistry:

<http://quimica.uvigo.es>

## (\*)Grao en Química

### Subjects

#### Year 1st

Code	Name	Quadmester	Total Cr.
V11G200V01101	Biología: Biología	1st	6
V11G200V01102	Física: Física I	1st	6
V11G200V01103	Química, física e biología: Laboratorio integrado I	1st	6
V11G200V01104	Matemáticas: Matemáticas I	1st	6

V11G200V01105	Química: Química I	1st	6
V11G200V01201	Física: Física II	2nd	6
V11G200V01202	Química, física e xeoloxía: Laboratorio integrado II	2nd	6
V11G200V01203	Matemáticas: Matemáticas II	2nd	6
V11G200V01204	Química: Química II	2nd	6
V11G200V01205	Xeoloxía: Xeoloxía	2nd	6

#### Year 2nd

Code	Name	Quadmester	Total Cr.
V11G200V01301	Física III	1st	6
V11G200V01302	Química analítica I	1st	9
V11G200V01303	Química física I	1st	6
V11G200V01304	Química orgánica I	1st	9
V11G200V01401	Ferramentas informáticas e de comunicación en química	2nd	6
V11G200V01402	Métodos numéricos en química	2nd	6
V11G200V01403	Química física II	2nd	9
V11G200V01404	Química inorgánica I	2nd	9

#### Year 3rd

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

#### Year 4th

Code	Name	Quadmester	Total Cr.
V11G200V01701	Proxecto	1st	6
V11G200V01702	Química de materiais	1st	6
V11G200V01703	Química inorgánica III	1st	9
V11G200V01704	Química orgánica III	1st	9
V11G200V01902	Química ambiental	2nd	6
V11G200V01903	Química de fármacos	2nd	6
V11G200V01904	Química industrial	2nd	6
V11G200V01991	Traballo de Fin de Grao	2nd	18

IDENTIFYING DATA				
<b>Biology: Biology</b>				
Subject	Biology: Biology			
Code	V11G200V01101			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Galician			
Department				
Coordinator	Suarez Alonso, Maria del Pilar			
Lecturers	Suarez Alonso, Maria del Pilar			
E-mail	psuarez@uvigo.es			
Web	http://fatic.uvigo.es			
General description	The matter of Biology has like aim the preparation of the *alumnado to comprise and explain better the living beings, as they are constituted and as they work, as they study , as they contrast the hypotheses and the experimental facts to elaborate the biological theories.			

Competencies		
Code		Typology
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	- know - Know How
CE15	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: chemistry of biological molecules and their processes	- know - Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- know - Know How
CT3	Learn independently	- Know How
CT4	Search and manage information from different sources	- Know How
CT7	Apply theoretical knowledge in practice	- know - Know How
CT8	Teamwork	- Know How
CT9	Work independently	- Know How
CT12	Plan and manage time properly	- Know How
CT13	Make decisions	- Know How
CT14	Analyze and synthesize information and draw conclusions	- Know How
CT15	Evaluate critically and constructively the environment and oneself	- Know How

Learning outcomes	
Learning outcomes	Competences
Understand the cell like fundamental unit of the be alive.	CB5 CE15 CT1 CT3 CT4 CT7 CT9 CT12 CT14
Understand the properties and organisation of the distinct *cellular organelles.	CB5 CE15 CT1 CT3 CT4 CT7 CT9 CT12 CT14

Know the cellular structure in \*\*procariotas and \*eukaryotic.

CB5  
CE15  
CT1  
CT3  
CT4  
CT7  
CT9  
CT12  
CT14

---

Relate the cellular structures with the metabolism.

CB5  
CE15  
CT1  
CT3  
CT4  
CT7  
CT9  
CT12  
CT14

---

Understand the distinct metabolic \*roads of the distinct organic molecules.

CB5  
CE15  
CT1  
CT3  
CT4  
CT7  
CT9  
CT12  
CT14

---

Describe the hereditary material and know the principles of the central dogma.

CB5  
CE15  
CT1  
CT3  
CT4  
CT7  
CT8  
CT12  
CT13  
CT14  
CT15

---

Define the process of mutation and his implication in the evolutionary processes.

CB5  
CE15  
CT1  
CT3  
CT4  
CT7  
CT9  
CT12  
CT14

---

Know the technicians of DNA \*\*recombinante.

CB5  
CE15  
CT1  
CT3  
CT4  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

---

Comprise the importance of the immune \*system.

CB5  
CE15  
CT1  
CT3  
CT4  
CT7  
CT8  
CT12  
CT13  
CT14  
CT15

## Contents

### Topic

1. The cell	Size, form and cellular function cellular classification Cellular Theory Procaryotic cell eukaryotic Cell
2. *Biomembranas And systems of cellular transport.	Cellular membrane: functions, biochemical composition, physic-chemical properties. Synthesis of the cellular membrane. System of transport through the biological membranes: bombs, protein transporters and channels.
3. The core and the chromosomes. The cellular organelles.	Nuclei Cellular: structure, composition and functions. Structure and functions of the nucleolus Structures and functions of chromatin and chromosomes. Structure, composition and functions of: matrix extracellular, cytoskeleton and centrioles, endoplasmatic reticulum, apparatus of Golgi, endosomes and lisosomes, mitochondria, peroxisomes and cloroplasts.
4. Cellular division and cellular cycle.	Definition and characteristics of mitosis . Differences between somatics and germinal cells. Phases of the cellular cycle Biological meaning of mitosis. Concept of the apoptosis, cellular proliferation and cancer. Concept and differences between asexual and sexual reproduction. Definition and characteristic of meiosis. Phases of meiosis Origin of the genetic variability of the **meiosis Differences between **mitosis and **meiosis.
5. General design of the metabolism: catabolism and anabolism.	Concept of: energetic metabolism, metabolic route, catabolism, anabolism. The equivalent of ATP Extraction of the chemical energy of the organic compounds: glucides, lipids and proteins.
6. Photosynthesis	Nature of the light. Photosynthetic pigments. Stages of the photosynthesis: luminous phase and dark phase (cycle of Calvin). The problem of the photorespiration: plants C4 and plants CAM.
7. DNA, structure and function	Composition, structure of the DNA Other structures of the DNA (DNAz) Function of the DNA Replication of the DNA Initiation the technicians of the recombinant DNA
8. RNA and the expression of the genetic message.	Composition, structure of the RNA RNAm, RNAt and RNAr Other types cellular RNAs and its functions. Review of the concepts of transcription and translation. Language of the genic information.

9. Mutation and evolution.	<p>Genic mutations: concept and types. Molecular consequences of the genic mutations.</p> <p>Structural chromosomal mutations:</p> <p>Numerical chromosomal mutations:</p> <p>Origin and consequences of the mutations.</p> <p>Relation of the mutations and cancer.</p> <p>Evolutionary theories</p> <p>Arguments in favour of wool evolution.</p>
10. The immune system.	<p>Concept of immune system.</p> <p>Components of the immune system.</p> <p>Mechanism of the innate defence of the immune system.</p> <p>Antibodies and interferon.</p> <p>Types of immune response.</p> <p>Alterations of the immune system.</p> <p>Importance of the vaccines.</p>

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	26	48	74
Seminars	13	26	39
Troubleshooting and / or exercises	0	17	17
Tutored works	2	13	15
Short answer tests	1	4	5

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

Methodologies	
	Description
Master Session	<p>In these classes the professor will explain and will develop the concepts and basic foundations of the *temario of clear form and *amena to facilitate his understanding.</p> <p>The contents of each subject will be exposed in the platform FEAR with sufficient time so that the students can consult them.</p> <p>It recommends that the student work on this material, consulting besides the bibliography recommended.</p>
Seminars	<p>In these classes will be oriented to: to) explanations of all type of doubts of the previously explained concepts in the masterclasses.</p> <p>*b) The students of individual way or in group will realise pictures *sinópticos of the subjects analysed in the masterclasses with the end to have an overview of the *temario, what will facilitate them his understanding and interrelationship.</p> <p>*c) In this section also will work some contents of the *temario of Biology, that by experience of the *profesorado are of more difficult understanding and that therefore require a greater didactic support.</p>
Troubleshooting and / or exercises	<p>Each student of individual way will have to realise realise a series of corresponding exercises to each subject to strengthen his study and understanding.</p> <p>These bulletins of exercises will be exposed in the platform FEAR as well as his date of delivery for his evaluation.</p>
Tutored works	<p>To develop the competition *CT8, the students will realise two works in group.</p> <p>The works will be related with the fields of the biotechnology, molecular biology and immunology and will be proposed by the professor. Part of the necessary information for his execution will be contributed by the professor and the rest by the students.</p>

Personalized attention	
Methodologies	Description
Tutored works	<p>They formulate, argue and resolve questions, exercises and problems related with the subject. Each student will sue to the teaching staff the clarifications that estimate opportune to comprise better to subject and develop successfully the tasks that went him proposals. These queries will attend in schedule of *titorías.</p>
Seminars	<p>They formulate, argue and resolve questions, exercises and problems related with the subject. Each student will sue to the teaching staff the clarifications that estimate opportune to comprise better to subject and develop successfully the tasks that went him proposals. These queries will attend in schedule of *titorías.</p>

Troubleshooting and / or exercises	They formulate, argue and resolve questions, exercises and problems related with the subject. Each student will sue to the teaching staff the clarifications that estimate opportune to comprise better to subject and develop successfully the tasks that went him proposals. These queries will attend in schedule of *titorías.
------------------------------------	--

Assessment			
	Description	Qualification Evaluated	Competences
Tutored works	It will evaluate the structuring and organisation of the contents, the oral exhibition and the sources consulted. These works will be exposed in the sessions of seminars to the rest of mates. The final qualification of these works will be of 10% of the final note.	10	CB5 CE15 CT1 CT3 CT4 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Troubleshooting and / or exercises	It will value the assistance (compulsory) to the seminars, the participation us same and the resolution by part of the *alumnado of a series of problems and/or exercises like academic follow-up of the student. The final qualification of these exercises will be of 20% of the final note.	20	CB5 CE15 CT1 CT3 CT7 CT9 CT12 CT13 CT14 CT15
Short answer tests	two short tests will be performed along the course on the matter explained in lectures and seminars. The first proof will be of partial character, will take place in the month of November, is not eliminatory and will represent 20% of the final note. The another proof is of final character and will represent 50% of the final note.	70	CB5 CE15 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14 CT15

### Other comments and July evaluation

Students who have done some of the evaluation activities, they will be considered as presented. You must obtain a minimum grade of 5 out of 10 in the final short proof to make average with the other sections of the evaluation, as long as they also exceed the minimum grade of 5 out of 10. The minimum final grade to pass the subject is 5.0 points. In the case of not passing the subject, the rating on the scoresheet shall be the weighted note of the final short proof. In the second convocation, the evaluation will be conducted as follows: 1. it will be retained the score achieved by students during the course for each evaluation section, provided that exceed the minimum grade of 5. None of these sections is recoverable. 2. A similar test of the end of the semester will be performed. This test is equivalent to 50% of the final note.

### Sources of information

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

Bruce Alberts, Dennis Bray, Karel Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Robert, Introducción a la Biología Celular, Tercera Edición, 2011, Editorial Médica Panamericana

Helmut Plattner, Joachim Hentschal, Biología Celular, Cuarta Edición, 2014, Editorial Médica Panamericana

Peter J Russell, iGenetics. A molecular approach, Third Edition, 2010, Pearson Benjamin Cummings

Leonardo Fainboin, Jorge Geffner, Introducción a la Inmunología Humana, Sexta Edición, 2011, Editorial Médica Panamericana

James D. Watson, Biología Molecular del gen, Séptima edición, 2016, Editorial Médica Panamericana

---

### **Recommendations**

#### **Subjects that continue the syllabus**

Chemistry, physics and biology: Integrated laboratory I/V11G200V01103

#### **Subjects that are recommended to be taken simultaneously**

Physics: Physics I/V11G200V01102

Mathematics: Mathematics I/V11G200V01104

Chemistry, physics and biology: Integrated laboratory I/V11G200V01103

Chemistry: Chemistry I/V11G200V01105

#### **Other comments**

It recommends have \*cursada the matter Biology that gives in the 2º course of \*Bachillerato so much in the modality of Sciences of the Health as in the one of Sciences (double option).



IDENTIFYING DATA				
<b>Physics: Physics I</b>				
Subject	Physics: Physics I			
Code	V11G200V01102			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Pérez Iglesias, María Teresa			
Lecturers	Pérez Iglesias, María Teresa			
E-mail	tpigles@uvigo.es			
Web	<a href="http://fatic.uvigo.es/">http://fatic.uvigo.es/</a>			
General description	Broadly Physics is the general scientific analysis of nature, with the goal of understanding how the universe behaves. It is fundamentally an experimental science. The theories that are developed are tested with observations. From such a wide definition, different perspectives or application levels can be adopted, from microscopic phenomena to macroscopic ones. Physics is thus the basis of innumerable scientific and technological applications. In particular for the student of Chemistry, it is a fundamental tool to understand theories and methods belonging to that of domain of science.			

Competencies		
Code		Typology
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	- know
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	- know - Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know How
CT3	Learn independently	- Know How
CT4	Search and manage information from different sources	- Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	- know - Know How
CT7	Apply theoretical knowledge in practice	- know - Know How
CT8	Teamwork	- Know How
CT9	Work independently	- Know How
CT12	Plan and manage time properly	- Know How
CT13	Make decisions	- know
CT14	Analyze and synthesize information and draw conclusions	- Know How
CT15	Evaluate critically and constructively the environment and oneself	- know

Learning outcomes	
Learning outcomes	Competences
Calculate the values of different kinematic magnitudes of a mechanical system when it starts from initial different conditions.	CB5 CE23 CT1 CT3 CT6 CT8 CT9 CT14

Describe the framework of classical mechanics and calculate for a mechanical system the values of its different magnitudes.	CB5 CE23 CT1 CT3 CT4 CT6 CT8 CT9 CT12 CT13 CT14 CT15
Explain the importance of the conservation theorems and apply some of them.	CB5 CE23 CT1 CT3 CT4 CT6 CT7 CT14
Describe and calculate the kinematic and dynamic magnitudes of a system that undergoes a simple harmonic motion.	CB5 CE23 CT3 CT6 CT7
Enunciate the postulates and principles of thermodynamics.	CB5 CE23 CT1 CT3 CT4 CT12 CT13 CT14
Explain the concept of thermodynamic system and its description using the corresponding variables and thermodynamic potentials.	CB5 CE23 CT1 CT3 CT4 CT12 CT13 CT14
Define the different temperature scales. Convert temperature values from one scale to another.	CB5 CE23 CT1 CT3 CT6 CT7 CT12 CT13 CT14 CT15
Calculate the work carried out by a thermodynamic system and the heat exchanged with the environment, as well as the variation of internal energy, enthalpy and entropy in quasi-static processes.	CB5 CE23 CT1 CT3 CT4 CT6 CT12 CT13 CT14

Distinguish between reversible and irreversible processes from the behaviour of the entropy variation.

CB5  
CE23  
CT1  
CT3  
CT4  
CT6  
CT12  
CT13  
CT14

## Contents

Topic	
1. DESCRIPTION OF THE PHYSICAL REALITY	Introduction - Physical magnitudes and units - Dimensional analysis - Errors.
2. KINEMATICS OF THE POINT AND RIGID BODY	Material point - Vector position, velocity and acceleration - Tangent and normal components of the acceleration - Study of some movements: rectilinear and plane - Rigid body.
3. PRINCIPLES OF THE DYNAMICS	Concept of force - Newton Law's - Newton's theory of gravitation.
4. DYNAMICS OF THE PARTICLE	Equations of motion - Momentum and angular momentum - Radial Forces: Conservation of the angular momentum - Work and power - Kinetic Energy - Conservation of the mechanical energy - Non conservative forces. The conservation of energy. - Energy diagrams.
5. OSCILLATING MOTION	Simple harmonic Motion: Kinematics, Dynamics and Energy.
6. DYNAMICS OF SYSTEMS OF PARTICLES	Internal and external forces - Equation of motion for the center of mass - Work of external and internal forces - Collisions.
7. THE RIGID BODY	Rigid Body: Degrees of freedom, Rotational motion: Moment of inertia, angular momentum, Kinetic Energy.
8. FLUIDS	Pressure and density. Pressure in a fluid at rest. Measurement of pressure - Surface Tension- Capillarity. Jurin's Law - Tate's Law.
9. INTRODUCTION TO THE THERMODYNAMICS. THERMOMETRY	Macroscopic and microscopic description - Thermal equilibrium - Zero'th law of Thermodynamics. Temperature - Measure of temperature. Thermometers - Ideal Gas. Ideal gas temperature scale.
10. HEAT AND WORK	Thermodynamic Equilibrium. Equations of state. Quasi-static Processes - Thermodynamic work - Heat capacity and specific heat. Latent heat.
11. THE FIRST LAW OF THERMODYNAMICS	The First Law of Thermodynamics - Internal Energy, enthalpy and heat capacities of the ideal gases. Mayer's Law -Adiabatic changes of an ideal gas.
12. THE SECOND LAW OF THERMODYNAMICS	Introduction - Second Law: Clausius and Kelvin-Planck Statements - Cycle of Carnot. Theorem of Carnot- Thermodynamic Scale of Temperatures - Inequality of Clausius- Entropy.

## Planning

	Class hours	Hours outside the classroom	Total hours
Seminars	26	28.6	54.6
Master Session	26	28.6	54.6
Presentations / exhibitions	2	13	15
Troubleshooting and / or exercises	4.5	15.3	19.8
Short answer tests	1.5	4.5	6

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

## Methodologies

	Description
Seminars	a) Exercises and problems will be solved, by the students or the teacher. Problems sheets will be available with sufficient anticipation. b) Doubts and difficult concepts will be discussed and clarified by group tutoring. c) Diverse tasks that students have to carry out will be programmed. d) Diverse tasks that students have to carry out will be tested.

Master Session	The student can find information on lectures at the web platform Thema.  a) In each topic the specific objectives will be analyzed. Its need and the possible applications will be indicated. b) The way to get objectives will be indicated. Emphasis will be made on those aspects that are more problematic and difficult. Different examples will be solved. c) In necessary case, it would be proposed some bibliographic references.
Presentations / exhibitions	a) Different activities will be carried out by the students working individually or in groups. b) In order that the students have a clear idea of the objectives to reach and the available material, information about these ones will be provided with enough time in advance.

### Personalized attention

Methodologies	Description
Presentations / exhibitions	Guided activities could need personalized attention. Voluntary Tutorials allows the clarification of doubts on an individual basis.
Seminars	The activities that will carry out in Seminars could need personalized attention. Voluntary Tutorials allows the clarification of doubts on an individual basis.

### Assessment

	Description	Qualification Evaluated	Competences
Presentations / exhibitions	The student will present a work related to the subject contents.	10	CE23 CT1 CT4 CT8 CT12
Seminars	Solving homework problems and other assignments that have been carried out in seminars.	25	CB5 CE23 CT1 CT3 CT4 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Short answer tests	Three tests written: a) The minimum mark to pass each exam will be 5 out of 10. b) The third test will be done with the first term final exam. c) The marks of the two first tests will be maintained until the extraordinary exam (june). d) In first term final exam each student will have the opportunity to repeat the test he/ she has failed or those where he/she wishes to improve the mark previously obtained.	15	CB5 CE23 CT3 CT6 CT7 CT9 CT13
Troubleshooting and / or exercises	Three tests written: a) The minimum mark to pass each exam will be 5 out of 10. b) The third test will be done with the first term final exam. c) The marks of the two first tests will be maintained until the extraordinary exam (june). d) In first term final exam each student will have the opportunity to repeat the test he/ she has failed or those where he/she wishes to improve the mark previously obtained.	50	CB5 CE23 CT3 CT6 CT7 CT9 CT13

### Other comments and July evaluation

Extraordinary exam (june) assessment: a) Written test to recover the written tests that were failed in the first term final exam. The criteria of evaluation in the second call will be the same as in the first term final exam assessment.

---

---

### Sources of information

Tipler P.A.; Mosca G., Física para la ciencia y la tecnología (2 volumes), 2010, Reverté, Barcelona.

Gettys E., Física para ingeniería y ciencias , 2005, McGraw-Hill Interamericana

Serway R.A., Física, 2009, Paraninfo

José M<sup>a</sup> de Juana, Física General (2 tomos), 2003, Alhambra.

Young; Freedman, Física universitaria I, 2013, Pearson Educación

---

---

### Recommendations

#### Subjects that continue the syllabus

Physics: Physics II/V11G200V01201

Chemistry, physics and geology: Integrated laboratory II/V11G200V01202

Physics III/V11G200V01301

---

#### Subjects that are recommended to be taken simultaneously

Chemistry, physics and biology: Integrated laboratory I/V11G200V01103

---

---

### Other comments

It is recommended that students had studied Physics and Mathematics in 2nd level of high school.

In particular students should be familiar with:

- Vector algebra.
  - Matrix algebra.
  - Polynomial algebra.
  - Graphic representation of polynomial, trigonometrical, logarithmic and exponential functions.
  - Differential and integral calculus.
-

IDENTIFYING DATA				
Chemistry, physics and biology: Integrated laboratory I				
Subject	Chemistry, physics and biology: Integrated laboratory I			
Code	V11G200V01103			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Lavilla Beltrán, María Isela Pérez Cid, Benita			
Lecturers	Calle González, Inmaculada de la Couce Fortúnez, María Delfina García Martínez, Emilia Lavilla Beltrán, María Isela Leao Martins, Jose Manuel Muñoz López, Luis Pérez Cid, Benita Salgueiriño Maceira, Verónica Suarez Alonso, Maria del Pilar			
E-mail	isela@uvigo.es benita@uvigo.es			
Web				
General description	"Machine translation into english of the original teaching guide" In this matter pretends that students initiate and learn the criteria and indispensable manipulations to work in a chemical laboratory ia correct way, safe and respectful with the enviroment. Student will learn to use glass materials, instrumentation and basic operations, reaching skills that will allow them to work in specialized laboratories. There will be a focus on the observation and preparation of a laboratory notebook as well as in the realisation of a final report of the work carried out.			
Competencies				
Code				Typology
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy			- Know How
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use			- Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way			- Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory			- Know How
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy			- Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University			- know - Know How
CT3	Learn independently			- Know How
CT4	Search and manage information from different sources			- Know How
CT5	Use information and communication technologies and manage basic computer tools			- Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations			- know - Know How
CT7	Apply theoretical knowledge in practice			- know - Know How
CT8	Teamwork			- Know How

CT9 Work independently	- Know How
CT12 Plan and manage time properly	- Know How
CT13 Make decisions	- Know How
CT14 Analyze and synthesize information and draw conclusions	- Know How
CT15 Evaluate critically and constructively the environment and oneself	- Know How

### Learning outcomes

Learning outcomes	Competences
Interpret the results of the work of laboratory and relate them with the appropriate theories.	CB5 CE28 CT7 CT9 CT12 CT14
Handle properly the common material in the chemical laboratory.	CB5 CT7 CT9
Calibrate the experimental teams and use patterns when it was necessary.	CB5 CE28 CT7 CT9 CT12 CT13
Determine some properties of the chemicals: melting-point, boiling-point, *viscosidad, density, superficial tension, specific heat.	CB5 CE27 CT6
Prepare dissolutions.	CB5 CE25 CT7 CT9 CT12
Separate the components of mixes, so much *homogéneas like heterogeneous.	CB5 CE25 CT7 CT9 CT12
*Predecir And check how a balance alters by addition or elimination of reagents, changes of volume, pressure or temperature.	CE25 CE27 CT7 CT9
Realise the necessary mathematical operations to quantify the processes carried out in the laboratory.	CB5 CE29 CT3 CT6 CT7 CT9 CT12
Look for information on the properties (physical, chemical, dangerousness, etc.) of the chemicals.	CB5 CT4 CT5 CT9 CT12
Apply the norms of security and hygiene in the chemical laboratory	CB5 CE25 CT7 CT9 CT13 CT15
Delete the waste generated in the laboratory of suitable form.	CB5 CE25 CT7 CT13 CT15

Handle solids and liquids of safe way to temperature acclimatise in the atmosphere of the laboratory.	CB5 CE25 CT7 CT9 CT15
Interpret the data derived of the measures realised in the laboratory.	CE29 CT3 CT8 CT9 CT14
Elaborate a fascicle of laboratory that register of systematic way all the events and changes observed in the development of the work of laboratory.	CB5 CE27 CT1 CT4 CT9 CT12
Handle the technicians and the scientific instrumentation-technical of the biochemistry and the molecular biology.	CB5 CT7 CT8 CT9 CT12 CT15
Separate, isolate, identify and quantify the distinct *biomoléculas.	CB5 CE25 CT14
Realise an assessment of the risks associated to the use of chemicals.	CE25 CT7 CT9 CT15

## Contents

### Topic

- 1) Norms of hygiene and security in the laboratory (1 session ).
- 2) basic Concepts of the calculation of errors in the measures: I handle of the calibrate and analysis of distribution of populations (1 session).
- 3) Recognition and utilisation of the basic material of laboratory. Design of a fascicle of laboratory (1 session ).
- 4) Determination of densities of liquids and solid (1 session).
- 5) Preparation of dissolutions (2 sessions):  
to) From a solid solute (exact and approximate concentration).  
\*b) From a liquid solute (\*Ej.: \*HCl, \*H<sub>2</sub>UNDER4, etc.).  
\*c) Prepare dissolutions diluted of the ready previously.
- 6) Measure of the superficial tension (1 session).
- 7) Measure of the \*viscosidad (1 session).
- 8) Establishment of a chemical equation: stoichiometry (1 session).
- 9) Separation of the components of a mix by means of sublimation and leak (1 session).
- 10) Reactions of precipitation (1 session).
- 11) Purification of liquids: distillation (1 session).
- 12) Isolation of organic compounds: liquid extraction-liquid. (1 session).
- 13) Heat of reaction. (1 session).
- 14) Purification of solids: crystallisation. Measure of melting-points. (1 session).



15) Study of the chemical balance. Principle of Him \*Chatelier (1 session):  
to) Effect of the temperature.  
\*b) Effect of the concentration.

16) specific Heats of liquids and solid (1 session).

17) Extraction of present lipids in the \*yema of egg. Methods of extraction and identification of the distinct types of lipids. Methods of chromatography in fine layer of lipids (\*CCF) (1 session).

18) sour Volumetries-basic (2 sessions):  
to) Assessment of hydroxide of sodium with hydrogen \*ftalato of potassium.  
\*b) Assessment of acid \*clorhídrico with the hydroxide of ready sodium in (to).

19) Isolation of nucleic acids. Method of extraction and identification of nucleic acids. Methods of colorimetric reaction (1 session).

20) Determination of the concentration of proteins in liver of rat. Realisation of a straight pattern (1 session).

21) Volumetries \*redox (2 sessions):  
to) Assessment of \*oxalato of sodium with \*permanganato of potassium.  
\*b) Determination of the concentration of a dissolution of \*hipoclorito by means of assessment with \*tiosulfato.

22) Isolation of glycogen. Extraction by means of precipitation and extraction with alcohol (1 session).

23) Determination of the concentration of glucose. Specific chemical methods colorimetric (1 session).

<b>Planning</b>			
	Class hours	Hours outside the classroom	Total hours
Laboratory practises	72	40	112
Master Session	6	0	6
Short answer tests	2	6	8
Practical tests, real task execution and / or simulated.	3	6	9
Reports / memories of practice	0	15	15
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

<b>Methodologies</b>	
	Description
Laboratory practises	They will realise experiments of laboratory, of individual form, in sessions of 3 hours each one. The student will have of the scripts of practices and questionnaires related as well as of material of support, in the platform *tem@, so that it can have a previous knowledge of the same that it allow him prepare the experiments to realise. During the development of the practices the student will elaborate a fascicle of laboratory in which it will have to annotate all the relative observations to the experiment realised. It will owe also elaborate a report of practices and/or questionnaire on request of the professor that require it.
Master Session	To the start of each session of laboratory, the professor will do an exhibition of the contents to develop by the students.

<b>Personalized attention</b>	
Methodologies	Description
Laboratory practises	Each student will ask to the professor the explanations that estimate timely for a better understanding of the matter and to develop successfully the tasks that were him proposed. These queries will do in *horado of *tutorías.

Tests	Description		
Reports / memories of practice	Each student will ask to the professor the explanations that estimate timely for a better understanding of the matter and to develop successfully the tasks that were him proposed. These queries will do in *horado of *tutorías.		
Assessment			
	Description	Qualification Evaluated	Competences
Laboratory practises	The professor will realise a follow-up, through questionnaires and of the fascicle of laboratory, of the experimental work realised by the student in the sessions of laboratory. Since it treats of a matter of experimental type, is compulsory the assistance to the sessions of laboratory. If the number of absences (even being justified) is upper to 6 will suppose to suspend the *asignatura.	40	CB5 CE25 CE27 CE28 CE29 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Short answer tests	Once finished all the practical sessions, will realise a proof written (of brief answer) relative to concrete appearances of the operations realised in the laboratory. The date of the proof will publish with *antelación.	20	CE28 CE29 CT1 CT3 CT6
Practical tests, real task execution and / or simulated.	It will realise a practical proof (a session of laboratory) that will allow to evaluate the competitions and skills purchased by the student. Said proof will be realised of independent form for each group of practices. This proof will carry out the day established in the official calendar of evaluations.	30	CB5 CE25 CE27 CE28 CE29 CT1 CT3 CT6 CT7 CT9 CT12 CT13 CT14 CT15
Reports / memories of practice	By request of the professor, the student will elaborate reports of practices that reflect the work developed in the laboratory.	10	CB5 CE28 CE29 CT1 CT4 CT5 CT6 CT14

---

**Other comments and July evaluation**

---

The assistance to more than two sessions of laboratory involves that the student already is being evaluated, by what his qualification in the record will not be able to be no presented. Is necessary to obtain a minimum note of 4 on 10 in each one of the sections of the evaluation to be able to do the average; in the section "reports" it will be necessary to obtain a minimum note of 4 on 10 in the reports of the matters of each one of the matters that evaluate them; all the previous will apply also to the second announcement. In the case of not surpassing the matter, the qualification in the record will be the note ponderada of the practical proof of laboratory. In the second announcement the evaluation will carry out of the following way: will conserve the punctuation obtained by the student during the course in the section "practices of laboratory" (40%), no recoverable. In case of have not obtained the minimum note demanded in any of the remaining sections will be able to recover the following: 1) "Proof of short answer" (20%): the date of the examination will be the one who fix in the official calendar. 2) "practical Proof" (30%): the date of the examination will be the one who fix in the official calendar. 3) "Reports of practical" (10%): they will deliver with antelación to the official date of the examination in accordance with the indications of the profesorado. The final qualification will be the sum of the notes of all the sections whenever they surpass the minima demanded. Of not being the case, the qualification that will appear in the record will be the note ponderada of the practical proof (said note will not be able to be inferior to the one of the first announcement).

---

---

**Sources of information**

---

Mathews-Van Holde, Bioquímica, McGraw-Hill, 4ª Ed. 2013 ,

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

M.A. Martinez Grau, A.G. Csasky , Técnicas Experimentales en Síntesis Orgánica , Síntesis, 2ª Ed. 2012,

P.A. Tipler, G. Mosca , Física para la Ciencia y la Tecnología (2 volúmenes) , Reverté, 6ª Ed. 2010,

Voet D., Voet J.G., Bioquímica, Editorial Médica Panamericana, 2006,

E. Gettys, F.J. Keller, M.J. Skove , Física Clásica y Moderna, McGraw-Hill, 1991,

R. Chang, Química, McGraw-Hill, 11ª Ed, 2013,

R.H. Petrucci, W.S. Harwood, F.G. Herring , Química General, Prentice Hall, 10ª Ed. 2011,

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

---

---

**Recommendations**

---

**Subjects that continue the syllabus**

---

Chemistry, physics and geology: Integrated laboratory II/V11G200V01202

---

**Subjects that are recommended to be taken simultaneously**

---

Biology: Biology/V11G200V01101

Physics: Physics I/V11G200V01102

Mathematics: Mathematics I/V11G200V01104

Chemistry: Chemistry I/V11G200V01105

---

IDENTIFYING DATA				
<b>Mathematics: Mathematics I</b>				
Subject	Mathematics: Mathematics I			
Code	V11G200V01104			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Galician			
Department				
Coordinator	Quinteiro Sandomingo, María del Carmen			
Lecturers	Quinteiro Sandomingo, María del Carmen			
E-mail	quinteir@uvigo.es			
Web	<a href="http://faitic.uvigo.es/">http://faitic.uvigo.es/</a>			
General description	<p>"Machine translation into english of the original teaching guide"</p> <p>The matter collects contents, theoretical and practical of algebra linear and calculus (in a variable). The follow-up of the same will improve the capacity of compression and employment of the mathematical language. It will allow to the students purchase skills of calculation and initiate in the use of computer applications.</p>			

Competencies		
Code		Typology
CB4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences	- know - Know How
CE22	Process and perform computational calculations with chemical information and chemical data	- know - Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	- know - Know How
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	- know - Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	
CT3	Learn independently	- know - Know How
CT4	Search and manage information from different sources	- know - Know How
CT5	Use information and communication technologies and manage basic computer tools	- know - Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	- know - Know How
CT7	Apply theoretical knowledge in practice	- know - Know How
CT8	Teamwork	- know - Know How
CT9	Work independently	- know - Know How
CT12	Plan and manage time properly	- know - Know How
CT13	Make decisions	
CT14	Analyze and synthesize information and draw conclusions	- know - Know How
CT15	Evaluate critically and constructively the environment and oneself	- know - Know How

Learning outcomes	
Learning outcomes	Competences

Operate with vectors, distances and angles.	CE22 CE29 CT6 CT7 CT9
Formulate matrix models to tackle problems of distinct branches of the Science.	CE22 CE29 CT5 CT6 CT9
Dominate the properties of the matrices and of his application for the approach and resolution of systems of linear equations.	CE29 CT7 CT9
Resolve systems of linear equations using packages of symbolic and numerical calculation.	CE22 CE29 CT5 CT7
Operate properly with real numbers and complexes.	CE22 CE29 CT6 CT7
Realise calculations of limits, continuity, derivative and integrals of real functions of real variable and of partial derivatives of functions of several variables.	CE22 CE29 CT7
Identify real problems that can be tackled by means of the differential calculation and integral and resolve them with these technicians.	CE22 CE29 CT6 CT7 CT9 CT14
Analyse and represent functions, knowing deduce properties of the same from his graphic.	CE29 CT7
Formulate and resolve problems of optimisation.	CE29 CT7 CT9 CT14
Calculate integrals of line of scalar and vectorial fields and know his connection with concepts of the Physics.	CE29 CT7
Handle some computer package of symbolic calculation to resolve problems of differential calculation and integral.	CE22 CT5 CT7
Express of oral form and writing, mathematical concepts.	CB4 CE23 CT1 CT3 CT4 CT5 CT8 CT12 CT13 CT14 CT15

## Contents

Topic	
Introduction to the real functions of real variable	The real numbers and the straight real. Operations with real numbers. Real functions of real variable. Command and rank. Graphic of a real function of real variable. Elementary functions.
Differential calculation in a variable	Limits and continuity of real functions of real variable. Derived of a function in a point. Calculation of derivatives. Consequences of the *derivación. Relative extremes. Graphic representation of real functions of real variable.
Integration of real functions of real variable.	Integral of Riemann. Fundamental theorem of the integral calculation. Calculation of primitive.

Real vectorial spaces	Operations with vectors in the plane and in the space. Scalar product. Angle formed by two vectors. Vectorial product in $\mathbb{R}^3$ . Mixed product. Vectorial spaces. *Subespacios. Bases.
Systems of linear equations	Matrices. *Determinantes. Basic operations with matrices and *determinantes. Discussion and resolution of systems of equations *lineares. Method of Gauss.
Scalar functions and vectorial functions	Scalar functions and vectorial functions. Partial derivatives of scalar functions. Vector gradient. Ways and integrals of line. Fields *conservativos.
Complex numbers	Complex numbers. Operations with complex numbers.

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	20	30	50
Practice in computer rooms	6	3	9
Troubleshooting and / or exercises	26	39	65
Long answer tests and development	3	22	25
Practical tests, real task execution and / or simulated.	0	1	1

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

## Methodologies

	Description
Master Session	The *profesorado will expose the theoretical foundations of the matter; it will present possible applications; it will formulate problems, questions and exercises; it will propose tasks and activities with orientations on the methods and technical to employ to carry out them.
Practice in computer rooms	Activities oriented to the learning and handle of computer programs of Mathematics, for the calculation and the graphic representation of functions and data.
Troubleshooting and / or exercises	In this activity, each student, well of individual way or in group, will have to resolve exercises and *problemas related with the matter. It will have to be able to formulate the mathematical model more convenient, apply the most appropriate technician to resolve each case and interpret and present, of oral way or written, the results.

## Personalized attention

Methodologies	Description
Troubleshooting and / or exercises	Each student will sue to the *profesorado the explanations that estimate timely for better comprise the matter and develop successfully the tasks that were him proposed. These queries will attend in the schedule of *tutorías.
Practice in computer rooms	Each student will sue to the *profesorado the explanations that estimate timely for better comprise the matter and develop successfully the tasks that were him proposed. These queries will attend in the schedule of *tutorías.

## Assessment

Description	Qualification	Evaluated Competences
-------------	---------------	-----------------------

Troubleshooting and / or exercises	Each student will have to resolve a series of exercises or problems in the term of time and under the conditions established by the *profesorado. The works sued will be able to be of distinct types: presentation of a document written, exit to the *encerado, oral exhibition of any subject related with the matter,... These activities will allow to evaluate of way continued the learning of each student.	15	CB4 CE23 CE29 CT1 CT3 CT4 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Long answer tests and development	Final examination. Proof for the evaluation of the competitions purchased. It will realise when finishing the period *lectivo and will include questions and exercises to which the students and the students will answer organising and presenting, of extensive way, the knowledges that have on the matter.	80	CE29 CT1 CT6 CT7 CT12
Practical tests, real task execution and / or simulated.	Proof to evaluate the skill in the handle and application of the computer resources learnt during the practices of laboratory. It will take place during the sessions of practices of computing	5	CE22 CT5 CT6

#### Other comments and July evaluation

To surpass the matter, the note obtained will have to be equal or upper to 50% of the total punctuation. The students and the students that do not surpass the matter in January, and pretend to do it in the announcement of July, will have to repeat \*obligatoriamente the final examination. The note obtained during the course in the others proofs (Resolution of problems and/or exercises; practical Proofs, of execution of real tasks and/or mock) will keep for the announcement of July. Any student that participate in one of the two proofs of long answer realised when finishing the period \*lectivo (in January or, to be the case, in July) will not be able to, in no case, obtain the qualification of NO PRESENTED.

#### Sources of information

A.S. Ackleh, E.J. Allen, R.B. Kearfott e P. Seshaiyer, Classical and Modern Numerical Analysis, 2009, CRC Press  
R. A. Adams, Cálculo, 2009, Pearson  
M. Besada, F. J. García, M. A. Mirás, C. Quinteiro, C. Vázquez, Matemáticas á Boloñesa, 2014, Servizo de Publicacións da Universidade de Vigo  
S. A. Dianat, E. Saber, Advanced Linear Algebra for Engineers with Matlab, 2009, CRC Press  
R. Larson, R. Hostetler e B. H. Edwards, Cálculo (volume 1), 2009, Editorial Pirámide  
R. Larson, R. Hostetler, Precálculo, 2012, Cengage Learning  
R. Larson, B. H. Edwards e D.C. Falvo, Álgebra lineal, 2004, Editorial Pirámide  
J. Medina Moreno, Álgebra lineal y cálculo para estudios de químicas con problemas resueltos, 2015, Paraninfo  
G. Pota, Mathematical Problems for Chemistry Students, 2006, Elsevier  
E. Steiner, The Chemistry Maths Book , 2008, Oxford University Press  
Centro virtual de divulgación de las Matemáticas, <http://www.divulgamat.net/>, , Real Sociedad Matemática Española

#### Recommendations

##### Subjects that continue the syllabus

Mathematics: Mathematics II/V11G200V01203  
Numerical methods in chemistry/V11G200V01402

##### Subjects that are recommended to be taken simultaneously

Biology: Biology/V11G200V01101  
Physics: Physics I/V11G200V01102  
Chemistry, physics and biology: Integrated laboratory I/V11G200V01103  
Chemistry: Chemistry I/V11G200V01105

---

**Other comments**

It recommends have \*cursado the matter of Mathematics of the last course of \*Bachillerato.

---



IDENTIFYING DATA				
<b>Chemistry: Chemistry I</b>				
Subject	Chemistry: Chemistry I			
Code	V11G200V01105			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Galician			
Department				
Coordinator	Tojo Suárez, María Concepción			
Lecturers	Bravo Bernárdez, Jorge Rodríguez Arguelles, María Carmen Tojo Suárez, María Concepción			
E-mail	ctojo@uvigo.es			
Web				
General description	Subject in the that impart contents of General Chemistry.			

Competencies		
Code		Typology
CB1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study	- know
CE1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.	- know
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	- know
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	- Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know How
CT3	Learn independently	- Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	- know - Know How
CT7	Apply theoretical knowledge in practice	- Know How
CT9	Work independently	- Know How
CT12	Plan and manage time properly	- Know How
CT13	Make decisions	- Know How
CT14	Analyze and synthesize information and draw conclusions	- Know How
CT15	Evaluate critically and constructively the environment and oneself	- know - Know How

Learning outcomes	
Learning outcomes	Competences
Use mol, empirical and molecular formula. Name binary compounds.	CB1 CE1 CE19 CT1 CT3 CT6 CT7 CT9 CT12 CT13 CT14 CT15

Describe the general structure of the atom and the main models. Use the periodic table.	CB1 CE1 CE19 CT1 CT3 CT6 CT7 CT9 CT12 CT13 CT14 CT15
Explain the covalent bond and Lewis structures. Predict the bond polarity. Name and formulate poliatomic ions. Describe the properties of ionic compounds.	CB1 CE1 CE19 CT1 CT3 CT6 CT7 CT9 CT12 CT13 CT14 CT15
Use the RPECV model. Determine the orbitals hybridization in one central atom and the corresponding molecular geometry. Identify sigma and pi bonds. Predict the polarity of molecules. Describe the different types of intermolecular interactions and used them to explain the melting and boiling points.	CB1 CE1 CE19 CT1 CT3 CT6 CT7 CT9 CT12 CT13 CT14 CT15
Adjust simple chemical equations and do stoichiometric calculations. Recognize types of general reactions. Explain neutralization reactions and oxidation-reduction reactions.	CB1 CE2 CE19 CT1 CT3 CT6 CT7 CT9 CT12 CT13 CT14 CT15
Explain the properties of gases. Calculate the quantities of gas reactants and products that take part in chemical reactions. Describe the ideal gases model and compare it with real gases.	CB1 CE1 CE19 CT1 CT3 CT6 CT7 CT9 CT12 CT13 CT14 CT15

Explain the properties of liquids, and the phase transitions that take place between solids, liquid and gases. Perform calculations on the basis of simple unitary cells and the dimensions of atoms and ions. Explain the metallic bonding and interpret the properties of metals, semiconductors and insulating materials.

CB1  
CE1  
CE19  
CT1  
CT3  
CT6  
CT7  
CT9  
CT12  
CT13  
CT14  
CT15

Describe the different forms of energy. Recognise and use the thermodynamic language. Apply the Hess law. Calculate the variations of the different thermodynamic functions in a chemical reaction.

CB1  
CE1  
CE2  
CE19  
CT1  
CT3  
CT6  
CT7  
CT9  
CT12  
CT13  
CT14  
CT15

Describe the properties of a system in chemical equilibrium. Calculate the equilibrium constant and the concentrations of reactants and products in system in chemical equilibrium. Use the Le Chatelier principle.

CB1  
CE1  
CE2  
CE19  
CT1  
CT3  
CT6  
CT7  
CT9  
CT12  
CT13  
CT14  
CT15

Explain the properties of water. Predict the solubility. Describe the role of water in the acid-base reactions. Identify the conjugate base and the conjugate acid. Calculate the pH. Identify the oxidizing and reducing agents in a redox reaction and balance redox reactions.

CB1  
CE1  
CE2  
CE19  
CT1  
CT3  
CT6  
CT7  
CT9  
CT12  
CT13  
CT14  
CT15

Define the main concepts of Chemical Kinetics. Determine the rate laws and the rate constants. Calculate the activation energy and the frequency factor. Explain the catalytic action.

CB1  
CE1  
CE2  
CE19  
CT1  
CT3  
CT6  
CT7  
CT9  
CT12  
CT13  
CT14  
CT15

## Contents

Topic

Subject 1. Nature of Chemistry	The matter and its properties. Classification of the matter. Atoms and elements. Concept of mol. Chemical compounds. Formulation. Classification. Molecular mass and mol of a compound. Determination of empirical and molecular formula.
Subject 2. Chemical reactions	Classification. Chemical equations. Stoichiometric calculations. Limiting reactant. Yield.
Subject 3. Gases	Properties of gases. The atmosphere. Ideal gases law. Density and molar mass of gases. Partial pressures. Real gases.
Subject 4. Thermochemistry and the spontaneity of a chemical processes.	Thermochemistry and the spontaneity of chemical processes. Units of energy. Transfer of energy and phase transition. Thermochemical equations. Hess's law. Entropy and second law of thermodynamics. Gibbs energy.
Subject 5. Chemical equilibrium	Equilibrium constant: determination and meaning. Calculation of equilibrium concentrations. Le Chatelier's principle. Gibbs energy and equilibrium constant.
Subject 6. Water and chemistry of solutions	Water as a solvent. How substances are solved. Temperature and solubility. Solubility equilibrium. Concept of Brønsted acid-base. Water autoionization. Ionization constants. Acid-base reactions. Hydrolysis. Buffer solutions. Redox reactions. Balance of redox reactions.
Subject 7. Condensed phases	Liquid state. Order in liquids. Solid state. Melting point. Boiling point. Phase equilibria. Phase diagram.
Subject 8. Chemical kinetics	Reaction rate. Effect of concentration. Rate law and order of reaction. Mechanisms of reaction. Catalysis. Thermodynamic and kinetic stability.
Subject 9. The atom	Subatomic particles. Nuclear atom. Chemical elements. Isotopes. Electronic structure of atoms. Electronic configuration. Periodic table. Periodic properties.
Subject 10. Chemical bonding	Simple covalent bonds and Lewis structures. Multiple covalent bond. Lewis structures and resonance. Polarity of a bond and electronegativity. Coordinated covalent bonds. Ions and ionic compounds.
Subject 11. Molecular structure	Prediction of molecular forms: RPECV. Hybridization. Molecular polarity. Condensed phases formation. Intermolecular interactions.

### Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	26	26	52
Seminars	26	26	52
Troubleshooting and / or exercises	0	19	19
Long answer tests and development	4	14	18
Short answer tests	2	7	9

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

### Methodologies

	Description
Master Session	In this kind of sessions the general aspects of the program will be introduced in an structured way. The basics and the more important or difficult to understand aspects will be emphasized. The required material to study the next week will be available through the Tem@ platform. In this case, students are advised to study previously the available material and to consult the recommended bibliography to complete the information. In this way the explanations of the program contents will result in a better academic progress.
Seminars	Two classes a week will be devoted to students solve some of the problems or proposed exercises related with the subject. Some of these exercises or any other proposed by the teacher can be ordered to be qualified. As well as the correct exercises resolution, the suitable use of the language and handle mathematics (including error analysis, correct estimate of magnitude orders, use of units and ways of data presentation) will be valued.
Troubleshooting and / or exercises	The list of problems must be solved by students, with the help, if necessary, of the teacher during seminars or tutorial timetable. These list of problems can be requested in the established date if teacher ask for them. As well as the correct exercises resolution, the suitable use of the language and handle mathematics (including error analysis, correct estimate of magnitude orders, use of units and ways of data presentation) will be valued.

### Personalized attention

Methodologies	Description
Troubleshooting and / or exercises	The students can consult all type of questions about the subject during the tutorial timetable.
Seminars	The students can consult all type of questions about the subject during the tutorial timetable.

Assessment			
	Description	Qualification Evaluated	Competences
Troubleshooting and / or exercises	The attendance (mandatory) to seminars, the involvement of students and the resolution by students of a serie of problems and/or exercises can be valued to monitor the student progress.	25	CB1 CE1 CE2 CE19 CT1 CT6 CT7 CT13 CT14 CT15
Long answer tests and development	Exams to evaluate the competences that students have acquired. After the lessons and training sessions finish, an exam will take place. A minimum score of 4 out of 10 in this exam is needed to take into account the rest of marks in the evaluation.	45	CB1 CE1 CE2 CE19 CT1 CT3 CT6 CT7 CT9 CT12 CT13 CT14
Short answer tests	Students must pass two tests of the contents explained in the magistral sessions and seminars.	30	CB1 CE1 CE2 CE19 CT1 CT3 CT6 CT7 CT9 CT12 CT13 CT14

#### Other comments and July evaluation

The final mark in Chemistry I may be the highest mark between the final exam mark and the weighted averaged mark (which is obtained including continuous evaluation).

#### Call on July:

The mark obtained during the course in the section Troubleshooting and/or exercises is maintained.

The exam includes the whole list of topics of the training course. A minimum score of 4,5 out of 10 in this exam is needed to pass the subject.

---

**Sources of information**

---

R. Chang, Química, , McGraw-Hill

R. A. Petrucci, W. S. Harwood y F.G. Herring, Química General, , Prentice Hall

K.W. Whitten, R.E. Davis y M.L. Peck, Química General, , McGraw-Hill

P. Atkins y L. Jones, Principios de Química. Los caminos del descubrimiento, , Médica Panamericana

J.A. López Cancio, Problemas de Química. Cuestiones y ejercicios, , Pearson Education, S.A.

C.Orozco Barrenetxea, M.N. González Delgado y A. Pérez Serrano, Problemas Resueltos de Química Aplicada, , Paraninfo

---

---

**Recommendations**

---

**Subjects that continue the syllabus**

---

Chemistry: Chemistry 2/V11G200V01204

---

**Subjects that are recommended to be taken simultaneously**

---

Biology: Biology/V11G200V01101

Physics: Physics I/V11G200V01102

Mathematics: Mathematics I/V11G200V01104

Chemistry, physics and biology: Integrated laboratory I/V11G200V01103

---

IDENTIFYING DATA				
<b>Physics: Physics II</b>				
Subject	Physics: Physics II			
Code	V11G200V01201			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Garcia Sanchez, Josefa			
Lecturers	Garcia Sanchez, Josefa Legido Soto, José Luís Sánchez Vázquez, Pablo Breogán			
E-mail	fafina@uvigo.es			
Web	http://fatic.uvigo.es			
General description	<p>"Machine translation into english of the original teaching guide"</p> <p>Physics, like scientific discipline, occupies, in general, of the description of the components of the matter and of his mutual interactions, developing theories that, in a formal and consistent way, have an agreement with the empirical knowledge of the reality. From a so wide definition, can adopt distinct perspectives or levels of application, from the microscopic phenomena (at atomic scale) to the macroscopic ones, that give place to his distinct branches. Physics, in this way, is basic precursor of countless scientific and technological applications and, in particular for the student of Chemistry, is indispensable like base and tool to understand developments and theories that will be treated specifically in other matters of the plan of studies of the degree.</p>			

Competencies		
Code		Typology
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	- know - Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- know
CT3	Learn independently	- know
CT4	Search and manage information from different sources	- know
CT5	Use information and communication technologies and manage basic computer tools	- Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	- know
CT7	Apply theoretical knowledge in practice	- know
CT8	Teamwork	- know
CT9	Work independently	- know
CT12	Plan and manage time properly	- know
CT14	Analyze and synthesize information and draw conclusions	- know

Learning outcomes	
Learning outcomes	Competences
1. Determine the electrical field produced by a distribution of particles loaded so much discreet like continuous and in the case to possess high symmetry.	CE23 CT1 CT3 CT4 CT5 CT6 CT9 CT12 CT14

2. Explain the utility of the electrostatic potential and calculate it for a distribution of particles loaded so much discreet like continuous.	CE23 CT1 CT3 CT4 CT5 CT6 CT9 CT12 CT14
3. Calculate the polarisation and the dipolar moment in simple cases.	CE23 CT1 CT3 CT5 CT6 CT12 CT14
4. Explain the electrostatic properties of a driver.	CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT12 CT14
5. Describe cualitatively from the atomic point of view the effect of an electrical field on a dielectric.	CE23 CT1 CT3 CT4 CT5 CT6 CT12 CT14
6. Determine the physical effects of the electrical current.	CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT12 CT14
7. Calculate the characteristics and type of path of loaded particles in an electrical or magnetic field.	CE23 CT1 CT3 CT5 CT6 CT8 CT12 CT14
8. Distinguish the materials by his behaviour in a magnetic field.	CE23 CT1 CT3 CT5 CT6 CT12 CT14
9. Calculate the magnetisation and the magnetic moment in simple cases.	CE23 CT1 CT3 CT4 CT5 CT6 CT12 CT14



10. Explain the difference between conservatives and non conservative electrical fields.	CE23 CT1 CT3 CT5 CT12 CT14
11. Explain of qualitative form basic appearances of the interaction of the electromagnetic radiation with the matter.	CE23 CT1 CT3 CT5 CT12 CT14
12. Determine the limit of resolution of a network of diffraction.	CE23 CT1 CT3 CT4 CT5 CT6 CT12 CT14

## Contents

Topic	
Subject 1. ELECTROSTATIC FIELD	Introduction. Electrical load. Law of Coulomb. Electrical field. Continuous distribution of Load. Lines of Electrical Field. Scalar sources of Electrical Field. Law of Gauss. Electrical Potential energy. Electrical potential. Equipotential Surfaces. Electrical dipole. Capacity and Combination of Condensers.
Subject 2. CONTINUOUS CURRENT	Introduction. Electrical current and density of current. Law of Ohm. Resistance. Electromotive Strength. Law of Joule. Calorific Power loss. Circuits of continuous current:-Association of resistances, -Rules of Kirchhoff.
Subject 3. MAGNETIC FIELD	Introduction. Magnetic strength. Strength of Lorentz. Magnetic strength on a driver by which circulates current. Magnetic field of a load in movement. Magnetic field of an element of current. Law of *Biot-*Savart. Magnetic strength between two parallel drivers. Lines of magnetic field and magnetic flow. Law of Gauss. Law of *Ampère. Magnetic materials.
Subject 4. ELECTROMAGNETIC INDUCTION	Phenomena of electromagnetic induction: experiences of Faraday, magnetic flow, laws of Faraday and of *Lenz, experience of Henry. Applications: generators and electrical receptors, mutual induction and self-induction. Magnetic energy.
Subject 5. WAVES	Introduction. Simple Harmonic movement. Superposition Of BUT. Swings cushioned. Swings forced. Resonance. Waves in material means. Equation of wave. Harmonic waves. Interference of waves. Superposition.
Subject 6. COMMON PROPERTIES To THE DIFFERENT WAVES.	Reflection and refraction. Superposition: Interference, pulses, stationary waves. Diffraction. Doppler Effect.
Subject 7. PHYSICAL OPTICS	Nature of the light: electromagnetic waves, luminous ray, speed of propagation. Wave phenomena: dispersion, interference, diffraction of *Fraunhofer: by a slit, by a pair of equal parallel slits, networks of diffraction. Polarisation. Optical activity.

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	24	43.2	67.2
Teaching and/or informatives events	2	2	4
Seminars	26	46.8	72.8
Short answer tests	1.5	1.5	3
Troubleshooting and / or exercises	1.5	1.5	3

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

## Methodologies

Description
-------------

Master Session	<p>In the TEMA platform, at disposal of the students, there will be information on the teaching sessions.</p> <p>a) the specific aims pursued in each subject will be analysed, indicating needs and possible applications.</p> <p>b) the way to reach the aims will be shown. Those aspects result more problematic or difficult will be treated in more detail and distinct examples will be solved.</p> <p>c) Diferent bibliographic references will be proposed.</p>
Teaching and/or informatives events	Activities to the students to be presented in oral and/or written formd will be proposed.
Seminars	<p>a) exercises and problems that will be previously at disposal of the students in the page web will be solved.</p> <p>b) Doubts and concepts of difficult understanding will be clarified.</p> <p>c) Problems of the bulletins that student have to solve by themselves may be proposed.</p>

### Personalized attention

Methodologies	Description
Seminars	Bulletins of questions and problems to be solved by the students will be proposed, and in case of neccessity, students may attend to personal tutorials to clarify concepts and help them with their resolutions.
Teaching and/or informatives events	It will be facilitated and promoted the assistance to events that organise the faculty and also informative videos will projected. There will be colloquia with the students in which these events will be discussed and also students can be requested to write the answers to some questions on the matter.

### Assessment

	Description	Qualification Evaluated	Competences
Seminars	Realisation of exercises of individual form or in group and/or public exhibition (if it proceeds) in the seminars.	10	CE23 CT1 CT4 CT5 CT6 CT7 CT9 CT12 CT14
Teaching and/or informatives events	Realisation of exercises or works directed of individual form or in group and/or public exhibition (if it proceeds) in the seminars	5	CE23 CT1 CT5 CT8 CT12 CT14
Short answer tests	1ª announcement. a) Three proofs written. These proofs will eliminate matter until the 2ª announcement. b) In June a final examination to recover the matter or to raise qualifications will be done.	35	CE23 CT1 CT3 CT6 CT7 CT9 CT12 CT14

Troubleshooting and / or exercises	1ª announcement: a) Three written proofs. These proofs will eliminate matter until the 2ª announcement. b) In June a final examination to recover the matter or to raise qualifications will be done.	50	CE23 CT1 CT3 CT6 CT7 CT9 CT12 CT14
------------------------------------	---	----	---

### Other comments and July evaluation

- If the student does not have note any in the different sections will consider No Presented, NP.

- July: Evaluation of the second announcement.

a) it will keep the note of the first corresponding announcement to the works tutelados and seminars.

b) The student will be able to do an only proof written on the contents of the three proofs realised to surpass the corresponding

part to proofs of short answer and to the resolution of problems and/or exercises

### Sources of information

Young H.D., Freedman R.A., Física universitaria, con física moderna, Vol.2, 2013, Pearson Educación

Tipler, P.A., Mosca G. , Física para la ciencia y la tecnología (Vol. 2) , 2010, Reverté, Barcelona

Serway, R.A; Beichner R. J., Física para Ciencias e Ingeniería, 2010, McGraw-Hill

Lea S.M.; Burke J.R., Física. La naturaleza de las cosas, 2010, Paraninfo

Gettys, E.; Kéller, F.J. y Skove, M.J., Física Clásica y Moderna. , 2010, McGraw-Hill, Madrid,

Fleisch, D., A student's guide to Maxwell's equations, 2008, Cambridge University Press

### Recommendations

#### Subjects that continue the syllabus

Chemistry, physics and geology: Integrated laboratory II/V11G200V01202

Physics III/V11G200V01301

#### Subjects that are recommended to be taken simultaneously

Mathematics: Mathematics II/V11G200V01203

Chemistry, physics and geology: Integrated laboratory II/V11G200V01202

#### Subjects that it is recommended to have taken before

Physics: Physics I/V11G200V01102

Mathematics: Mathematics I/V11G200V01104

IDENTIFYING DATA				
Chemistry, physics and geology: Integrated laboratory II				
Subject	Chemistry, physics and geology: Integrated laboratory II			
Code	V11G200V01202			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	García Fontán, María Soledad			
Lecturers	Gago Duport, Luís Carlos García Fontán, María Soledad Legido Soto, José Luís Martínez Piñeiro, Manuel Prieto Jiménez, Inmaculada Tojo Suárez, Emilia			
E-mail	sgarcia@uvigo.es			
Web	http://fatic.uvigo.es			
General description	<p>"Machine translation into english of the original teaching guide"</p> <p>In this matter students will apply in a more specific way the criteria and practical skills learnt in the matter Integrated Laboratory I. Students will carry out diverse experiments that will allow them to work in more specialized laboratories. There will be a focus on the observation and preparation of a laboratory notebook as well as in the realisation of a final report of the work carried out.</p>			

Competencies		
Code		Typology
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	- know - Know How
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	- know - Know How
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work	- Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	- Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	- know
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	- know - Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know How
CT3	Learn independently	- know
CT4	Search and manage information from different sources	- know - Know How
CT5	Use information and communication technologies and manage basic computer tools	- Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	- Know How
CT7	Apply theoretical knowledge in practice	- know
CT8	Teamwork	- Know How - Know be
CT9	Work independently	- Know How
CT12	Plan and manage time properly	- know - Know How
CT13	Make decisions	- know

CT14 Analyze and synthesize information and draw conclusions	- know
CT15 Evaluate critically and constructively the environment and oneself	- know

### Learning outcomes

Learning outcomes	Competences
Analyse as they affect the speed of distinct reaction factors, as for example the nature of the reagents, the concentration of the same, the presence of a catalyst or the temperature.	CB5 CE28 CT3 CT7 CT9 CT13 CT14
Distinguish a galvanic cell of a *célula electrolytic and know build both types of cells.	CB5 CE25 CE28 CT1 CT3 CT4 CT7 CT8 CT12 CT13 CT14 CT15
Reproduce basic experiences in physics with the aim to show or apply some of the basic laws.	CB5 CE27 CE28 CE29 CT4 CT6 CT7 CT8 CT9 CT13 CT14 CT15
Apply the knowledge and the skills purchased the resolution of simple problems of separation, purification and characterisation of chemical compounds.	CB5 CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14
Handle different *equipación *comun in the laboratory of Physics and Chemical: *polímetro, sources of feeding, oscilloscope, etc	CB5 CE26 CE27 CE29 CT6 CT14
Adjust the experimental conditions for a chemical process (temperature, agitation, etc.).	CB5 CE26 CE27 CE28 CT3 CT7 CT8 CT13

Handle properly the molecular models for the representation of organic and inorganic compounds	CB5 CE28 CT1 CT3 CT7 CT9 CT12 CT13 CT14
Carry out the *sintesis of organic and inorganic substances simple	CB5 CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT9 CT12 CT13 CT14 CT15
Use programs of diffraction and interpret images of electronic microscopy differentiating the structural information (*HREM, *SAED) and the morphological (SEM)	CB5 CE28 CT1 CT3 CT4 CT5 CT7 CT8 CT14

---

## Contents

---

Topic

---

- Galvanic and electrolytic cells. Utilisation of the equation of \*Nernst. (2 sessions)
- Technical of separation: solid extraction-liquid and chromatography in fine layer. (1 session)
- Technical of separation: chromatography in fine layer and chromatography in column. (1 session)
- chemical Balance: Study of the balance of dissociation by methods \*conductimétrico and \*potenciométrico (1 session)
- Kinetical chemical: kinetical Study of a chemical reaction (2 sessions)
- Law of Lambert-\*Beer: Determination of the concentration of a \*colorante by means of spectroscopy (1 session)
- Equation of state of the ideal gases (1 session)
- Modelling of simple inorganic molecules. (1 session)
- Representation of organic molecules: molecular models. (1 session)
- Obtaining of simple inorganic compounds. (2 sessions)
- Obtaining of simple organic compounds. (1 sessions)
- Obtaining of organic polymers. (1 session)
- Introduction to the morphological study and \*microestructural of the half crystalline: Analysis \*mineralógico by means of \*microscopía optical with light polarised (2 sessions)
- Introduction to the technicians of crystalline growth in the laboratory: methods of creation of the supersaturation and training of \*monocristales. Polymorphism. Growth of glasses in \*geles (1 session)
- Determination of the resistance specifies of a driver. (1 session)
- Law of Ohm: circuits of continuous current. (1 session)
- \*Calibración of a thermistor. (1 session)
- Phenomena of electromagnetic induction: currents induced, laws of Faraday and \*Lenz. \*Tranformador. (1 session)
- Theorem of transfer of maximum power in a circuit. (1 session)

Planning			
	Class hours	Hours outside the classroom	Total hours
Laboratory practises	72	40	112
Outdoor study / field practices	8	10	18
Short answer tests	2	6	8
Practical tests, real task execution and / or simulated.	3	9	12

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

Methodologies	
	Description
Laboratory practises	They will realise practices of laboratory in sessions of 3 hours each one. The student/will have it of the scripts of practices, as well as of the material of support in the platform *FAITIC, so that it can have previous knowledge of the experiments to realise.
Outdoor study / field practices	Each student of individual way elaborates a document on the subject of the practice of field.

Personalized attention	
Methodologies	Description

Laboratory practises	Time devoted by the professor to attend all the doubts and questions posed by the student/the along the course. The student will consult with *profesorado the explanations that estimate timely to be able to comprise better the matter and develop successfully the tasks that were him proposed. These queries will attend in the schedule of *titorías.
Outdoor study / field practices	The student will consult with *profesorado the explanations that estimate timely to be able to comprise better the matter and develop successfully the tasks that were him proposed

Assessment			
	Description	Qualification Evaluated	Competences
Laboratory practises	<p>The professor will realise the follow-up of the experimental work realised by the student/the in the sessions of laboratory, as well as of the fascicle elaborated. Since it treats of a matter of experimental type, is compulsory the assistance to the sessions of laboratory. It is important to indicate that the no assistance will be penalised in the final note. Yes the number of absences without justifying is upper to 2, will suppose to suspend the matter. If the number of absences justified, and owed the causes of greater strength, is upper to 6 will suppose to suspend the matter. The days that are missing will compute like zeros in the note of laboratory.</p> <p>In the punctuation of this section will earn special importance the following points:</p> <ul style="list-style-type: none"> <li>-As *deenvuelve the student in the laboratory, including his degree of autonomy.</li> <li>-As it solves the problems that pose him the hour to do the practice.</li> <li>-Which is his command of the necessary previous knowledges to realise the practice.</li> <li>-Cleaning and treatment of the material.</li> <li>-Command of the necessary calculations to realise the practice.</li> <li>-Preparation of fascicle/inform of laboratory.</li> </ul>	40	CB5 CE25 CE26 CE27 CE28 CE29 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Outdoor study / field practices	It will realise a memory on the subject of the practice of field. The assistance is compulsory to be able to be evaluated.	10	CB5 CE27 CE28 CT1 CT7 CT14 CT15
Short answer tests	It will realise a proof written (of brief answer) relative to concrete appearances of the operations realised in the laboratory.	25	CB5 CE28 CE29 CT1 CT6 CT7 CT14



Practical tests, real task execution and / or simulated.	It will realise a practical proof (session of laboratory) that will allow to evaluate the competitions and skills purchased by the student/the. Said proofs will be realised of independent form for each group of practices.	25	CB5 CE25 CE26 CE28 CT1 CT7 CT9 CT12 CT13 CT14
--	---	----	--

### Other comments and July evaluation

To be evaluated the student has to obtain a minimum note in some of the distinct sections that comprises the evaluation, this minimum note is of 3.5 in the theoretical and practical proofs and in the exit of field, and of 4 in the assessment of the practices of laboratory. The assistance to more than two practical sessions will involve that the student already is being evaluated, therefore, his qualification will not be able to be "No Presented". In the second announcement the evaluation will carry out of the following way: A theoretical proof-practical in which they will evaluate the results of the learning of the student: 50 %. Will conserve the punctuation reached by the student during the course; in the following sections: follow-up of the work of laboratory (40%) and practical of field (10%).

### Sources of information

P. Atkins, L. Jones, Principios de Química, 3ª, Panamericana 2006  
R.H. Petrucci, W.S. Harwood, F.G. Herring, Química General, 8ª, Prentice Hall 2003  
C. Hammond, The Basic of Crystallography and Diffraction, 2ª, The Basic of Crystallography and Diffraction  
I.N. Levine, Fisicoquímica, , McGraw-Hill 2004  
M.A. Martínez Grau, A.G. Csásky, Técnicas Experimentales en Síntesis Orgánica, , Sintesis 1998  
D. P. Shoemaker, C.W. Garland, J.W. Nibler, Experiments in Physical Chemistry, 8ª, McGraw-Hill 2008  
P.A. Tipler. G. Mosca, Física para la ciencia y la Tecnología, , Física para la ciencia y la Tecnología  
Chang, Raymond, Chemistry, 7ª, McGraw-Hill 2002  
L.G. Wade, Química Orgánica, 7ª, Pearson Educación

### Recommendations

#### Subjects that are recommended to be taken simultaneously

Physics: Physics II/V11G200V01201  
Geology: Geology/V11G200V01205  
Mathematics: Mathematics II/V11G200V01203  
Chemistry: Chemistry 2/V11G200V01204

#### Subjects that it is recommended to have taken before

Biology: Biology/V11G200V01101  
Physics: Physics I/V11G200V01102  
Mathematics: Mathematics I/V11G200V01104  
Chemistry, physics and biology: Integrated laboratory I/V11G200V01103  
Chemistry: Chemistry I/V11G200V01105

IDENTIFYING DATA				
<b>Mathematics: Mathematics II</b>				
Subject	Mathematics: Mathematics II			
Code	V11G200V01203			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Mirás Calvo, Miguel Ángel Verdejo Rodríguez, Amelia			
Lecturers	Mirás Calvo, Miguel Ángel Verdejo Rodríguez, Amelia			
E-mail	mmiras@uvigo.es averdejo@uvigo.es			
Web	<a href="http://http://faitic.uvigo.es/">http://http://faitic.uvigo.es/</a>			
General description	This course covers theoretical and practical topics of Calculus (several variables), optimization e statistics. It is intended to improve the student's abilities in comprehension and use of mathematical language. It will also give the student the necessary general computation skills and the basic knowledge of mathematics-oriented software.			

Competencies		
Code		Typology
CB4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences	- Know How
CE22	Process and perform computational calculations with chemical information and chemical data	- know - Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	- Know How
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	- know - Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know How
CT3	Learn independently	- Know How
CT4	Search and manage information from different sources	- Know How
CT5	Use information and communication technologies and manage basic computer tools	- Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	- know - Know How
CT7	Apply theoretical knowledge in practice	- know - Know How
CT8	Teamwork	- Know How
CT9	Work independently	- Know How
CT12	Plan and manage time properly	- Know How
CT13	Make decisions	- Know How
CT14	Analyze and synthesize information and draw conclusions	- Know How
CT15	Evaluate critically and constructively the environment and oneself	- know - Know How

Learning outcomes	
Learning outcomes	Competences
To relate curves and surfaces with geometrical objects and functions of several variables.	CE29 CT6 CT9
To compute the volume of three-dimensional domains and basic surface integrals as well as using polar, spherical and cylindrical coordinates.	CE29 CT6

To apply the basic notions and rules of the calculus of several variables.	CE29 CT3 CT6 CT9
Differentiating implicitly	CE23 CT3 CT9
To express and solve optimization problems without constraints	CE23 CE29 CT1 CT3 CT4 CT6 CT7 CT14
To model and solve practical problems using differentiable and integral calculus techniques.	CE22 CE23 CE29 CT3 CT6 CT7 CT9 CT12 CT13 CT14
To use an appropriate graphic, numerical and symbolical software to solve practical problems of calculus of several variables.	CE22 CE29 CT4 CT5 CT6 CT7 CT13 CT14
To compute eigenvalues and check whether a matrix is diagonalizable.	CE29 CT3 CT6 CT9
To establish the definiteness of a quadratic form.	CE29 CT3 CT6 CT9
To use adequate software to solve linear algebra problems.	CE22 CE29 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14
To perform a descriptive statistical data analysis	CE22 CE29 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14
To compute probabilities in different spaces and apply the concept of random variable to model real situations.	CE23 CE29 CT3 CT6 CT9

To use basic statistical software.	CE22 CE23 CE29 CT1 CT4 CT5 CT6 CT7 CT14
To write or make and oral presentation of mathematical concepts.	CB4 CE23 CT1 CT3 CT4 CT5 CT8 CT12 CT13 CT14 CT15

## Contents

Topic	
Chapter 1: Eigenvalues and symmetric matrices	Computation of eigenvalues. Diagonalizable matrices. Sign of a quadratic form
Chapter 2: Calculus of several variables	Intoduction to real funcions of several variables. Continuous and differentiable functions. Higher order derivatives. The chain rule. Implicit differentiation. Computation of extreme points
Chapter 3: Multiple integration	Integrals of functions of two and three variables on bounded domains. Polar, spherical and cylindrical coordinates. Surface Integrals
Chapter 4: Basic Statistics	Descriptive statistics Introduction to probability

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	20	30	50
Troubleshooting and / or exercises	26	36	62
Practice in computer rooms	6	3	9
Long answer tests and development	3	20	23
Practical tests, real task execution and / or simulated.	0	6	6

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

## Methodologies

	Description
Master Session	The teachers will lecture on the theoretical foundations of the topics cover in the course; they will present possible applications; they will formulate problems, questions and exercises; and they will propose tasks and activities with orientations on the methods and techniques needed.
Troubleshooting and / or exercises	In this activity, the students, individually or in group, must solve problems and exercises. The students must be able to find a convincing mathematical model, use the appropriate technique according to the available information and give a sound interpretation of the results.
Practice in computer rooms	Activities designed to learn how to use mathematical software to make numerical computations and plotting of functions and data.

## Personalized attention

Methodologies	Description
---------------	-------------

Troubleshooting and / or exercises	Each student can ask the teachers for advice and guidance related to the contents and activities of the course. They will be attended during tutorial hours.
Practice in computer rooms	Questions and doubts related to the computer classes will be attended during tutorial hours.

Assessment			
	Description	Qualification	Evaluated Competences
Troubleshooting and / or exercises	The student must solve some given problems and exercises within the time and under the conditions specified by the teacher. The activities can be of very different types: go out to the blackboard, written assignment, oral presentation, puzzle,...	15	CB4 CE23 CT1 CT3 CT4 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Long answer tests and development	Final exam. A formal individual examination consisting on theoretical and practical questions that will take place right after the classes period.	80	CE22 CE29 CT3 CT6 CT7 CT9 CT12 CT13 CT14
Practical tests, real task execution and / or simulated.	Practical exercise to evaluate the student degree of knowledge and application of the mathematical software used in the lab classes.	5	CE22 CE29 CT4 CT5 CT6 CT7 CT14

#### Other comments and July evaluation

Second call (failed subject):

To pass the subject the student must obtained a global score greater or equal than 50% of the possible highest score.

The student who fail the subject in the first call must repeat the final exam in July. The other marks will be maintained.

A final mark or qualification will be assigned to those students who attend any of the final exams.

#### Sources of information

Robert G. Mortimer, Mathematics for physical chemistry, 2013, Elsevier

Besada, M.; García, J.; Mirás, M.; Vázquez, C., Cálculo diferencial en varias variables, 2011, Garceta

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

Besada, M.; García, J.; Mirás, M.; Quinteiro, C.; Vázquez, C., Matemáticas á Boloñesa, 2015, Servicio de Publicacións. Universidade de Vigo

Centro virtual de divulgación de las Matemáticas, <http://www.divulgamat.net/>, , Real Sociedad Matemática Española

Matemáticas a través do teatro, <http://webs.uvigo.es/dramatematica>, , Proxecto Innovación Educativa. Universidade de Vig  
R. Larson, R. Hostetler; B. H. Edwards, Cálculo esencial, 2010, Itemex  
Robert A. Adams; Christopker Essex, Calculus. A complete course, 2013, Pearson  
William Bober, Chi-Tay Tsai; Oren Masory, Numerical and analytical methods with MATLAB, 2013, CRC Press  
Dingyu Xue; Yangquan Chen, Solving applied mathematical problems with MATLAB, 2009, CRC Press

---

## **Recommendations**

### **Subjects that continue the syllabus**

Numerical methods in chemistry/V11G200V01402

### **Subjects that are recommended to be taken simultaneously**

Physics: Physics II/V11G200V01201

Geology: Geology/V11G200V01205

Chemistry, physics and geology: Integrated laboratory II/V11G200V01202

Chemistry: Chemistry 2/V11G200V01204

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

Biology: Biology/V11G200V01101

Physics: Physics I/V11G200V01102

Mathematics: Mathematics I/V11G200V01104

Chemistry, physics and biology: Integrated laboratory I/V11G200V01103

Chemistry: Chemistry I/V11G200V01105

IDENTIFYING DATA				
<b>Chemistry: Chemistry 2</b>				
Subject	Chemistry: Chemistry 2			
Code	V11G200V01204			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Pastoriza Santos, Isabel			
Lecturers	Castro Fojo, Jesús Antonio Hervés Beloso, Juan Pablo Pastoriza Santos, Isabel Pérez Juste, Jorge Rodríguez Arguelles, María Carmen Teijeira Bautista, Marta			
E-mail	pastoriza@uvigo.es			
Web	http://fatic.uvigo.es			
General description	Chemistry II pretends to introduce a microscopic vision of the matter, providing to students the basis for the understanding of disciplines more specific, that will give in future courses, and explaining the nature of the matter.			

Competencies		
Code		Typology
CE1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.	- know - Know How
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	- know - Know How
CE5	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Characteristics of the different states of matter and the theories used to describe them	- know - Know How
CE9	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: characteristic properties of the elements and their compounds, including group relationships and variations in the periodic table	- know - Know How
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	- know - Know How
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	- Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know How
CT3	Learn independently	- Know be
CT4	Search and manage information from different sources	
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	- Know How
CT7	Apply theoretical knowledge in practice	- Know How
CT8	Teamwork	- Know be
CT9	Work independently	- Know be
CT12	Plan and manage time properly	- Know How - Know be
CT13	Make decisions	- Know How - Know be
CT14	Analyze and synthesize information and draw conclusions	- Know How
CT15	Evaluate critically and constructively the environment and oneself	- Know How

Learning outcomes	
Learning outcomes	Competences

Interpret the functions of radial distribution and the angular representations of the s, p, d and f orbitals. Describe the configuration in the fundamental state of atoms and ions. Justify the variations of different atomic parameters along the Periodic Table. Interpret the electronegativity and the polarizability of an atom.	CE5 CE9 CE19 CT1 CT3 CT4 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Recognize the atomic orbitals involved in a bonding. Build diagrams of OM for diatomic molecules and deduce properties of the bonding. Define overlap integral. Apply the method of hybridization to explain the bonding in simple molecules.	CE5 CE19 CT1 CT3 CT4 CT7 CT8 CT9 CT12 CT13 CT14
Describe the state of aggregation of the elements and his behaviour in front of oxygen and water. Describe the natural resources of the elements and some methods of obtaining.	CE5 CE9 CT1 CT3 CT4 CT7 CT8 CT9 CT12 CT14
Use the models of bonding to explain the structure of the main functional groups. Relate its structure with its macroscopic properties.	CE1 CE9 CT1 CT3 CT4 CT7 CT8 CT9 CT12 CT14
Identify the acidic protons in an Brönsted acid. Classify the Brönsted acids. Predict the acidity and basicity of organic compounds. Identify acids and bases of Lewis and types of acid-base reactions. Identify acids and bases as hard or soft and explain its interaction.	CE1 CE2 CE19 CT1 CT3 CT4 CT7 CT8 CT9 CT12 CT14
Represent the three-dimensional structure of organic molecules. Apply the principles of stereochemistry. Determine the absolute configuration. Apply the nomenclatures R/S and Z/Y.	CE1 CE12



Explain the bonding solids. Relate structure and properties in amorphous solids. Describe the superconductivity. Interpret one model structure. Predict the coordination number in function of the relation of ionic radii. Use the cycle of Born-Haber to determine the lattice enthalpy.	CE5 CE19 CT1 CT3 CT4 CT7 CT8 CT9 CT12 CT14
Describe the types of polymers. Describe the types of colloids and his properties. Explain the behavior of surfactants.	CE9 CT1 CT3 CT4 CT7 CT8 CT9 CT12 CT14
Define the standard potentials of reduction. Calculate the variation of energy of Gibbs in a redox reaction. Explain an electrochemical cell. Predict the products and its quantities in a electrolysis.	CE1 CE19 CT1 CT3 CT4 CT7 CT8 CT9 CT12 CT14
Characterize the types of radiation in a radioactive disintegration. Write nuclear reactions. Calculate the nuclear binding energy and the half life of an isotope. Describe the reactions in nuclear chain. Enumerate examples of the use of radioisotopes.	CE1 CE19 CT1 CT3 CT4 CT7 CT8 CT9 CT12 CT14

Contents	
Topic	
Subject 1: Structure of matter	Structure of the hydrogenic atoms. Polyelectronic atoms. Atomic parameters. Lanthanide contraction. Electronegativity. Polarizability.
Subject 2: Chemical bonding	Theory of OM. Types of orbital: sigma, pi, delta. Diagram of energies for diatomic homo- and heteronuclear molecules. Bonding in alkenes and alkynes.
Subject 3: Nuclear chemistry	Nuclear reactions. Radioactive disintegration. Artificial transmutations. Nuclear fission. Nuclear fusion. Nuclear radiation. Applications of the radioactivity.
Subject 4: Solids	Structure of the simple solids. Structure of the metals. Alloys. Metallic bonding. Semiconductors. Ionic solids. Energetic aspects.
Subject 5: Chemical properties of the main group elements	Brönsted acids and bases. Lewis acids and bases. Oxidants and reductants.
Subject 6: Electrochemistry	Nerst Equation. Concentration cells. Batteries. Fuel cells. Electrolysis. Commercial electrolytic processes. Corrosion.
Subject 7: Organic Compounds and functional groups	Structure and geometry. Approach and nomenclature of organic compounds. Physical properties.
Subject 8: Isomery	Geometrical isomery. Conformational stereoisomery. Configurational stereoisomery.

Planning			
	Class hours	Hours outside the classroom	Total hours

Master Session	26	38	64
Others	0	4	4
Seminars	26	38	64
Long answer tests and development	2	10	12
Short answer tests	2	4	6

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

### Methodologies

	Description
Master Session	In these sessions, we present the general aspects of the program
Others	In the different activities we pay attention to transversal competitions collected in the memory of the degree.
Seminars	Each week we employ two hours to the resolution of some problems or exercises proposed related with the matter. These exercises will be delivered previously to the student through the platform Tem@ expecting that the student work them. In these sessions, we can collect questions or short problems to control the progress of the students.

### 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 addition to the seminars will be able to consult in the tutorials

### Assessment

	Description	Qualification Evaluated	Competences
Seminars	The attitude and participation of the student will be valued. We also may collect questions or problems as tracking student progress	20	CE1 CE2 CE5 CE9 CE12 CE19
Others	In the different activities, we pay attention to transversal competitions collected in the memory of the degree.	5	CT1 CT3 CT4 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Short answer tests	The students will have two test along the course on the matter explained in the sessions and seminars	30	CE1 CE2 CE5 CE9 CE12 CE19

Long answer tests and development	Test for evaluation of the competitions purchased in the matter. It is necessary a minimum of 4 on 10 in this test to take into account the other evaluation notes.	45	CE1 CE2 CE5 CE9 CE12 CE19
-----------------------------------	---	----	--

### Other comments and July evaluation

Students must attend all tests performed along the course. Participation in evaluation activities throughout the semester or in some of the assessment tests involve the condition of presented and therefore the student will be graded.

The final note will be the highest obtained by comparing the final exam note and the final exam note ponderated with continuous evaluation. Assessment in July: It is governed by the above

### Sources of information

#### Basic Bibliography

- Chemistry, R. Chang. 7th Ed. McGraw-Hill, 2002.
- General chemistry : principles and modern applications , R. A. Petrucci, W. S. Harwood e F.G. Herring. 10th Ed. Pearson Canada, 2011.
- General chemistry, K. W. Whitten, R. E. Davis e M. L. Peck. Saunders College Publishing, cop. 1981.
- Chemistry. J. McMurry, R. C. Fay. 4ª Ed. Pearson Educación, 2004.
- Principios de Química, P. Atkins and L. Jones. 5ª Ed. Panamericana, 2012.
- Principles of Inorganic Chemistry. B. W. Pfenning. 1ª Ed. Wiley, 2015.
- Organic chemistry, L.G. Jr Wade. 7ª Ed. Pearson Prentice Hall, 2010.
- Nomenclatura y representación de los compuestos orgánicos. E. Quiñoá e R. Riguera. 2ª Ed. McGraw-Hill Interamericana, 2005.

#### Complementary Bibliography

1. Química. La ciencia central. T. L. Brown, H. E. LeMay, B. E. Bursten, C. J. Murphy y P. M. Woodward. 12ª Ed., Pearson Educación, 2014.
2. The Chemical bond. G. Frenking, S. Shaik. Weinheim : Wiley-VCH, cop. 2014.
3. Inorganic Chemistry. P. Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, F. 5ª Ed. Oxford University Press, 2010.
4. Organic Chemistry. F. Carey. 4th Ed. McGraw-Hill, 2000.
5. Organic Chemistry. P. Y. Bruice. 3rd Ed. Pearson-Prentice-Hall, 2001.

### Recommendations

#### Subjects that continue the syllabus

Physical chemistry I/V11G200V01303  
Inorganic chemistry I/V11G200V01404  
Organic chemistry I/V11G200V01304

#### Subjects that are recommended to be taken simultaneously

Physics: Physics II/V11G200V01201  
Geology: Geology/V11G200V01205  
Mathematics: Mathematics II/V11G200V01203  
Chemistry, physics and geology: Integrated laboratory II/V11G200V01202

#### Subjects that it is recommended to have taken before

Biology: Biology/V11G200V01101  
Physics: Physics I/V11G200V01102  
Mathematics: Mathematics I/V11G200V01104  
Chemistry, physics and biology: Integrated laboratory I/V11G200V01103  
Chemistry: Chemistry I/V11G200V01105

IDENTIFYING DATA				
<b>Geology: Geology</b>				
Subject	Geology: Geology			
Code	V11G200V01205			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Gago Duport, Luís Carlos			
Lecturers	Gago Duport, Luís Carlos			
E-mail	duport@uvigo.es			
Web	http://fatic.uvigo.es			
General description	<p>The study of the structure of the matter in crystalline state, aim of the Crystallography, is of importance for the understanding of the most diverse phenomena, in the field of the Chemistry. Consistently, the approach of the Geology of first course of the degree in Chemistry is preferably oriented to the knowledge and characterisation of the crystalline structures and of the mechanisms of crystallisation that tackle from the point of view of the Crystallography, the Mineralogy and the Geochemistry. Of particular way, the technicians of diffraction have turned into the most spread between the chemical researchers for the characterisation and determination of structures of the most diverse substances: superconducting materials, mineral, organic compounds, inorganic, pharmaceutical products, biological macromolecules, and ceramic materials, amongst other, thus in the course seat, from an introductory and intuitive point of view, the bases of the diffraction and show the main experimental technicians associated to the process of characterisation of crystalline solids.</p>			

Competencies		
Code		Typology
CE1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.	- know
CE14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules	- know
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	- Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know How
CT3	Learn independently	- Know How
CT4	Search and manage information from different sources	- Know How
CT5	Use information and communication technologies and manage basic computer tools	- know - Know How
CT7	Apply theoretical knowledge in practice	- know - Know How
CT8	Teamwork	- Know How
CT9	Work independently	- Know How
CT12	Plan and manage time properly	- Know How
CT13	Make decisions	- Know How
CT14	Analyze and synthesize information and draw conclusions	- Know How
CT15	Evaluate critically and constructively the environment and oneself	- Know How

Learning outcomes	
Learning outcomes	Competences
3. Comprise the bases of the geometrical crystallography like half for the structural characterisation of the crystalline solids, including the basic concepts like periodicity and symmetry.	CT1 CT3 CT5 CT9 CT12

5. Know the basic appearances of the notation *cristalográfica and his application to the characterisation so much of the symmetry in the molecules (*Schoenflies) as to the structural characterisation of the glasses (*Hermann-*Mauguin).	CE1 CT1 CT7 CT8 CT13 CT14 CT15
6. Understand the basic principles of the diffraction like technician for the structural analysis and the concepts *cristalográficos associated: Law of *Bragg, reciprocal cell, problem of the phases.	CE1 CE14 CT1 CT3 CT5 CT9 CT15
10. Understand the processes of isotopic exchange in crystalline solids and know his applications for the measure of the geological time and like markers of thermodynamic and kinetical conditions.	CE1 CT1 CT4 CT5 CT15
7. Purchase a basic knowledge on the principles for the structural determination by means of diagrams of diffraction of rays.	CT1 CT4 CT5 CT9 CT15
6. Understand the basic principles of the diffraction like technician for the structural analysis and the concepts *cristalográficos associated: Law of *Bragg, reciprocal cell, problem of the phases.	CE1 CT1 CT5 CT7 CT15
5. Know the basic appearances of the notation *cristalográfica and his application to the characterisation so much of the symmetry in the molecules (*Schoenflies) as to the structural characterisation of the glasses (*Hermann-*Mauguin).	CE1 CT1 CT5 CT7 CT14 CT15
1. Know and comprise, the crystallisation like a process of transition of phase, differentiating the stages of *nucleación and crystalline growth.	CE1 CT1 CT3 CT9 CT14 CT15
8. Know of basic form the derivative information of the distinct technicians of diffraction : *R-X, electrons, neutrons and his main applications in the field of the science of materials and of the molecular characterisation.	CE1 CT14 CT15
9. Purchase a practical experience in the handle of programs of diffraction and in the interpretation of images of *microscopía electronic differentiated the structural information (*HREM, *SAED) and morphological (SEM).	CE1 CE27 CT1 CT4 CT5 CT8 CT15
1. Know and comprise, the operation of the Earth like system.	CE1 CT1 CT3 CT9 CT12 CT15
2. Be able to characterise the interaction between the different *reservorios, the physical processes, chemists and biological *involucrados as well as the different scales space-temporary associated.	CE1 CT1 CT4 CT7 CT9 CT13 CT15

(*)	CE1 CT1 CT3 CT7 CT8 CT14 CT15
(*)	CE1 CT1 CT3 CT4 CT7 CT15

## Contents

Topic	
The process of crystallisation	Thermodynamic appearances of the *nucleación and crystalline growth. Kinetic of the crystalline growth. Structural factors associated.
The crystalline solids	Crystalline structure. Microscopic appearances. Crystalline morphology: macroscopic appearances.
Basic concepts of geometrical crystallography	Periodicity and symmetry. Two-dimensional networks. Groups of punctual symmetry. Notations of *Schoenflies and *Hermann-Mauguin.
Three-dimensional networks	Space groups. Indexes of Miller. Fractional coordinates and axes of zone.
Crystallography of X-rays	The reciprocal network. Transformed of Fourier and diffraction in the reciprocal space.
Techniques of diffraction	Methods of *monocrystal and of dust. Spectrums of diffraction of X-rays: Law of *Bragg. Sphere of *Ewald. Factor of structure. The problem of the phase.
Interpretation of spectrums of diffraction	Analysis of diagrams of diffraction of dust. Structural determination by means of electronic microscopy of high resolution (*HREM). Methods of characterisation of materials no crystalline.
Some applications of the techniques of diffraction	Characterisation of ceramic materials and alloys. Determination of the structure of proteins. Analysis *textural of amorphous materials and biological samples. Follow-up in real time of transitions of phase.
Growth of glasses in natural means	*Biomineeralización. Environments *evaporíticos. Models of prediction of precipitation of crystalline phases.
Geochronology	Radioactive isotopes. Nuclear stability. Mechanisms of decomposition. Half life. Systems of temporary dating: *K-*Ar, *Rb-*Sr, *Sm-*Nd, Or-*Th-*Pb, <sup>14</sup> C. Other methods of dating: footprints of fission.
Stable isotopes in Geology	Isotopic relation. Factors that determine the isotopic fractionation. Applications like kinetic and thermodynamic markers of processes *geoquímicos.

## Planning

	Class hours	Hours outside the classroom	Total hours
Tutored works	2	13	15
Master Session	26	52	78
Troubleshooting and / or exercises	13	26	39
Others	0	14	14
Multiple choice tests	4	0	4

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

## Methodologies

	Description
Tutored works	They are works that realises each student of individual way and will consist in the characterisation *cristalográfica of a crystalline substance in the structural appearances, *composicionales and morphological. They adopt the format of a small work of investigation and carry implicit the knowledge and handle of the concepts and nomenclature explained in the theoretical classes and seminars.

Master Session	They explain the basic principles of the crystallisation like process and of the structures of the crystalline solids from the ideas of periodicity and symmetry of the crystalline networks. It enters to the student to the technicians of diffraction.
Troubleshooting and / or exercises	They will employ the seminars for the preparation of practical works associated to the process of growth of glasses. And *tabajara with programs of *resolucion of structures by means of *difraccion and *microscopía *electronica
Others	They will realise presentations by groups with to expose the results and *principlaes conclusions of the works developed by groups about the processes of crystalline growth. And structural characterisation

### Personalized attention

Methodologies	Description
Tutored works	These works will realise during the seminars using crystallographical software where the notation of symmetry of Herman-Mauguin is employed.
Troubleshooting and / or exercises	They developed in the classroom of computing, during the seminars, employing programs of X-ray diffraction and by means of the treatment of images of electron microscopy (HREM).
Others	They will develop in the classroom of computing and in marry theoretical as well as by means of tutorials and/or queries employing the platform Tema or the email.

### Assessment

	Description	Qualification Evaluated	Competences
Tutored works	It will value that the concepts explained in the theory are employed properly, as well as the notation and nomenclature *cristalográfica. Also appearances like the coherence in the development of the work and the precision in the measures and in the quantification of the results.	10	CE1 CE14 CE27 CT1 CT3 CT4 CT5 CT7 CT8 CT12 CT13 CT14
Troubleshooting and / or exercises	It will value the realisation of practical works realised by groups during the seminars	30	CE1 CE27 CT3 CT7 CT9 CT14 CT15
Others	It will value the exhibition in groups of the conclusions obtained in the works realised in the seminars about the resolution of structures	20	CE1 CT1 CT4 CT8 CT14
Multiple choice tests	It will evaluate the degree of understanding of the concepts and definitions *cristalográficos, associated to the theoretical part.	40	CE1 CE14 CT1 CT9 CT14

### Other comments and July evaluation

&\*It;\*p>\*gt;The evaluation in the second announcement will consist in the realisation of a theoretical exercise&\*amp;\*nbsp;about&\*amp;\*nbsp;the basic concepts of the Crystallography and his application to the resolution of

structures, developed during&\*nbsp;the classes&\*nbsp;\*magistrales. Likewise, it will be&\*nbsp;necessary realise a practical exercise in the handle of the&\*nbsp;computer tools for the analysis of crystalline structures employees during the course.</p></div>

## Sources of information Edward Tarbuck y Frederick Lutgens, Ciencias de la Tierra. Una introducción a la Geología Física, 8ª, 978-84-8322-665-0 Christofer Hammond , The Basic of Crystallography and Diffraction, 3ª, 978-0-19-954645-9 Andrew Putnis , Introduction to Mineral Sciences , 1ª, 0-521-41922-0 Jose Luis Amorós, El Cristal : morfología, estructura y propiedades físicas, 4ª, 84-363-1079-9 Rousseau, J.-J., Basic crystallography, , 0-471-97048-4 Vitalij K. Pecharsky, Peter Y. Zavalij, Fundamentals of powder diffraction and structural characterization of materials, , 0-387-24147-7 Douglas, Bodie E., Structure and chemistry of crystalline solids, 1ª, 978-0-387-26147-8 Robert A. Evarestov, V.P. Smirnov, Site symmetry in crystals : theory and applications, 2ª, 3-540-61466-4 Woolfson, M. M., An Introduction to X-ray crystallography, 2ª, 0-521-41271-4 Salvador Galí Medina, Cristalografía : teoría particular, grupos puntuales y grupos espaciales, 1ª, 8476659288RecommendationsSubjects that continue the syllabus Inorganic chemistry I/V11G200V01404 Structural Determination/V11G200V01501Subjects that are recommended to be taken simultaneously Physics: Physics II/V11G200V01201 Mathematics: Mathematics II/V11G200V01203 Chemistry, physics and geology: Integrated laboratory II/V11G200V01202 Chemistry: Chemistry 2/V11G200V01204Subjects that it is recommended to have taken before Biology: Biology/V11G200V01101 Physics: Physics I/V11G200V01102 Mathematics: Mathematics I/V11G200V01104 Chemistry, physics and biology: Integrated laboratory I/V11G200V01103 Chemistry: Chemistry I/V11G200V01105 Página 56 de 216



IDENTIFYING DATA				
<b>Physics III</b>				
Subject	Physics III			
Code	V11G200V01301			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Flores Rodríguez, Jesús Ramón			
Lecturers	Flores Rodríguez, Jesús Ramón Martínez Piñeiro, Manuel			
E-mail	flores@uvigo.es			
Web				
General description	The matter pretends to be an introduction to Quantum Mechanics and Statistical mechanics, oriented to theirs applications in Chemistry.			

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

Learning outcomes	
Learning outcomes	Competences
Describe *unificadamente the electromagnetic field by means of the laws of Maxwell. Apply the basic conditions of border in the empty or in presence of material means.	CE3 CT1 CT12 CT14
Derive the equation of propagation of an electromagnetic wave, characterised through his main characteristic. Relate this concept with the electromagnetic spectrum.	CE3 CT12 CT14
Explain the empirical phenomena related with the interaction radiation matter no explained by the Classical Theory, and the solutions proposed for his resolution (duality wave corpuscle, *cuantización of the radiation).	CE3 CT12 CT14 CT15

Bill the postulates of the Quantum Mechanics and his consequences in the reformulation of the microscopic theory of the Classical Physics.	CE3 CT1 CT12 CT14 CT15
Explain the foundations of the theory of mathematical operators, including the concepts of function and own value, spectrum, *linealidad and *hermiticidad, space of functions, etc.	CE3 CT1 CT9 CT12 CT14
Write the fundamental operators of the Quantum Mechanics (position, linear and angular moment, Hamiltonian of simple systems).	CE3 CE19 CT1 CT9 CT12 CT14
Apply the previous concepts to the mechanical study-quantum of simple systems, like a particle subjected to a potential of *pozo square infinite, or to a harmonic potential, resolving the equation of Schrödinger independent of the time.	CE3 CE19 CT1 CT3 CT6 CT8 CT12 CT13 CT14
Calculate the functions and own values of the for the moment angular operator.	CE3 CE19 CT6 CT12 CT14
Resolve the equations of wave of the atom of hydrogen, calculating his orbital.	CE3 CE19 CT6 CT8 CT12 CT14
Resolve the equation of Schrödinger for atoms *polielectrónicos by means of approximate methods.	CE3 CE19 CE20 CT1 CT5 CT6 CT9 CT12 CT13 CT14
Explain of simple form the transitions between states and the spectrums of broadcast or resultant absorption.	CE3 CE19 CE20 CE22 CE23 CT1 CT6 CT8 CT9 CT12 CT14 CT15

Bill the laws of the Statistical mechanics that govern the behaviour of systems of particles, *particularizado to the statistics of Maxwell *Boltzmann. Derive the function of partition of a system and know in detail his physical meaning.	CE14 CE20 CE22 CE23 CT1 CT4 CT5 CT6 CT7 CT8 CT12 CT13
Apply the statistics of Maxwell *Boltzmann to the case of the ideal gases monatomic and polyatomic to estimate thermodynamic properties from microscopic properties like mass, molecular geometry and frequencies of vibration.	CE14 CE19 CT1 CT4 CT5 CT6 CT7 CT8 CT12 CT13

## Contents

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	26	49.4	75.4
Troubleshooting and / or exercises	26	39	65
Introductory activities	1	0.6	1.6
Short answer tests	4	0	4
Long answer tests and development	4	0	4

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

## Methodologies

	Description
Master Session	*Exposición Of the fundamental appearances of each subject and approach of those that go to tackle in the seminars
Troubleshooting and / or exercises	Resolution of numerical problems, theoretical questions and development of the theoretical appearances posed in the Masterclasses with the participation of the student.
Introductory activities	Class of presentation of the *asignatura with exhibition: of parts of the *temario, contents, distribution in short proofs and final examination, general norms of evaluation, etc.

## Personalized attention

Methodologies	Description
Master Session	Answers to the questions related with the matter that pose the students in the classes of resolution of problems and in *tutorías. The students will know from principle of course the schedules of *tutorías of the professors of the matter. In the *tutorías the students will be able to review his examinations
Troubleshooting and / or exercises	Answers to the questions related with the matter that pose the students in the classes of resolution of problems and in *tutorías. The students will know from principle of course the schedules of *tutorías of the professors of the matter. In the *tutorías the students will be able to review his examinations

## Assessment

	Description	Qualification	Evaluated Competences
Troubleshooting and / or exercises	Basically it will centre in the resolution of exercises in the classroom. Nevertheless, it will be able to *tambien ask to the student that deliver exercises proposed and that the resolve of autonomous way. In this case the professor will be able to ask to the student that explain him *individualmente as it has resolved the exercise.	15	
Long answer tests and development	When finishing the course will celebrate a complete proof in which the students that wish it will be able to repeat those appearances that did not surpass in the short proofs realised.	42.5	
Short answer tests	They will celebrate 2 proofs of short answer. They will refer , respectively, to the matter of the subjects 1 to 3 and 4 to 8. The *superación of each one of them will allow that the students can not going back to examine of this matter in the final examination of the *cuatrimestre, but no like this in the examination of second opportunity (June-July).	42.5	

## Other comments and July evaluation

During the course will realise two short proofs referred to the subjects 1-3, the first, and to the subjects 4-8, the second. Both will contain problems and questions and his \*superación will free to the students of this part of the \*asignatura. Of voluntary way, the students will be able to participate in the resolution of exercises in the seminars or deliver exercises proposed. Also will be able to present to a final examination, that will include all the matter, that will allow them increase the punctuation reached in the partial. All student will have to reach at least a qualification of 3.5 on 10 in the global of his proofs written to be able to accumulate the corresponding punctuation to resolution of exercises. In the second announcement will keep the punctuation reached by means of the resolution of exercises. This examination will value of

similar way to the final examination.

The student that do not present to any proof during the course will be described in first announcement as no presented.

---

**Sources of information**

R. Eisberg, y R. Resnick, Física Cuantica, 1983, Limusa

M. Alonso y E.J. Finn, Física, 2000, Pearson Educación

I. N. Levine, Fisicoquímica, 2004, McGraw-Hill

P.W. Atkins y J. de Paula, Atkin's Physical Chemistry, 2014, Oxford Univ. Press

J. Bertrán y otros, Química Cuántica, 2000, Síntesis

I.N. Levine, Química Cuántica, 2001, Prentice Hall

---

**Recommendations****Subjects that continue the syllabus**

Physical chemistry II/V11G200V01403

---

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

Physics: Physics I/V11G200V01102

Physics: Physics II/V11G200V01201

Mathematics: Mathematics I/V11G200V01104

Mathematics: Mathematics II/V11G200V01203

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

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

CT7	Apply theoretical knowledge in practice	- know - Know How
CT8	Teamwork	- Know How
CT9	Work independently	- Know How
CT12	Plan and manage time properly	- Know How
CT13	Make decisions	- Know How
CT14	Analyze and synthesize information and draw conclusions	- Know How
CT15	Evaluate critically and constructively the environment and oneself	- Know How
CT16	Develop an ethical commitment	- Know How

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

Describe the principles of the quantitative chemical analysis (volumetric and gravimetric) and its experimental limitations.	CE2 CE4 CE19 CT1 CT14
Identify and evaluate the possible interaction between concurrent reactions: acid-base, complexes, precipitation and redox.	CB5 CE2 CE18 CE19 CE20 CT7 CT9 CT12 CT14
Elaborate and interpret titration curves of acid-base, complexes, precipitation and redox and know select the most suitable indicators.	CB5 CE2 CE18 CE19 CE20 CT5 CT7 CT9 CT12 CT14
Describe the foundations of the gravimetric analysis and the factors that influence the purity of precipitates.	CE2 CE20 CT1 CT4 CT14
Carry out, in the laboratory, the precipitation and the separation by filtration in gravimetric analysis.	CE2 CE17 CE19 CE21 CE25 CE26 CE28 CT7 CT8 CT12
Use properly the gravimetric and volumetric techniques, including the suitable handling of the necessary equipment.	CB5 CE17 CE19 CE21 CE26 CE27 CT7 CT9 CT12 CT14
Handle the systematic calculation in the volumetric (direct, indirect and back titrations) and gravimetric analysis and learn how to interpret the results obtained.	CB5 CE20 CE22 CE28 CE29 CT6 CT7 CT14 CT15 CT16

## Contents

### Topic

Subject 1: Analytical Chemistry and analytical process.	The Analytical Chemistry as a metrological science. Classification of the analytical methods. The analytical process: steps. Types of analytical problems and working scales. Conceptual and technical hierarchy.
---	---



Subject 2: Evaluation of the analytical results.	Analytical properties. Errors in Analytical Chemistry: classification. Basic statistics applied to the expression of the results. Comparison and rejection of the results. Concept of traceability.
Subject 3: Introduction to the qualitative and quantitative Chemical Analysis .	Previous operations to the analysis. Sampling and sample treatment. Decomposition and dissolution. Introduction to the analytical separations. Qualitative analysis: characteristics of the binary answers. Classical quantitative analysis and instrumental. Methodologies of quantification. Calculable and relative methods.
Subject 4: Quantitative analysis: volumetric and gravimetric.	Volumetric reactions. Pattern solutions. Direct, indirect and back titrations. Formation, properties and purity of the precipitates. Calculations in volumetric and gravimetric analysis .
Subject 5: Acid-base titrations	Behaviour of monoprotic, polyprotic and amphoteric species. Titration curves. Detection of the end point: acid-base indicators. Titrant reagents. Analytical applications.
Subject 6: Complexometric titrations	Stability of the complexes. Masking reactions. Titration curves . Detection of the end point: metallochromic indicators. Analytical applications.
Subject 7: Precipitation titrations.	Factors affecting the solubility of precipitates. Titration curves. Detection of the end point: Mohr, Volhard and Fajans methods. Analytical applications.
Subject 8: Redox titrations	Factors influencing the redox potential. Titration curves. Detection of the end point: redox and specific indicators. Analytical applications.
Qualitative analysis (Laboratory)	Separation and identification of chemical species. (3 sessions)  Resolution of an analytical problem by using a systematic separation procedure. (2 sessions)
Gravimetric analysis (Laboratory)	Gravimetric determination of nickel with dimethylglyoxime. (1 session)
Acid-base titrations (Laboratory)	Determination of the acidity of a vinegar sample. (1 session)  Determination of acetylsalicylic acid in analgesics. (1 session)
Complexation titrations (Laboratory)	Standardization of an EDTA solution with Zn (II). (1 session)  Determination of the hardness of a water sample. (1 session)
Precipitation titrations (Laboratory)	Determination of chloride in seawater using the Mohr method. (1 session)
Redox titrations (Laboratory)	Determination of peroxide in hydrogen peroxide sample. (1 session)  Determination of active chlorine in a bleach sample . (1 session)

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	26	33	59
Troubleshooting and / or exercises	26	36	62
Laboratory practises	45.5	12.5	58
Reports / memories of practice	0	6	6
Short answer tests	4	11	15
Long answer tests and development	3.5	12	15.5
Practical tests, real task execution and / or simulated.	3.5	6	9.5

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

## Methodologies

	Description
Master Session	They are theoretical classes (two hours each week) in which the professor will offer a global vision of each one of the subjects of the program, specially in the most relevant issues and in those with more difficulty for the student. Classroom sessions will develop in an interactive way with the students, commenting with them the on-line material (available in the platform Tem@) and the most adapted bibliography for the preparation, in depth, of each subject.

Troubleshooting and / or exercises	Two hours per week will be devoted to problems and/or exercises solving (seminars) aimed at reinforcing the knowledges acquired during the classroom sessions. In some sessions the professor will explain to the students the problems-type that allow them to solve the worksheet exercises. Instead, in other sessions, the own students will solve and will explain in the blackboard the exercises proposed (on-line material). Will be able to request to the students that deliver, of individual form, some of these solved exercises , that will be corrected by the professor.
Laboratory practises	Students will do experiments in the laboratory, in an individual way, in 3.5 hours per session. The student will have the scripts of the practices in the platform Tem@, so that they can have a previous knowledge of the experiments to perform. During the development of the practices the student will elaborate a notebook in which they will annotate all the relative to the experiment carried out (reactions, procedures, observations, results, etc.). Those students who have approved the laboratory practices in the academic year 2015-16, do not need to repeat them. In this case, marks reached in the laboratory sessions will be maintained.

### Personalized attention

Methodologies	Description
Laboratory practises	Time devoted by the teacher to solve all doubts and queries raised by students during the course. The teacher will inform students in advance on the suitable timetable for tutorials.
Troubleshooting and / or exercises	Time devoted by the teacher to solve all doubts and queries raised by students during the course. The teacher will inform students in advance on the suitable timetable for tutorials.
Tests	Description
Reports / memories of practice	Time devoted by the teacher to solve all doubts and queries raised by students during the course. The teacher will inform students in advance on the suitable timetable for tutorials.

### Assessment

	Description	Qualification Evaluated	Competences
Laboratory practises	The teacher will carry out a follow-up the performance of students in the laboratory sessions (skills acquired). It is important to indicate that it is COMPULSORY the assistance to all the laboratory sessions. If the number of absences is equal or upper than 25 % of the laboratory sessions, students will not be allowed to pass the course.	15	CB5 CE1 CE2 CE4 CE17 CE18 CE19 CE20 CE21 CE22 CE25 CE26 CE27 CE28 CE29 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15 CT16

Troubleshooting and / or exercises	The teacher will evaluate the exercises/problems included in the worksheets and solved by students.	8	CE1 CE2 CE4 CE18 CE19 CE22 CT4 CT5 CT6 CT7 CT9 CT14
Practical tests, real task execution and / or simulated.	At the end of the laboratory sessions, students will carry out a exam so that practical skills acquired can be evaluated. It is mandatory to overcome this examination to pass the practical part of the course.	15	CB5 CE28 CE29 CT1 CT3 CT6 CT7 CT9 CT12 CT13 CT15 CT16
Long answer tests and development	Students will carry out a final written exam corresponding to the four last subjects of the program. Students who have not passed the exam corresponding to the first four subjects, will need to pass the examination of the whole course.	30	CB5 CE1 CE2 CE4 CE18 CE19 CE20 CE22 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14 CT16
Reports / memories of practice	During the laboratory sessions, students will elaborate a notebook in which reflects the experimental work performed (reactions, procedures, observations, results, etc.). This notebook will be evaluated by the professor.	5	CE20 CT1 CT3 CT6 CT9 CT12 CT14 CT15 CT16

Short answer tests	Students will carry out a first short proof about formulation of chemical compounds and calculation of concentrations that will represent a 7 % of the final mark.	27	CB5 CE1 CE2 CE4 CE19 CE20 CE22 CT1 CT3 CT4 CT5 CT6 CT7 CT9 CT12 CT13 CT14 CT16
	Students will carry out a second short exam corresponding to the four first subjects of the program (20% of the final mark). If students pass this exam, they only need to pass the examination corresponding to the rest of subjects in the final exam.		

### Other comments and July evaluation

**First Announcement:** To pass the course, it is compulsory to pass individually each one of the parts: theory and laboratory practices. For this, it is necessary to pass the written and laboratory examinations. The corresponding mark of the laboratory practices will be only taken into account once students have passed the theoretical examination. The participation of the student in any of the acts of evaluation of the course will involve the condition of presented and, therefore, the allocation of a mark. For this effect, they are considered acts of evaluation the assistance to practical laboratory sessions (two or more) and the realisation of written exams.

**Second Announcement:** In the extraordinary announcement the students will have to repeat those exams (theory and/or laboratory) that have not passed in the ordinary announcement. It will be preserved the mark reached by the student, during the course, in the other activities that appear in the evaluation section.

### Sources of information

J. Guiteras, R. Rubio, G. Fonrodona, Curso Experimental en Química Analítica, Síntesis, 2003.  
D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Fundamentos de Química Analítica, 9ª Ed., Thompson, Madrid, 2014.  
D.C. Harris, Análisis Químico Cuantitativo, 3ª Ed., Reverté, Barcelona, 2007.  
Gary D. Christian, Química Analítica, 6ª Ed., McGraw-Hill, 2009.  
D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Química Analítica, 7ª Ed., McGraw-Hill, Madrid, 2001  
F. Burriel, S. Arribas, F. Lucena y J. Hernández, Química Analítica Cualitativa, 18ª Ed., Paraninfo, Madrid, 2001  
D. Harvey, Química Analítica Moderna, McGraw-Hill, Madrid, 2002  
M. Valcárcel, Principios de Química Analítica, Springer, 1999.  
J. A. López Cancio, Problemas Resueltos de Química Analítica, Thompson, 2005.  
P. Yañez-Sedeño Orive, J.M. Pingarrón Carrazón, F.J. Manuel de Villena Rueda, Problemas Resueltos de Química Analítica, Síntesis, 2003  
J. N. Miller y J.C. Miller, Estadística y Quimiometría para Química Analítica, 4ª Ed., Prentice Hall, 2002

### Recommendations

#### Subjects that continue the syllabus

Analytical chemistry II/V11G200V01503  
Analytical chemistry 3/V11G200V01601

#### Subjects that are recommended to be taken simultaneously

Physics III/V11G200V01301

Physical chemistry I/V11G200V01303

Organic chemistry I/V11G200V01304

---

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

---

Chemistry, physics and biology: Integrated laboratory I/V11G200V01103

Chemistry, physics and geology: Integrated laboratory II/V11G200V01202

Chemistry: Chemistry I/V11G200V01105

Chemistry: Chemistry 2/V11G200V01204

---

IDENTIFYING DATA				
Physical chemistry I				
Subject	Physical chemistry I			
Code	V11G200V01303			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Hervés Beloso, Juan Pablo			
Lecturers	Hervés Beloso, Juan Pablo Mandado Alonso, Marcos			
E-mail	jherves@uvigo.es			
Web	<a href="http://webs.uvigo.es/qf1_web/">http://webs.uvigo.es/qf1_web/</a>			
General description	<p>Physical Chemical I is one of the first contacts of a student of Chemistry with the Physical Chemistry. This discipline studies the properties and the behaviour of the chemical systems employing the methods of the Physics. This matter presents the rigorous macroscopic treatment of chemical systems in equilibrium, systems already entered in Chemistry I. Taking advantage of the basic knowledge of the principles of the Thermodynamics, they will be applied to systems of chemical interest to obtain a quantitative description of them. For this purpose, it is fundamental to be familiarised with differential calculus in more than a variable and integral calculus in one variable, skill already seen in Mathematics II.</p> <p>The knowledge on the macroscopic description of the chemical systems that will be reached in this subject are complementary with the contents of the subject Physical Chemistry III the following year. The experimental applications of these knowledges will be studied in the subject of the second term Physical Chemistry II.</p>			

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

**Learning outcomes**

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

Handle thermodynamic tables to obtain values of the distinct functions of thermodynamic state of reaction and calculate the thermodynamic functions of reaction to distinct temperatures

CE6  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

---

Calculate the fugacity function for a real gas from his equation of state or from experimental measures

CE6  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

---

Calculate the thermodynamic constant of reactions in solution, from the concentrations of the species or from the thermodynamic functions

CE6  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

---

Calculate the thermodynamic characteristics of a change of phase, and know the interval of applicability of the equations employed

CE6  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

---



Calculate the thermodynamic properties of an ideal solution from his composition

CE6  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

---

Calculate the colligative properties of a solution from the concentration of the solute and the properties of the dissolvent. Establish when these results can be applied to a real case

CE6  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

---

Calculate the activities and activity coefficients of non-electrolytic solutions and employ the suitable model for the calculation of the mean ionic activity coefficient. Obtain this coefficient from experimental measures

CE6  
CE18  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

---

Employ pertinent experimental measures of the galvanic cells to determine functions of state of reaction

CE6  
CE18  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

---

Determine the activity and/or the mean ionic activity coefficient of an electrolyte by means of experimental measures of EMF of galvanic cells

CE6  
CE18  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

Analyse the importance of the interphase and of the distinct phenomena associated to the interphase in the thermodynamic processes of the material systems

CE6  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

Establish the importance of the superficial tension and the distinct processes associated in function of the nature of the system

CE6  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

Differentiate between processes of physical and chemical adsorption and describe the models employed for his description

CE6  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

Topic	
Principles of the thermodynamics in Chemistry.	First principle of the Thermodynamics. Internal energy. Enthalpy. Heat capacity. Thermochemistry. Second principle of the thermodynamics. Entropy. Molecular interpretation of the entropy. Third principle of the Thermodynamics. Calculation of the variations of entropy.
Thermodynamic functions	Equations of Gibbs. Relations of Maxwell. Calculation of variations of the functions of state. Open systems. Partial molar magnitudes. Chemical potential. Chemical potential of an ideal gas. Chemical potential in a mix of ideal gases. Chemical potential of the real gases. Fugacity.
Chemical equilibrium between gases.	Conditions of thermodynamic equilibrium. Degree of advance. Constant of thermodynamic balance in reactions in gas phase. Influence of the temperature in the constant of balance. Factors that affect to the position of the equilibrium: principle of Le Châtelier.
Balance of phases in systems of a component.	Concepts of component, phase and degree of freedom. Conditions of balance between phases. Rule of the phases. Changes of phase of prime importance. Equations of *Clapeyron and *Clausius-*Clapeyron. Changes of phase of upper order.
Ideal solutions.	Partial molar volumes. Equation of *Gibbs-*Duhem. Ideal dissolution: Law of *Raoult. Diagrams *P-*x and *T-*x. Ideal dilute solution: Law of Henry. Colligative Properties.
Non ideal solutions.	Deviations of the law of *Raoult. Activity and coefficient of activity. Coefficients of activity in the scales of molality and molarity. Electrolyte solutions. Theory of *Debye-*Hückel.
Chemical equilibrium in solution.	Constant of thermodynamic equilibrium in reactions in solution. Acid-base equilibria. Product of solubility. Saline effects. Electrochemical systems. Galvanic and electrolytic cells. Measure of the electromotive strength of a galvanic cell. Equation of *Nernst. Potential of electrode.
Thermodynamics of surfaces.	Surfaces and interfaces. Superficial tension. Phenomena derived of the superficial tension. Adsorption. Physisorption and Chemisorption Isotherms.

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	26	31	57
Seminars	26	38	64
Troubleshooting and / or exercises	0	14	14
Self-assessment tests	0	10	10
Short answer tests	2	0	2
Long answer tests and development	3	0	3

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

## Methodologies

	Description
Master Session	They will consist in the brief exposition by the professor of the fundamental aspects of each subject, employing the available material in the TEMA platform. Also numerical problems will be proposed for helping to comprise and settle concepts.
Seminars	Seminar will be devoted to the resolution of problems and will deepen on those aspects that present greater difficulties to the students. These classes will be mainly a task for the students under the supervision of the professor.

## Personalized attention

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

Assessment			
	Description	Qualification	Evaluated Competences
Self-assessment tests	Quiz-tests in the TEMA platform	Hasta un 7,5	CE6 CE18 CE19 CE20 CT3 CT4 CT5 CT7 CT9 CT12 CT13 CT14 CT15
Troubleshooting and / or exercises	Problems proposed for each subject of the matter.	Hasta un 7,5	CE6 CE18 CE19 CE20 CE23 CT1 CT3 CT4 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Long answer tests and development	Written examination of the contents of the matter.	Mínimo un 65	CE6 CE18 CE19 CE20 CT1 CT3 CT4 CT6 CT7 CT9 CT12 CT13 CT14

---

**Other comments and July evaluation**

---

- The voluntary work of the student (tests + problems proposed) will be able to constitute until 15% of the final qualification whenever the student realise, at least, the half of the activities proposed along the course.

- It will be done a short written proof (of two hours of length) of the first-half of the matter. This proof can eliminate contents. The realisation of this proof is the minimum condition so that the matter was described in record. This short proof will be able to suppose until 20% of the final qualification.

-It will be realised a global written proof at the end of term (around three hours of length) on the whole of the contents of the matter. This global proof will suppose at least 65% of the final qualification. In case that the student surpass the short proof (> 5) students will be able to opt in the global written proof between examining only of the second half of the matter or of the whole of the subject. In the first case, the note of the global proof will do average with the short proof.

IMPORTANT: To surpass the matter in record is indispensable requirement reach in the global proof a minimum note of 4 points on 10.

- In the following callings of the matter the previous percentages will be respected and the qualifications obtained in the voluntary work and in the short proof realised during the course will be kept, except in the case of change of professor, who will be the one who establish new norms.

---

---

**Sources of information**

---

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

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

Engel, Química Física, Pearson, 2006

Chang, Fisicoquímica, McGraw-Hill, 2008

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

Levine, Problemas de Fisicoquímica, McGraw-Hill, 2005

Rodríguez Renuncio, Problemas resueltos de Termodinámica Química, Síntesis, 2000

Metz, Fisicoquímica. Problemas y Soluciones, McGraw-Hill, 1991

---

---

**Recommendations**

---

**Subjects that continue the syllabus**

---

Physical chemistry II/V11G200V01403

---

---

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

---

Mathematics: Mathematics II/V11G200V01203

Chemistry: Chemistry I/V11G200V01105

Chemistry: Chemistry 2/V11G200V01204

---

IDENTIFYING DATA				
<b>Organic chemistry I</b>				
Subject	Organic chemistry I			
Code	V11G200V01304			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Iglesias Antelo, María Beatriz			
Lecturers	Cid Fernández, María Magdalena Iglesias Antelo, María Beatriz Muñoz López, Luis Terán Moldes, María del Carmen			
E-mail	bantelo@uvigo.es			
Web				
General description	In this subject, students reach an understanding of the fundamental principles of Organic Chemistry, regarding organic compounds structure and reactivity. Following two lessons on general concepts, the reactivity of functional groups with multiple carbon-oxygen and carbon-carbon bonds, including aromatic compounds, is studied.			

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

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

### Learning outcomes

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

For each transformation, describe in detail the reaction mechanism, indicating reaction steps, transition states, intermediates etc.	CE2 CE11 CT1 CT3 CT4 CT7 CT9 CT12 CT14
Predict the result of the reaction of a specific substrate with a given reagent in specific conditions, regarding regioselectivity and stereoselectivity of the process.	CE11 CE12 CE13 CE19 CT1 CT3 CT4 CT7 CT9 CT12 CT14
Apply the rules for safety and health in laboratory work and carry out the treatment and correct elimination of the waste generated.	CE25 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14 CT15
Carry out correctly the usual experimental procedures in simple organic preparations.	CE21 CE26 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14
Carry out the work up of the reaction product, as well as its isolation and purification by means of usual techniques (extraction, distillation, recrystallization and chromatography).	CE21 CE26 CE27 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14
Write and describe appropriately the completed experiments in the laboratory notebook, so that they can be reproduced.	CE23 CE27 CE28 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14 CT15



**Contents**

Topic	
Lesson 1. Configurational stereoisomerism	Functional groups. Three-dimensional representation of organic structures. Absolute configuration of stereogenic centres, cyclic compounds and alkenes.
Lesson 2. Reactivity of organic compounds	Acid-base reactivity of organic compounds. Reaction mechanisms: stepwise reactions. Energetic profile of a reaction. Heterolytic bond cleavage. Ionic reactions. Reaction intermediates: carbanions. Redox reactivity of organic compounds. Formal states of oxidation.
Lesson 3. Addition reactions to carbon-carbon multiple bonds	Structure and general reactivity of functional groups with carbon-carbon multiple bonds: alkenes and alkynes. Hydrogenation: heats of hydrogenation and stability of alkenes and dienes; homolytic bond cleavage; concerted reactions. Electrophilic addition reactions to alkenes. Addition of HX; reaction intermediates: carbocations; regioselectivity; electrophiles and nucleophiles. Hydration reactions; orientation and stereochemistry. Addition of halogens (X <sub>2</sub> ). Dihydroxylation reactions. Addition reactions to alkynes.
Lesson 4. Aromatic substitution reactions	Structure and general reactivity of aromatic compounds. General mechanism for the electrophilic aromatic substitution reaction. Reactions with non-carbon electrophiles. Reactions with carbon electrophiles. Electrophilic aromatic substitution reactions in substituted systems: orientation and reactivity. Modulation of the reactivity of aromatic rings. Nucleophilic aromatic substitution reactions.
Lesson 5. Reactions of nucleophilic addition to the carbonyl group	Structure and general reactivity of the carbonyl group (aldehydes and ketones). General mechanism for the nucleophilic addition reaction. Non reversible nucleophilic additions: addition of organometallic compounds (alkynyl anions, organolithium and organomagnesium reagents); addition of stabilized carbanions; addition of hydride. Reversible nucleophilic additions: addition of oxygen and sulphur compounds (water, alcohols and thiols); addition of nitrogen compounds (amines and other nitrogen compounds); addition of hydrogen cyanide.
Lesson 6. Reactions of nucleophilic substitution at the carbonyl group	Structure and general reactivity of carboxylic acids and their derivatives. Relative reactivity of acid derivatives: basicity and electrophilic character. Non reversible addition-elimination reactions: leaving group. Reversible addition-elimination reactions: basic catalysis and acid catalysis. Reactions with water and alcohols; reactions with ammonia and amines. Structure and reactivity of nitriles. Reactions of nitriles.
Practice 1	Separation of organic compounds mixtures by using two techniques: acid-base extraction (liquid-liquid extraction) and column chromatography. Four sessions.
Practice 2	Electrophilic addition to a double bond. One session.
Practice 3	Electrophilic aromatic substitution. One session.
Practice 4	Reduction of a ketone. One session.
Practice 5	Preparation of a hydrazone. One session.
Practice 6	Hydrolysis of an ester. One session.
Practice 7	Synthesis project. Four sessions.

**Planning**

	Class hours	Hours outside the classroom	Total hours
Master Session	26	26	52
Troubleshooting and / or exercises	26	49	75

Laboratory practises	45.5	9.5	55
Jobs and projects	0	9	9
Short answer tests	10	24	34

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

## Methodologies

	Description
Master Session	Exposition by the teaching staff of the syllabus' general aspects, with special emphasis in its fundamental features. The teaching staff will facilitate, through Tema, all the material needed for the student's personal work. Prior to class, the student must use this material and consult the recommended bibliography to complete the information, in order to improve his/her academic progress in the subject.
Troubleshooting and / or exercises	Two hours each week will be devoted to discussing the most prominent aspects of the topic, to solve questions arisen in the development of the lesson and to the resolution of the proposed exercises.
Laboratory practises	Laboratory experiments will be carried out, individually, in 3.5 h sessions. The students will find, in advance, in Tema, the material needed for the preparation of the experiments. At the start of each session the professor will do an exposition of the contents to be developed. During the experiments the student will elaborate a laboratory notebook recording all the observations pertinent to the experiment. At the end of the session the student will answer some questions regarding the work done.

## Personalized attention

Methodologies	Description
Troubleshooting and / or exercises	The teaching staff will attend the students' queries regarding the different topics within the subject. Attention to students schedules will be available through the Faculty of Chemistry webpage ( <a href="http://quimica.uvigo.es/profesorado.php">http://quimica.uvigo.es/profesorado.php</a> ).
Tests	Description
Jobs and projects	The teaching staff will tutor the students while preparing and carrying out a short laboratory project.

## Assessment

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

Short answer tests	First test: 15%. It will cover contents corresponding to the first three lessons.	60	CE2
			CE10
	Second test: 15%. It will cover contents corresponding to the last three lessons.		CE11
			CE12
	Written test for the experimental part: 15%. To be taken by the students that have achieved the mention APT in the monitoring of the laboratory work. In this test, student acquisition of competencies and skills related to the experimental aspects of the subject will be evaluated.		CE13
			CE19
			CT3
			CT7
	Global test: 15%. In this test, student acquisition of competencies and skills related to the theoretical aspects of the subject will be evaluated.		CT12
			CT14
Jobs and projects	The student will elaborate a report prior to the execution of a short project in the laboratory during the last week of practical classes.	15	CE20
			CE23
			CE25
			CT1
			CT4
			CT5
			CT9
			CT14

#### Other comments and July evaluation

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

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

If any of the previous conditions is not fulfilled, the final mark for the subject will be the mark obtained for the Short answer tests section multiplied by 0.6 (60%).

- Achieve a minimum mark of 5.0 in the weighted addition of the marks for all the sections (troubleshooting and/or exercises, short answer tests, jobs and projects).

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

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

#### EVALUATION IN JULY

45% of the Short answer tests section can be repeated in July, in the following way:

- **Tests (30%).** It will be carried out a global test in which the competences acquired in the theoretical aspects of the subject will be evaluated. The student must achieve a **minimum mark of 4 points out of 10** so that the result of this test will be taken into account in the global mark of the subject. This result will substitute the two lower marks obtained for the three theoretical tests carried out during the semester (first test, second test and global test), keeping the higher mark of the three, as long as it exceeds the required minimum.
- **Written test for the experimental part (15%).** A **minimum mark of 3 points out of 10** must be achieved. The new mark will substitute the one achieved in the written test for the experimental part taken at the end of the semester.

The final mark will be the weighted addition of the marks for all the sections (troubleshooting and/or exercises, short answer tests, jobs and projects), as long as all the required minima are reached. If this is not the case, the final mark for the subject

will be the mark obtained for the Short answer tests section multiplied by 0.6 (60%). In case that this mark was lower than the one obtained in the end of semester evaluation, the official mark will be this last one.

---

#### Sources of information

KLEIN, D., "Química Orgánica", 1ª edición en español, Editorial Médica Panamericana (2013)

VOLLHARDT, K.P.C.; SCHORE, N.E, "Química Orgánica", 5ª edición en español, Edicións Omega (2007)

WADE, L.G., "Química Orgánica", 7ª edición en español, Editorial Pearson-Educación de México (2012)

#### Supplementary bibliography

- CAREY, F. *Química Orgánica*, 6th edition in Spanish, McGraw-Hill Interamericana, 2006.
- CLAYDEN, J.; GREEVES, N.; WARREN, S. *Química Orgánica*, 2nd edition, Oxford University Press, 2012.
- YURKANIS BRUCE, P. *Fundamentos de Química Orgánica*, 3rd edition in Spanish, Pearson, 2015.
- DOBADO, J. A.; GARCÍA-CALVO, F.; GARCÍA, J. I. *Química Orgánica: ejercicios comentados*, Garceta, 2012.
- PALLEROS, D. R. *Experimental Organic Chemistry*, John Wiley and Sons, 2000.
- QUIÑOÁ, E.; RIGUERA, R. *Cuestiones y ejercicios de Química Orgánica*, 2nd edition, McGraw-Hill Interamericana, 2004.
- QUIÑOÁ, E.; RIGUERA, R. *Nomenclatura y representación de los compuestos orgánicos*, 2nd edition, McGraw-Hill Interamericana, 2005.

---

#### Recommendations

##### Subjects that continue the syllabus

Organic chemistry II/V11G200V01504

Organic chemistry III/V11G200V01704

##### Subjects that are recommended to be taken simultaneously

Physics III/V11G200V01301

Analytical chemistry I/V11G200V01302

Physical chemistry I/V11G200V01303

##### Subjects that it is recommended to have taken before

Biology: Biology/V11G200V01101

Chemistry, physics and biology: Integrated laboratory I/V11G200V01103

Chemistry, physics and geology: Integrated laboratory II/V11G200V01202

Chemistry: Chemistry I/V11G200V01105

Chemistry: Chemistry 2/V11G200V01204

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

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

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

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

(*) Draft simple documents and perform short oral presentations in English, on subjects related with Chemistry.	CE23 CT1 CT2 CT3 CT8 CT14
(*) Identify the most important programs of molecular modelling and understand the usefulness of the results obtained.	CE20 CT3 CT4 CT14

## Contents

### Topic

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	14	28	42
Practice in computer rooms	26	52	78
Troubleshooting and / or exercises	2	22	24
Long answer tests and development	1.5	4.5	6

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

Methodologies	
	Description
Master Session	The theoretical aspects of the subject are presented
Practice in computer rooms	Computer lab exercises: literature searches, use of bibliographic managers, use of statistical packages, report writing.
Troubleshooting and / or exercises	Report or article writing in English language. Simple exercises with modelling software

Personalized attention	
Methodologies	Description
Practice in computer rooms	
Troubleshooting and / or exercises	

Assessment			
	Description	Qualification Evaluated	Competences
Practice in computer rooms	Typically, literature searches	20	CE22 CE23 CT1 CT2 CT3 CT4 CT5 CT9 CT15 CT16
Troubleshooting and / or exercises	Typically, database searches and use of utilities of modelling software.	40	CE22 CE23 CT1 CT2 CT3 CT4 CT5 CT8 CT10 CT14 CT15 CT18
Long answer tests and development	Written exam consisting of short questions.	40	CT1 CT2 CT14 CT15

Other comments and July evaluation
------------------------------------



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

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

---

**Sources of information**

Douville, J.A. , The literature of chemistry, 1st, American Library Association

Kaplan, S.M. , The English-Spanish Spanish-English dictionary of chemistry, 2ª, Wiley, 2014

Day, R.A.; Gastel, B. , How to write and publish a scientific paper, 7ª, Cambridge Univ. Press, 2011

---

---

**Recommendations**

---

**Subjects that are recommended to be taken simultaneously**

Numerical methods in chemistry/V11G200V01402

Physical chemistry II/V11G200V01403

Inorganic chemistry I/V11G200V01404

---

---

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

Physics: Physics I/V11G200V01102

Physics: Physics II/V11G200V01201

Chemistry: Chemistry I/V11G200V01105

Chemistry: Chemistry 2/V11G200V01204

---

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

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

Learning outcomes	
Learning outcomes	Competences

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

## Topic

Subject 1. *Introduction the analysis **numerica.	Systems of numbering Need of the numerical methods. *Fontes And analysis of the error. Available *software.
Subject 2. Approximation of roots of equations of a variable.	*Condicionamiento Of the calculation of roots. Methods of separation of roots- Method of the *bisection. Method of Newton-**Raphson. *Theorem of the point did.
Subject 3. *Numerical interpolation.	The general problem of *interpolation. *Interpolation of *Lagrange. Error of *interpolation and excellent election of *nodes. *Interpolation **polinomial.
Subject 4. It adjust of curves.	It adjust of data. Straight of regression by square minima. Approximation of functions by square minima. *Interpolation **polinomial to *pieces.
Subject 5. *Derivación And numerical integration.	Diagrams of *derivación numerical *based in *interpolation. Formulas of *derivación *finite. Error of *derivación. Formulas of integration with *polynomial *interpolation. Error of integration. Formulas of *quadratures.
Subject 6. Numerical resolution of systems of equations.	Direct methods of resolution of linear systems: *Gauss. Classical *iterative methods. Methods of descent: Máximo descend and *gradient *conjugado. Resolution of systems no linear.

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	13	26	39
Practice in computer rooms	26	52	78
Multiple choice tests	4	12	16
Troubleshooting and / or exercises	2	8	10
Jobs and projects	0	7	7

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

## Methodologies

	Description
Master Session	Exhibition of the theoretical bases and orientation by part of the *profesorado on the contents of the matter
Practice in computer rooms	Development in the classrooms of computing of the exercises that propose in the theoretical classrooms using the scientific calculator **MATLAB.

## Personalized attention

Methodologies	Description
Practice in computer rooms	The students will work of autonomous way with the permanent supervision of the professor

## Assessment

	Description	Qualification	Evaluated Competences
Practice in computer rooms	At the end of the sessions in the classrooms of computing, the student will resolve some exercises of the even type that the ones of the realised in the classroom.	25	CE19 CE22 CE29 CT6
Multiple choice tests	During the course will realise **alomenos three partial proofs short type test and practical type that will explain a 25 by one hundred in the final qualification. Besides, in a final proof, will realise another tests type test of **tódala matter that *contabilizará another 10 by one hundred in the final qualification.	35	CE19 CE22 CE29 CT6
Troubleshooting and / or exercises	When finalising the course **realizará a practical proof resolving some practical exercises in the classroom of computing	30	CE19 CE22 CE29 CT6

Jobs and projects	**Participacion With *aprovechamiento in all the activities proposed by the *profesorado, are these to realise inside or out of the classroom.	10	CE19 CE22 CE29 CT6
-------------------	--	----	-----------------------------

---

### Other comments and July evaluation

The students that do not surpass the \*materiaen the common announcement and pretend to do it in the \*convocatoriaextraordinaria, will keep the qualifications obtained during the course in each \*unode the previous sections, except the qualifications of the practical proofs of computing, that will be able to be recovered, and \*lasdos proofs realised at the end of course that will be evaluated in the \*examencorrespondiente. In this case, the student has to put in contact with the professor with sufficient \*antelación to agree the work to realise before the final proofs. The participation of the student in any of the acts of evaluation of the matter will involve the condition of &quot;presented&quot; and, therefore, the allocation of a qualification. They consider acts of evaluation the assistance to the practices of computing (four or more), the realisation of some proof or the delivery of a minimum of 25% of the problems or exercises commissioned by the professor.

---

### Sources of information

Chapra, S.C.; Canale, R.P., Métodos numéricos para ingenieros, 2010, McGraw-Hill

Besada, M., MATLAB: todo un mundo, 2007, Servizo de publicacións da Universidade de Vigo

Mathews, J.H.; Fink, K.D., Métodos numéricos con MATLAB, 2000, Prentice Hall

Nakamura, S., Análisis numérico y visualización gráfica con MATLAB, 1997, Pearson Educación

---

### Recommendations

---

### Subjects that it is recommended to have taken before

Mathematics: Mathematics I/V11G200V01104

Mathematics: Mathematics II/V11G200V01203

---

IDENTIFYING DATA				
Physical chemistry II				
Subject	Physical chemistry II			
Code	V11G200V01403			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	2nd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Mosquera Castro, Ricardo Antonio			
Lecturers	Graña Rodríguez, Ana María Hermida Ramón, José Manuel Mosquera Castro, Ricardo Antonio Pastoriza Santos, Isabel Peña Gallego, María de los Ángeles Pérez Juste, Ignacio			
E-mail	mosquera@uvigo.es			
Web				
General description	Application of the principles and methods of Quantum Mechanics to the study of molecular structure and spectroscopy.			

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

CT7	Apply theoretical knowledge in practice	- know - Know be
CT8	Teamwork	- Know be
CT9	Work independently	- Know be
CT12	Plan and manage time properly	- Know be
CT13	Make decisions	- know - Know be
CT14	Analyze and synthesize information and draw conclusions	- know
CT15	Evaluate critically and constructively the environment and oneself	- Know be

### Learning outcomes

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

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



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

Introduction to group symmetry theory in chemistry	<ul style="list-style-type: none"> <li>- Symmetry elements and operations.</li> <li>- Symmetry point groups.</li> <li>- Matrix representations.</li> <li>- Irreducible Representations. Character tables.</li> <li>- Chemical applications.</li> </ul>
Qualitative aspects of molecular electronic structure.	<ul style="list-style-type: none"> <li>- Born-Oppenheimer approximation.</li> <li>- The H<sub>2</sub><sup>+</sup> molecule.</li> <li>- The MO method for homonuclear and heteronuclear diatomic molecules.</li> <li>- The MO method in polyatomic molecules.</li> <li>- The VB method.</li> </ul>
Quantitative treatments for the study of the molecular electronic structure.	<ul style="list-style-type: none"> <li>- Hartree-Fock method.</li> <li>- post-Hartree-Fock methods.</li> <li>- Semiempirical methods.</li> <li>- Calculation of molecular properties</li> </ul>
Introduction to Molecular Spectroscopy.	<ul style="list-style-type: none"> <li>- Radiation-matter interaction: General approach.</li> <li>- Transition dipole moment integral. Selection rules.</li> <li>- Intensity and position of the spectral transitions.</li> <li>- Instrumentation.</li> </ul>
Rotational spectroscopy.	<ul style="list-style-type: none"> <li>- Pure rotation spectra of diatomic molecules. Rigid and elastic rotor models.</li> <li>- Pure rotation spectra of polyatomic molecules.</li> <li>- Pure rotation Raman spectra.</li> <li>- Instrumentation and applications.</li> </ul>
Spectroscopy of Vibration-rotation.	<ul style="list-style-type: none"> <li>- Vibration-rotation spectra of diatomic molecules. Harmonic and anharmonic oscillator models with rotation depending on vibration.</li> <li>- Vibration-rotation spectra of polyatomic molecules.</li> <li>- Vibration-rotation Raman spectroscopy.</li> <li>- Instrumentation and applications.</li> </ul>
Electronic spectroscopy.	<ul style="list-style-type: none"> <li>- Molecular Electronic states.</li> <li>- Vibration-rotation structure: Franck-Condon principle</li> <li>- Chromophore and auxochrome Groups.</li> <li>- Electronic deactivation Processes.</li> <li>- Instrumentation and applications.</li> <li>- Lasers.</li> <li>- Photoelectron Spectroscopy and related techniques.</li> </ul>
Spectroscopies of Resonance.	<ul style="list-style-type: none"> <li>- Introduction to the magnetic resonance.</li> <li>- Chemical shift.</li> <li>- Spin-spin interaction. Coupling Constant.</li> <li>- Electronic spin resonance Spectroscopy.</li> </ul>
Practices of Chemical Thermodynamics (six sessions)	<ul style="list-style-type: none"> <li>- Experimental determination of chemical equilibrium constants employing spectroscopic or potentiometric techniques.</li> <li>- Experimental determination of combustion, dissolution, neutralisation, fusion or vaporisation enthalpies.</li> <li>- Colligative Properties.</li> <li>- Experimental determination of activity coefficients employing potentiometric techniques.</li> </ul>
Practices of Quantum Chemistry and Spectroscopy (seven sessions).	<ul style="list-style-type: none"> <li>- Computational study of the electronic structure of different molecules</li> <li>- Computational Study of conformational isomery.</li> <li>- Computational study of simple chemical processes.</li> <li>- Prediction, theoretical interpretation and resolution of the vibration-rotation spectrum of HCl in gas phase.</li> <li>- Electronic spectroscopy: Spectrum of the I<sub>2</sub> molecule in gas phase.</li> </ul>

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	26	39	65
Seminars	26	39	65
Laboratory practises	45.5	4.5	50
Autonomous troubleshooting and / or exercises	0	10	10
Long answer tests and development	4	8	12
Reports / memories of practice	0	9	9
Short answer tests	2	5	7
Multiple choice tests	0	4	4

Practical tests, real task execution and / or simulated.

1

2

3

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

<b>Methodologies</b>	
	Description
Master Session	They will consist in the presentation of the fundamental aspects of each subject by the teacher, using the material available in the TEM@ platform (diagrams, bulletins of problems, ...). In addition, numerical problems will be proposed for a better understanding of theoretical concepts.
Seminars	The classes of seminar will be mainly work of the student, under the supervision of the professor, and will be used for: - Problems solving, individually or by groups. - Once the student has worked the basic concepts, reinforce those contents of each subject that can present a greater complexity.
Laboratory practises	Completion of laboratory or computational chemistry practices under the supervision of a teacher in an autonomous way. Lab practices will be done by pairs in sessions of 3,5 hours. With advance enough, students will have in the TEM@ platform guide notes for the practices together with all the additional necessary material. Guide notes will present the essential elements to realise the experimental or computational practices, as well as the fundamental theoretical points and further data treatment. After practice completion, in the terms set by the teacher, it will be necessary to deliver the corresponding report, elaborated following the guidelines given by the teacher.
Autonomous troubleshooting and / or exercises	For each one of the subjects, some problems or other works to be solved by the student and delivered to the teacher in due time will be proposed.

<b>Personalized attention</b>	
Methodologies	Description
Master Session	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Seminars	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Laboratory practises	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Autonomous troubleshooting and / or exercises	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).

<b>Tests</b>	Description
Long answer tests and development	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Reports / memories of practice	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Short answer tests	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Multiple choice tests	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).
Practical tests, real task execution and / or simulated.	In tutorial sessions, the teacher may solve in an individual and more personal way those doubts of the students that can arise along the course in any one of its parts (theory lessons, seminars, laboratory practice and the several types of autonomous activities to realise).

<b>Assessment</b>			
	Description	Qualification	Evaluated Competences

Laboratory practises	This mark comprises the effort and the attitude, the skills and the competitions developed by the student during the realisation of the laboratory practices.	ata 10,0	CE3 CE6 CE8 CE19 CE20 CE21 CE22 CE27 CE28 CT1 CT4 CT5 CT6 CT7 CT8 CT12 CT13 CT14 CT15
Autonomous troubleshooting and / or exercises	For each one of the subjects or groups of subjects, problems or additional work to be done by the students will be proposed.	ata 3,75	CE3 CE8 CE19 CE20 CE22 CE23 CT1 CT3 CT4 CT5 CT6 CT9 CT12 CT13 CT14 CT15
Long answer tests and development	Realisation of one global writing test at the end of the term, in a date set by the Faculty of Chemistry.	como mínimo 52,5	CE3 CE8 CE19 CE20 CE22 CT1 CT3 CT6 CT9 CT12 CT14 CT15

Reports / memories of practice	Students must present a report for a laboratory practice proposed by the teachers. Students have to take care on format aspects related to the organisation, the correct use of the units, and the correct preparation of graphics and exhibition of the results. It will be also evaluated the critical analysis of results and getting right conclusions. Besides, all the practices will be evaluated by means of oral questions that the students can answer with the help of their laboratory notebook.	ata 5,0	CE3 CE6 CE8 CE19 CE20 CE22 CE23 CE27 CE28 CE29 CT1 CT3 CT4 CT5 CT6 CT8 CT9 CT12 CT14
Short answer tests	Realisation of two short writing test (not liberatory) along the term, in dates set by the Faculty of Chemistry.	hasta 15	CE3 CE8 CE19 CE20 CE22 CT1 CT3 CT6 CT9 CT12 CT14 CT15
Multiple choice tests	For each each subject or group of subjects the student will have the opportunity of answer quiz tests through the TEM@ platform.	ata 3,75	CE3 CE8 CE19 CT3 CT4 CT6 CT7 CT9 CT12 CT14 CT15

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

### Other comments and July evaluation

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

**Theoretical part:** The evaluation will suppose, in his group (short proofs (20%), long proof (70%), problems solving (5%), quiz-tests (5%)), 75% of the final qualification of the subject.

It is required to pass the subject to obtain in the long proof a minimum qualification of 4,0 on 10,0 points. In the case of not reaching this punctuation the qualification that will reflect in the record will be only the qualification of this examination, no taking into account any of the other sections.

Besides, it will be necessary to obtain an average of 3,0 in the theoretical questions of the examinations (short and long proofs). If it did not reach this punctuation the note reflected in the record will not be able to surpass 4,0.

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

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

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

**Condition of presented/no presented:** The realisation of the two short proofs, or of the proof written of practices, or of the long proof or the assistance to but of five sessions of laboratory, will involve the condition of "presented/to" and, therefore, the allocation of a qualification.

**Second Opportunity:** For the evaluation in the second opportunity, will keep the qualifications and the percentages of the short proofs, of the problems/works proposed, of the practices of laboratory and the corresponding reports and of the quiz-tests. In the case to have an equal or upper qualification to 5,0 points in the global proof (long) or the same or upper to 4,0 in the proof written of practices, will keep said qualification (and the percentage) and only will be necessary to realise to another.

### Sources of information

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

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

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

### Bibliografía Complementaria:

- ATKINS P. W., FRIEDMAN R.S., "Molecular Quantum Mechanics" (5ª Edición). Oxford University Press. (2011).
- LEVINE I.N., "Química Cuántica" (5ª ed.), Prentice Hall (2001).
- LEVINE I.N., "Quantum Chemistry" (7ª ed.), Pearson (2014).
- LEVINE I.N., "Fisicoquímica" (5ª ed.), McGraw Hill (2004).
- REQUENA A., ZÚÑIGA J., "Espectroscopía", Pearson Prentice Hall (2004).

### Libros de problemas:

- CARBALLEIRA OCAÑA L., PÉREZ JUSTE I., "Problemas de Espectroscopía Molecular", Netbiblo (2008).
- LEVINE I.N., "Problemas de Fisicoquímica" (5ª ed.), McGraw Hill (2005).

### Libros de prácticas:

- GARLAND C.W., NIBLER J.W., SHOEMAKER D.P., "Experiments in Physical Chemistry" (7ª ed.), McGraw-Hill (2003).
- FORESMAN J.B., FRISH A., "Exploring Chemistry with Electronic Structure Methods: a guide to using Gaussian" (2ª ed.), Gaussian Inc (1996).

---

### Recommendations

---

#### Subjects that are recommended to be taken simultaneously

---

IT tools and communication in chemistry/V11G200V01401

Numerical methods in chemistry/V11G200V01402

Inorganic chemistry I/V11G200V01404

---

#### Subjects that it is recommended to have taken before

---

Mathematics: Mathematics I/V11G200V01104

Mathematics: Mathematics II/V11G200V01203

Physics III/V11G200V01301

Physical chemistry I/V11G200V01303

---

IDENTIFYING DATA				
Inorganic chemistry I				
Subject	Inorganic chemistry I			
Code	V11G200V01404			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	García Bugarín, Mercedes			
Lecturers	Bolaño García, Sandra Carballo Rial, Rosa Couce Fortúnez, María Delfina García Bugarín, Mercedes			
E-mail	mgarcia@uvigo.es			
Web				
General description	<p>"Machine translation into english of the original teaching guide"</p> <p>In this asignatura studies the chemistry of the elements of the main groups and his compounds. It pretends give an overview of the different types of chemical behaviour and of the existent compounds.</p>			

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



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

<b>Contents</b>	
Topic	
1. Hydrogen	Obtaining. Physical and chemical properties. Hydrides: classification and general study of the same. The water.

2. Noble gases	General characteristics. Properties and uses. Fluorides of xenon. Combinations of xenon with oxygen.
3. *Halógenos	General characteristics. Obtaining, properties and reactivity. Halides. Oxides, *oxoácidos and *oxosales. Compound *interhalógenos and ions *polihalogenuro. *Pseudohalógenos. *Fluorocarbonos.
4. Elements of the group 16	General characteristics. Specific study of the oxygen. Obtaining, properties and reactivity. Peroxide of hydrogen. Sulphur. Obtaining, properties and reactivity. Combinations hydrogenated and *halogenadas of the sulphur. Oxides, *oxoácidos and *oxosales of sulphur.
5. Elements of the group 15	General characteristics. Obtaining, properties and reactivity. Combinations hydrogenated and *halogenadas. Oxides, *oxoácidos and *oxosales of nitrogen and phosphorus. Arsenic and bismuth.
6. Elements of the group 14	General characteristics. Carbon. Obtaining, properties and reactivity. Oxides and carbonates. Carbides. Combinations *halogenadas and nitrogenous. Silicon, germanium, tin and lead. Obtaining, properties and reactivity. Hydrides and halides. Oxides. Silicates. Silicones.
7. Elements of the group 13	General characteristics. Boron. Obtaining, properties and reactivity. Hydrides and halides. Composed with nitrogen. Oxides, *oxoácidos and *oxosales. Aluminium. Obtaining, properties and reactivity. Chemistry in aqueous dissolution of the *ion aluminium. Hydrides, halides and oxides. Compounds more important of gallium, Indium and *talio.
8. Elements of the group 1	Physical and chemical properties. Reactivity. Obtaining. Compounds more important.
9. Elements of the group 2	Physical and chemical properties. Reactivity. Obtaining. Compounds more important.
Practice 1-2	Study of the chemical properties of the oxides.
Practice 3-4	Obtaining and chemical behaviour of the *halógenos.
Practice 4-5	Obtaining and reactivity of compounds of the group 16.
Practice 6-7-8	Obtaining and reactivity of compounds of the group 15.
Practice 9-10	Obtaining and reactivity of compounds of the group 14.
Practice 11-12	Obtaining and reactivity of compounds of the group 13.

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	26	15	41
Troubleshooting and / or exercises	26	20	46
Laboratory practises	45.5	5.5	51
Long answer tests and development	4	70	74
Practical tests, real task execution and / or simulated.	3	10	13

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

Methodologies	
	Description
Master Session	Exhibition by part of the professor on the subject to develop, doing special *énfasis in the most important appearances or of difficult understanding for the student. The professor/to will use the platform *Tem@ to give information on the matter or on his development.
Troubleshooting and / or exercises	They will devote two weekly hours to argue and resolve questions on the matter that previously the student will have to work.
Laboratory practises	The experiments will realise along 13 sessions of 3,5 hours each one. The student will have of the scripts of practices as well as of the material of support in the platform *tem@ with the end that it can have previous knowledge of the experiments to realise. The student will have to elaborate the fascicle of laboratory during the realisation of the practices.

Personalized attention	
Methodologies	Description
Troubleshooting and / or exercises	

Assessment
------------

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

### Other comments and July evaluation

The assistance to the theoretical classes, practices of laboratory and seminars is compulsory.

The participation of the student in any of the acts of evaluation of the matter will involve the condition of "presented/to" and, therefore, the allocation of a qualification. They consider acts of evaluation the assistance to the practical classes of laboratory (three or more) and the realisation of proofs.

The students will be able to realise a Final Proof, that will be able to have a value of until a 60 %, in the date of closing of evaluation of the announcement of May-June when they require:

- Surpass any of the eliminatory proofs.
- Go up the note of the eliminatory proofs that allow him reach the minima required to approve the matter.
- Go up the note in the eliminatory proofs to improve the final note of the matter.

Announcement of July.

The students that do not surpass the matter at the end of the cuatrimestre will have to do a proof written in the period of closing of evaluation of the announcement of July. Said proof will substitute the results of the eliminatory proofs realised

along the cuatrimestre and will have a value of until a 60 %. The qualification of resolution of problems and practical of laboratory obtained to along the cuatrimestre keeps .

---

#### Sources of information

ATKINS, P.; OVERTON, T.; ROURKE, J.; WELLER, M. Y ARMSTRONG, F. , Inorganic Chemistry, Fifth Edition, Oxford, University Press, 2010

HOUSE, J. E. , Inorganic Chemistry, 2ª Ed, Elsevier. Burlinton, 2013

HOUSECROFT, C.E. Y SHARPE, A. G. , Inorganic Chemistry, 3ª Ed, Pearson. Harlow, 2013

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

RAYNER-CANHAM, G., OVERTON, T. , Descriptive Inorganic Chemistry, 5ª Ed, W.H. Freeman, 2010.

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

SHRIVER & ATKINS, Química Inorgánica, 4ª ed., McGraw-Hill, 2008

, , ,

---

#### Recommendations

---

##### Subjects that are recommended to be taken simultaneously

IT tools and communication in chemistry/V11G200V01401

Numerical methods in chemistry/V11G200V01402

Physical chemistry II/V11G200V01403

---

##### Subjects that it is recommended to have taken before

Chemistry, physics and biology: Integrated laboratory I/V11G200V01103

Chemistry, physics and geology: Integrated laboratory II/V11G200V01202

Chemistry: Chemistry I/V11G200V01105

Chemistry: Chemistry 2/V11G200V01204

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

Competencies		
Code		Typology
CB1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study	- know
CB2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study	- Know How
CB3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues	- Know How - Know be
CB4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences	- Know How - Know be
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances	- know - Know How
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	- know - Know How
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	- know - Know How
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	- Know How
CE20	Evaluate, interpret and synthesize data and chemical information	- Know How - Know be
CE24	Recognize and analyze new problems and plan strategies to solve them	- Know How - Know be
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know How - Know be
CT3	Learn independently	- Know How - Know be
CT4	Search and manage information from different sources	- Know How - Know be
CT5	Use information and communication technologies and manage basic computer tools	- Know How
CT7	Apply theoretical knowledge in practice	- Know How - Know be
CT8	Teamwork	- Know be
CT9	Work independently	- Know How - Know be
CT12	Plan and manage time properly	- Know be
CT13	Make decisions	- Know be

CT14 Analyze and synthesize information and draw conclusions	- Know How - Know be
CT15 Evaluate critically and constructively the environment and oneself	- Know be
CT16 Develop an ethical commitment	- Know be

### Learning outcomes

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

Understand the information provided by the different methods of X-ray diffraction.	CB2 CB3 CE4 CE12 CT3 CT4 CT9 CT13 CT14 CT15 CT16
Observe the presence of defects and disorder in solids.	CB1 CE4

## Contents

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

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	13	26	39
Troubleshooting and / or exercises	24	48	72
Practical tests, real task execution and / or simulated.	3	15	18
Jobs and projects	1	20	21

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

## Methodologies

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

## Personalized attention

Methodologies	Description
---------------	-------------

Troubleshooting and / or exercises Students may consult any doubt with the teaching staff of the subject in mentoring time.

Tests	Description
Jobs and projects	Students may consult any doubt with the teaching staff of the subject in mentoring time. In addition, students will be called individually or in small groups for mentoring of the work proposed.

## Assessment

	Description	Qualification	Evaluated Competences
Troubleshooting and / or exercises	In the different classes (lectures, seminars) the students will be given handouts with problems and/or exercises that will be used for their evaluation. Learning outcomes: (1). Describe the fundamental concepts of the methods for structural determination. (2). Analyse the information that, on the molecular structure, provide the different methods and understand their main limitations. (3). Predict the basic features of a particular spectrum for a given compound. (4). Describe the information supplied by the different methods of X-ray diffraction. (5). Observe at the microscopic level the presence of defects and disorder in the surface of solids.	20	CB1 CB2 CB3 CE4 CE8 CE12 CE19 CE20 CE24 CT7 CT8 CT13 CT15
Practical tests, real task execution and / or simulated.	There will be two short tests of about 1 hour duration in which the students will be asked to obtain structural information from experimental data (spectra and other physical data). The first tests covers chapters 1-3, and the second chapters 4-6. Learning outcomes: (1). Analyse the information that, on the molecular structure, provide the different methods and understand their main limitations. (2). Predict the basic features of a particular spectrum for a given compound. (3) Design the basic process to obtain a particular structural information of a compound. (4). Describe the information supplied by the different methods of X-ray diffraction. (5). Solve the molecular structure of a simple compound from its spectra (UV, IR, MS, NMR, X-Ray, etc).	45	CB1 CB2 CB3 CB4 CE8 CE12 CE19 CE20 CE24 CT3 CT7
Jobs and projects	The students will carry out a small project proposed by the professors of multidisciplinary spectroscopic nature. The results will be presented as a written report following the format of a scientific article. In addition, they might be asked to present the results orally. Learning outcomes:(1). Solve the molecular structure of a simple compound from its spectra (UV, IR, MS, NMR, X-Ray, etc).	35	CB1 CB2 CB3 CB4 CE4 CE8 CE12 CE19 CE20 CE24 CT1 CT4 CT5 CT9 CT12 CT14 CT16

## Other comments and July evaluation



To pass the course the students must handle the professor the following material: - A minimum of 80% of the handouts and homework proposed in the seminar classes.

- All the short tests.

- The final report.

To pass the course at the end of the quarter the students will be required to get a minimum of 5 points (on the basis of 10) in the final mark. Besides, it is indispensable to obtain in the evaluation of the different parts of the course the following minima: - 30% of the total value in each one of the short tests.

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

- 40% of the total value in the final report.

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

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

The students that fail at the end of the quartet will have to pass a final exam at the end of the academic year (June, July). Said proof will have a value of 45% of the final mark and will replace the results of the short tests. A minimum of 30% of the total value of the exam will be required to pass the course. The qualifications of the handouts and the project report are non-recoverable. In case the minima established in each part is not reached, the qualification will be FAILED. Once the minima is passed a global mark equal or higher than 5.0 (on the basis of 10) will be required to pass the course.

The final qualification of the students that pass the course will be normalised to 10 points.

---

#### Sources of information

Williams, D.H., Fleming, I., Spectroscopic Methods in Organic Chemistry, 6<sup>a</sup>, 2007

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

Pavia, D.L., Lampman, G.M., Kriz, G.S., Vyvyan, J.R., Introduction to Spectroscopy, 5<sup>a</sup>, 2014

Pretsch, Ernő, Structure determination of organic compounds : tables of spectral data, 4a, 2009

Clayden, Jonathan, Organic Chemistry, 2a, 2012

Web site: [www.spectroscopynow.com](http://www.spectroscopynow.com)

---

#### Recommendations

---

##### Subjects that it is recommended to have taken before

Geology: Geology/V11G200V01205

Chemistry: Chemistry I/V11G200V01105

Chemistry: Chemistry 2/V11G200V01204

Numerical methods in chemistry/V11G200V01402

Physical chemistry I/V11G200V01303

Physical chemistry II/V11G200V01403

Inorganic chemistry I/V11G200V01404

Organic chemistry I/V11G200V01304

---

##### Other comments

The students have to remember that to reach the competitions of the matter is indispensable to have purchased previously the following results of learning:

- Determination of the formal state of oxidation of a tie it to me inside a compound
  - Structures of the main functional groups in organic chemistry
  - Representation by means of structures of Lewis of organic substances
  - three-dimensional Structure of the organic substances in accordance with the model of orbital hybrid
  - Representation of reactions by means of diagrams of arrows
  - basic Concepts of spectroscopy
-

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

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

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

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

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

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	13	30	43
Troubleshooting and / or exercises	25	50	75
Laboratory practises	40	3	43
Autonomous troubleshooting and / or exercises	0	10	10
Presentations / exhibitions	5	5	10
Tutored works	1	10	11
Short answer tests	2	8	10
Long answer tests and development	3	20	23

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

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

Personalized attention	
Methodologies	Description

Troubleshooting and / or exercises	In the assigned hours of tutoring the professor will solve any doubts regarding the subject
Autonomous troubleshooting and / or exercises	In the assigned hours of tutoring the professor will solve any doubts regarding the subject
Tutored works	In the assigned hours of tutoring the professor will solve any doubts regarding the subject

### Assessment

	Description	Qualification Evaluated	Competences
Laboratory practises	The qualification will depend on the laboratory work and the laboratory report made by the students. Laboratory sessions are mandatory.	10	CE21 CE22 CE23 CE25 CE27 CE28 CE29 CT1 CT6 CT8 CT10 CT12 CT13 CT14 CT15
Presentations / exhibitions	The students will make an oral presentation related to laboratory work.	5	CE16 CE20 CE23 CT4 CT5 CT7 CT8 CT14
Autonomous troubleshooting and / or exercises	The students will have to deliver, in the terms indicated, the problems proposed of each subject.	5	CE1 CE16 CE19 CE22 CT3 CT7 CT9
Tutored works	The students will realise, and will deliver in the date indicated, an individual work on a subject proposed to the start of course.	5	CE1 CE16 CE20 CE23 CT1 CT3 CT14

Short answer tests	They will realise two short exams, one about the subjects 1 and 2 and another one about the subjects 3 and 4.	20	CE1 CE16 CE19 CT1 CT6 CT7 CT9
Long answer tests and development	At the end of the course the students have to do an exam related to all the subjects.	55	CE1 CE16 CE19 CT1 CT6 CT7 CT9

### Other comments and July evaluation

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

### Sources of information

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

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

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

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

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

### Recommendations

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

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



CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	- know - Know How - Know be
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	- know - Know How - Know be
CT1	Communicate orally and in writing in at least one of the official languages of the University	- know - Know How - Know be
CT3	Learn independently	- know - Know How - Know be
CT4	Search and manage information from different sources	- know - Know How - Know be
CT5	Use information and communication technologies and manage basic computer tools	- know - Know How - Know be
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	- know - Know How - Know be
CT7	Apply theoretical knowledge in practice	- know - Know How - Know be
CT8	Teamwork	- know - Know How - Know be
CT9	Work independently	- know - Know How - Know be
CT12	Plan and manage time properly	- know - Know How - Know be
CT13	Make decisions	- know - Know How - Know be
CT14	Analyze and synthesize information and draw conclusions	- know - Know How - Know be
CT15	Evaluate critically and constructively the environment and oneself	- know - Know How - Know be
CT17	Develop concern for environmental aspects and quality management	- know - Know How - Know be

### Learning outcomes

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

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

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

## Contents

Topic	Subject (QAII) description
General Introduction	Introduction
1-Introduction to the instrumental technicians	Classification of the instrumental techniques
	Quality parameters
	Instrumental methodology analysis
	Calibration
	Molecular absorption spectrophotometry UV-VIS: Principels, Instrumentation and applications

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

## Planning

	Class hours	Hours outside the classroom	Total hours
Troubleshooting and / or exercises	26	26	52
Laboratory practises	45.5	7	52.5
Master Session	26	26	52
Reports / memories of practice	0	38	38
Short answer tests	2	4	6
Long answer tests and development	3.5	10.5	14
Practical tests, real task execution and / or simulated.	3.5	7	10.5

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

## Methodologies

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

Personalized attention			
Methodologies		Description	
Troubleshooting and / or exercises			
Laboratory practises			
Tests		Description	
Reports / memories of practice			
Assessment			
	Description	Qualification Evaluated	Competences
Troubleshooting and / or exercises	The teacher will monitor the exercises given to students in seminars class. Scientific publication, practical situations will be discussed in seminars sessions and supervised by the teacher	10	CE4 CE8 CE18 CE29 CT1 CT6
Laboratory practises	The teacher will monitor the experimental work done by students in the lab sessions. It is REQUIRED to attend practical laboratory sessions to pass the course. Students who do not perform laboratory practices are considered FAIL throughout the cycle of evaluation of the course.	15	CE20 CE21 CE25 CE26 CE27 CE28 CT4 CT7 CT8 CT13
Reports / memories of practice	The student will prepare lab reports, which reflects the work performed in the laboratory. These reports must be submitted by the deadline and will be corrected by the teacher.	10	CE17 CE19 CE20 CE28 CE29 CT1 CT4 CT6 CT7 CT14
Short answer tests	The theoretical/practical short test will be used during semester evaluation. This test is not eliminatory and will contribute 10% of the final grade for the course.	10	CE4 CE8 CE18 CE19 CT1 CT3 CT6
Long answer tests and development	The exam (the test) will be performed at the end of the semester and contains a theoretical and theoretical-practical aspects. For compensation of subject , students must achieve at least 4.0 minimum score (4.0 minimum score in each part of the test).  ATTENTION: 3.0 is the minimal requirement in the final results achieve by the student for each long test corresponding to each teacher participate in the subject in order to carry out the weighting of overall examination. If you do not get this rating, the end result is FAIL	45	CE4 CE8 CE17 CE18 CE19 CT1 CT3 CT6 CT9

Practical tests, real task execution and / or simulated.	Laboratory test for each student will be made to assess their skills in the development of an experiment. This test is performed at the end of the lab sessions	10	CE20 CE21 CE25 CE26 CE27 CE28 CE29 CT1 CT6 CT7 CT9
--	---	----	--

### Other comments and July evaluation

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

### Sources of information

Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Principios de análisis instrumental, 6ª, Cengage Learning  
Lucas Hernández Hernández, Claudio González Pérez, Introducción al análisis instrumental, 1ª, Editorial Ariel  
Satinder Ahuja, Neil D. Jespersen, Modern instrumental analysis, 1ª, Elsevier  
James W. Robinson, Eileen M. Skelly Frame, George M. Frame, Undergraduate instrumental analysis, 6ª, Marcel Dekker  
Donald T. Sawyer; William R. Heineman; Janice M. Beebe, Chemistry Experiments for Instrumental Methods, 1ª, Wiley  
Rouessac, Annick Rouessac, Chemical Analysis: Modern Instrumentation Methods and Techniques, 6ª, Wiley

### Recommendations

#### Subjects that continue the syllabus

Analytical chemistry 3/V11G200V01601

#### Subjects that are recommended to be taken simultaneously

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

#### Subjects that it is recommended to have taken before

Chemistry, physics and biology: Integrated laboratory I/V11G200V01103  
Chemistry, physics and geology: Integrated laboratory II/V11G200V01202  
Chemistry: Chemistry I/V11G200V01105  
Chemistry: Chemistry 2/V11G200V01204  
Numerical methods in chemistry/V11G200V01402  
Analytical chemistry I/V11G200V01302

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

Competencies		
Code		Typology
CB1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study	- know
CB2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study	
CB3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues	- Know How
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	- Know How
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	- know - Know How
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	- know - Know How
CE10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds	- know - Know How
CE11	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: nature and behavior of functional groups in organic molecules	- know - Know How
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	- know - Know How
CE13	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main synthetic routes in organic chemistry, including interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds	- know - Know How
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	- know - Know How
CE20	Evaluate, interpret and synthesize data and chemical information	- know - Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	- know - Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- know - Know How
CT3	Learn independently	- know - Know How

CT4 Search and manage information from different sources	- know - Know How
CT5 Use information and communication technologies and manage basic computer tools	- know - Know How
CT8 Teamwork	- Know How - Know be
CT9 Work independently	- Know How - Know be
CT12 Plan and manage time properly	- Know How - Know be
CT13 Make decisions	- Know How - Know be
CT14 Analyze and synthesize information and draw conclusions	- Know How

### Learning outcomes

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



Differentiate, according to the conditions of reaction and the \*sustratos used, the mechanisms of replacement \*nucleófila \*SN1 and \*SN2.

CE2  
CE11  
CE12  
CE13  
CT1  
CT3  
CT4  
CT5  
CT8  
CT9  
CT12  
CT13  
CT14

Apply the processes of replacement \*nucleófila on carbons \*sp3 in the obtaining of organic compounds with simple links.

CE2  
CE11  
CE12  
CE13  
CT1  
CT3  
CT4  
CT5  
CT8  
CT9  
CT12  
CT13  
CT14

\*Predecir The possible competition between the processes of replacement \*nucleófila and elimination for a \*sustrato given.

CE11  
CE12  
CE13  
CT1  
CT3  
CT4  
CT5  
CT8  
CT9  
CT12  
CT13  
CT14

Apply the reactivity of \*enoles and \*enolatos.

CE11  
CE12  
CE13  
CT1  
CT3  
CT4  
CT5  
CT8  
CT9  
CT12  
CT13  
CT14

Apply the processes of elimination in the preparation of organic compounds with multiple links.

CE11  
CE12  
CE13  
CT1  
CT3  
CT4  
CT5  
CT8  
CT9  
CT12  
CT13  
CT14

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

Apply the reactions \*pericíclicas to the organic synthesis.

CE2  
CE11  
CE13  
CT1  
CT3  
CT4  
CT5  
CT8  
CT9  
CT12  
CT13  
CT14

(\*)Characterize \*compuestos organic \*sencillos from \*sus \*datos espectroscópicos.

CE8  
CE11  
CE19  
CE20  
CE23  
CT1  
CT3  
CT4  
CT5  
CT8  
CT12  
CT13  
CT14

## Contents

### Topic

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

## Planning

	Class hours	Hours outside the classroom	Total hours
Tutored works	2	2	4
Master Session	26	31	57
Seminars	24	45	69

Short answer tests	3	6	9
Long answer tests and development	3	8	11

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

## Methodologies

	Description
Tutored works	The student, of individual form or in group, will prepare a short exhibition on a subject *relacionado with the matter. This activity includes the research of information, editorial and presentation of the work.
Master Session	The sessions *magistrales will consist in the exhibition by part of the professor of the fundamental appearances of each subject. Before each session, the student will have to work the material that the professor will facilitate him through the platform FEAR, related with the content that will treat in each session.
Seminars	The students, with the support of the professor, will resolve exercises and questions previously proposed in Bulletins, related with the theoretical contents. A selection of the exercises will be delivered regularly to the professor for his evaluation.

## Personalized attention

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

## Assessment

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

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

## Other comments and July evaluation

### IMPORTANT NOTES:

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

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

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

### EVALUATION IN THE ANNOUNCEMENT OF JULIO:

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

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

2. Proof written: Máximo 7.0 points.

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

## Sources of information

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

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

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

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

'''

## Recommendations

### Subjects that continue the syllabus

Organic chemistry III/V11G200V01704

### Subjects that are recommended to be taken simultaneously

Structural Determination/V11G200V01501

Chemical engineering/V11G200V01502

Analytical chemistry II/V11G200V01503

### Subjects that it is recommended to have taken before

Chemistry: Chemistry I/V11G200V01105

Chemistry: Chemistry 2/V11G200V01204

Organic chemistry I/V11G200V01304

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

Competencies		
Code		Typology
CB1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study	- know
CB2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study	- Know How
CB3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues	- Know How
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances	- know
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	
CE17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management	- know
CE18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry	- know
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	- Know How
CE20	Evaluate, interpret and synthesize data and chemical information	
CE22	Process and perform computational calculations with chemical information and chemical data	- Know How
CE24	Recognize and analyze new problems and plan strategies to solve them	- Know How
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy	
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know be
CT3	Learn independently	- Know be
CT4	Search and manage information from different sources	- Know How
CT5	Use information and communication technologies and manage basic computer tools	- Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	- Know How
CT7	Apply theoretical knowledge in practice	- Know How
CT8	Teamwork	- Know be
CT9	Work independently	- Know be

CT12 Plan and manage time properly	- Know be
CT13 Make decisions	- Know be
CT14 Analyze and synthesize information and draw conclusions	- Know How
CT17 Develop concern for environmental aspects and quality management	- Know be

### Learning outcomes

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



3. Evaluate and interpret the analytical results of systems *multicomponentes and *multivariables.	CB1 CB2 CB3 CE4 CE17 CE20 CE22 CT1 CT3 CT5 CT6 CT7 CT8 CT9 CT13 CT17
6. Recognise the different methods of treatment of sample as well as evaluate his possibilities in the resolution of diverse analytical problems inside the field of the analysis of trace.	CB1 CB2 CE4 CE19 CE20 CT1 CT3 CT4 CT7 CT9 CT12 CT13 CT14 CT17
5. Describe the planning of the sampling and the factors that take part in him for the analysis of trace.	CB1 CE4 CE17 CE24 CT1 CT3 CT4 CT6 CT7 CT9 CT12 CT13 CT17
7. Compare and value the different methods of existent extraction in the actuality, like the extraction by fluent *supercríticos, in solid phase, *microextracción, etc.	CB1 CB2 CE4 CE19 CE20 CT1 CT3 CT8 CT9 CT12 CT14 CT17
8. Describe the analytical methodology and instrumentation as well as know the applications of technicians of general use in analysis of trace like the voltammetry of *redisolución *anódica, spectrometry of atomic absorption with atomisation *electrotérmica, spectrometry of masses with source of plasma and the different attachments between the chromatography and the spectrometry of masses.	CB1 CE4 CE8 CE18 CE19 CT1 CT3 CT4 CT8 CT9

9. Classify the different types of automatic systems and *miniaturizados, establishing his advantages and inconvenient, modalities and applications more notable and of immediate future. Justify the automation in the different stages of the analytical process.	CB1 CB2 CE4 CE17 CE20 CT1 CT3 CT4 CT5 CT8 CT9 CT17
10. Explain the foundations of the sensors and *biosensores chemical, as well as his more important applications. Explain and value the importance of the utilisation of the sensors for the fast and reliable obtaining of analytical information.	CB1 CB2 CB3 CE4 CE17 CE20 CT1 CT3 CT4 CT8 CT9 CT12
11. Describe the characteristics of the continuous automatic analysers, discontinuous and *robotizados. Know the phenomena of dispersion in continuous analysers of injection in flow and of sequential injection, as well as the form to characterise them.	CB1 CE4 CE17 CE19 CE20 CT1 CT3 CT4 CT5 CT8 CT9 CT14 CT17
12. Explain the construction of analytical tools in miniature and his applications.	CB1 CE4 CE17 CE19 CT1 CT3 CT4 CT5 CT9 CT12 CT14

## Contents

Topic	
SUBJECT 1. Analysis of trace	Concept and importance of the analysis of trace. Sources of pollution in the laboratory. Experimental methods in analysis of trace. Sampling. Methods of decomposition in analysis of trace inorganic. Methods of extraction in analysis of trace organic. Techniques selected of analysis of trace.
SUBJECT 2. Automation	Automation in the laboratory of analysis: generalities. Automatic analysers. Discontinuous analysers, continuous and *robotizados. Analysers of injection in flow and flow *segmentado: characteristics. Phenomena of dispersion. Characteristics of the signal of injection in flow. Techniques of gradient. Analysers of sequential injection. Instrumentation and applications.
SUBJECT 3. Sensors and *biosensores chemical	Concept of sensor. Components of a chemical sensor. Classification. Sensors and *biosensores. Elements of recognition. Types of *transductores. (*Bio)Electrochemical and optical sensors. Applications of interest. Miniaturisation of analytical systems.

SUBJECT 4. Introduction to the Chemometrics	Definition and historical evolution of the Chemometrics. The chemometrics in the different stages of the analytical process. Basic statistical concepts. Parameters that estimate the central value and the dispersion: parametric and no parametric. Properties of the variance and the average. Expression of analytical results.
SUBJECT 5. Basic chemometrics: comparison of analytical results	Test of significance. Proofs of hypothesis: structure of the proofs of hypothesis. Errors type I and II. Probability. Rejection of anomalous results. Parametric proofs of comparison of two variances. Parametric proofs of comparison of two averages. Comparison of several half *muestras by means of *ANOVA of a road. Control of the accuracy and precision over time: charts of control. Proofs no parametric.
SUBJECT 6. The quality in the analytical laboratories: *cualimetría.	Introduction to the *cualimetría: quality and chemometrics. Quality and analytical properties: validation of analytical methods. *Trazabilidad. Generic approximation to the quality. Systems of quality: Norms ISO. Accreditation and certification of the laboratories.

## Planning

	Class hours	Hours outside the classroom	Total hours
Seminars	13	26	39
Tutored works	0	9	9
Master Session	26	52	78
Short answer tests	2	4	6
Short answer tests	2	4	6
Long answer tests and development	4	8	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 the classes of seminar will reinforce the learning of the *temario explained during the sessions *magistrales, carrying out the resolution of numerical problems and theoretical exercises-practical. The professor will propose, of regular form, different problems/exercises that will be resolved of individual form by the student and delivered for his evaluation.
Tutored works	It will provide to the student a series of articles published in magazines of education in Chemistry and related with the contents of the matter. Once studied the article, the student will have to answer to a questionnaire of questions provided by the professor.
Master Session	The professor will develop the contents of the program from the proportionate material to the student through the platform FEAR. In the sessions *magistrales, the professor will present the fundamental appearances of the matter that will have to complement by means of the bibliography recommended.

## Personalized attention

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

## Assessment

Description	Qualification Evaluated Competences
-------------	-------------------------------------

Seminars	In the classes of seminar, the professor will resolve part of the problems/exercises, leaving others to be resolved by the student. The delivery of the problems/exercises resolved is compulsory. To be able to evaluate is activity, the student will have to carry out at least 75% of the deliveries. Besides it will be necessary to obtain a minimum punctuation of 3 on 10 points so that the qualification of this activity can add to the rest of elements of evaluation.	10	CB1 CB2 CB3 CE4 CE8 CE17 CE18 CE19 CE20 CE22 CT6 CT7 CT9 CT12 CT14
Tutored works	The realisation of the works is compulsory. So that this activity can be evaluated, the student will have to carry out at least 75% of the deliveries. Besides it will be necessary to obtain a minimum punctuation of 3 on 10 points so that the qualification of this activity can add to the rest of elements of evaluation.	5	CB1 CB2 CB3 CE4 CE8 CE17 CE18 CE19 CE20 CE24 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT14 CT17
Short answer tests	It will effect a first short proof on the subjects 1, 2 and 3, roughly to half of the *cuatrimestre. The short proof will be able to consist in questions of short answer, problems and ask type test. The presentation to this proof *inhabilita to the student to obtain the qualification of no presented.	20	CB1 CB2 CB3 CE4 CE8 CE17 CE18 CE19 CE20 CT1 CT6 CT7 CT9 CT12 CT13 CT14

Short answer tests	It will effect a second short proof on the subjects 4, 5 and 6 to the end of the *cuatrimestre. The short proof will be able to consist in questions, problems and exercises. The presentation to this proof *inhabilita to the student to obtain the qualification of no presented.	25	CB1 CB2 CB3 CE4 CE17 CE19 CE20 CE22 CE24 CT1 CT6 CT7 CT9 CT12 CT13 CT14
Long answer tests and development	Compulsory final examination. It will consist in a global proof of the *temario that will include problems, exercises and ask type test. It will be necessary to obtain 3 points on 10 in this examination so that the qualification can add to the one of the rest of elements of evaluation.	40	CB1 CB2 CB3 CE4 CE8 CE17 CE18 CE19 CE20 CE22 CE24 CT1 CT6 CT7 CT9 CT12 CT13 CT14

### Other comments and July evaluation

The participation of the student in any one of the activities evaluated (deliveries of problems and exercises, proofs of short answer) \*inhabilita to the student to obtain the qualification of NO PRESENTED.&\*nbsp;ANNOUNCEMENT OF JULIO:The qualification in this announcement will be formed by two components:1. Punctuations obtained by the student during the course (maximum 5 points)&\*nbsp;they will keep the qualifications in the works \*tutelados (maximum 0.5 points), problems/exercises resolved (maximum 1 point) and short proofs (maximum 3.5 points).2. Global written proof of the contents of the matter (maximum 5 points)This proof will include problems, exercises and ask type test. To be able to approve in this announcement, the student has to obtain at least 3 points on 10 in this proof.The presentation to this proof \*inhabilita to the student to obtain the qualification of NO presented.

### Sources of information

G. Ramis Ramos; M.C. Álvarez Coque, Quimiometría, Síntesis, 2001  
J.C. Miller; J.N. Miller, Estadística y Quimiometría para Química Analítica, Prentice-Hall, 2002  
R. Compañó Beltrán; R. Ríos Castro, Garantía de calidad en los laboratorios analíticos, Síntesis, 2002  
C. Cámara , Toma y tratamiento de muestras, Síntesis, 2002  
R. Cela, Técnicas de separación en Química Analítica, Síntesis, 2002  
S. Mitra, Sample preparation techniques in analytical chemistry, Wiley, 2003  
B.R. Eggins, Chemical sensors and biosensors, Wiley, 2002  
C. Cámara , Análisis químico de trazas, Síntesis, 2011

L. Hernández, Introducción al análisis instrumental, Ariel, 2002

---

K.A. Robinson, Análisis Instrumental, Prentice-Hall, 2000

---

Skoog, Principios de Análisis Instrumental, McGraw-Hill, 2001

---

Kellner, Analytical Chemistry, Wiley-VCH, 2004

---

Valcárcel, Automatización y miniaturización en Química Analítica, Springer, 2000

---

---

## **Recommendations**

---

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

---

Analytical chemistry I/V11G200V01302

---

Analytical chemistry II/V11G200V01503

---

IDENTIFYING DATA				
<b>Biological chemistry</b>				
Subject	Biological chemistry			
Code	V11G200V01602			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	Valverde Pérez, Diana			
Lecturers	Pérez Cid, Benita Silva López, Carlos Suarez Alonso, Maria del Pilar Valverde Pérez, Diana			
E-mail	dianaval@uvigo.es			
Web				
General description	Introductory course of Biochemistry, global and integrated knowledge of the molecular mechanisms responsible of biological processes.			

Competencies		
Code		Typology
CB1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study	- know
CB2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study	- Know How
CB3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues	- know
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	- know
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances	- know
CE15	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: chemistry of biological molecules and their processes	- know
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	- Know How
CE21	Recognize and implement good scientific practices for measurement and experimentation	- Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	- know
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	- know
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work	- Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	- Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	- Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know be
CT3	Learn independently	- Know be
CT4	Search and manage information from different sources	- Know be
CT5	Use information and communication technologies and manage basic computer tools	- Know How
CT7	Apply theoretical knowledge in practice	- Know How
CT8	Teamwork	- Know be
CT9	Work independently	- Know be
CT12	Plan and manage time properly	- Know be
CT13	Make decisions	- know

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

### Learning outcomes

Learning outcomes	Competences
Identify and recognise the structure of the distinct types of biomolecules and represent them properly	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Identify and recognise the properties and chemical reactivity of the diverse types of biomolecules	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Recognise the distinct biological activities of the diverse types of biomolecules	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Define the kinetical enzymatic of reactions catalized by enzymes as well as their general mechanisms	CB1 CB3 CE4 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15



Recognise the distinct types of inhibition of the enzymatic activity and his quantification	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Relate the vitamins with the corresponding coenzymes of enzymatic reactions	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Explain the concept of Bioenergy. Importance of endergonic and exergonic process in the biological systems	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Enumerate the main structural appearances of the ATP that determine his paper in the transfer of energy. Describe the cycle of the ATP.	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Distinguish the metabolic roads of the biomolecules, as well as their interrelationships and regulation	CB1 CB3 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Explain the fundamentals of the current technics of proteomics and molecular biology in relation with the isolation, separation, purification, determination, identification and manipulation of proteins and nucleic acids	CB1 CB2 CB3 CE4 CE15 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Apply experimentally some basic technicians in Biochemistry	CB1 CB2 CB3 CE4 CE15 CE19 CE21 CE23 CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Distinguish the main operations involved in the commercial production of biomolecules, as well as his foundations	CB1 CB2 CB3 CB5 CE15 CE21 CE23 CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Recognise the possible practical applications of biomolecules, with special emphasis in the characteristic operational conditions	CB1 CB2 CB3 CB5 CE15 CE19 CE21 CE23 CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Justify the application of the distinct instrumental technics in the analysis of biomolecules	CB2 CB3 CE4 CE15 CE19 CE21 CE23 CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15

Distinguish analytical protocols of application of the previously mentioned technis to the analysis of biomolecules in diverse areas (clinical, pharmaceutical, biomedical, etc.)

CB1  
CB2  
CB3  
CB5  
CE4  
CE15  
CE19  
CE21  
CE23  
CE25  
CE26  
CE27  
CE28  
CT1  
CT3  
CT4  
CT5  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

## Contents

### Topic

1.Biomolecules	Carbohydrates: Classification and structure. Lipids: Classification and structure. Biological functions of the lipids. Proteins: Structure and configuration of the proteins. Relation structure -function. Nucleic Acids: Structure and function.
2.Biocatalisis	Nomenclature and classification of the enzymes Enzymatic Kinetics Mechanisms of the enzymatic reactions Effect of the temperature in the enzymatic reaction and inhibition Quantification of the enzymatic activity. Allosteric enzymes
3.Vitamins and coenzymes	Structure and role in metabolic reactions
4.Metabolism of glucides	Degradative Metabolism of glucides: glycolysis. Metabolic crossroad of pyruvate. Degradative Oxidation of acetyl-CoA. Respiratory chain and oxidative phosphorylation. Oxidative Route of the pentoses phosphate. Gluconeogenesis. Metabolism of glycogen.
5. Metabolism of lipids	Degradation of lipids: oxidation of fatty acids . Biosynthesis of fatty acids.
6. Metabolism of proteins	Proteolysis. Degradation of amino acids. Destination of the ion ammonium. Biosynthesis of amino acids.
7.Metabolism of nucleotides	Degradation of nucleic acids and nucleotides. Biosynthesis of nucleotides.
8.Experimental methods in Biochemistry	Technics for synthesis and isolation of biomolécules Separation, determination and identification of proteins Determination and quantification of lipids Determination and quantification of glycogen Evaluation of the enzymatic activity. Effect of the temperature and inhibition Polymerase chain reaction. Utilisation of restriction enzymes

## Planning

	Class hours	Hours outside the classroom	Total hours
Seminars	13	19.5	32.5

Laboratory practises	45.5	68.25	113.75
Troubleshooting and / or exercises	3	3	6
Master Session	26	26	52
Short answer tests	6	9	15
Practical tests, real task execution and / or simulated.	2.3	3.45	5.75

\*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 formulate , they argue and they resolve questions, related with the matter.
Laboratory practises	They will propose questions practise, to resolve in the laboratory.
Troubleshooting and / or exercises	Activity in which they formulate problems and/or exercises related with the matter. The student has to develop the suitable or correct solutions by means of the realisation of routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. It is used to employ as I complement of the magistral lesson.
Master Session	Exhibition by the professor of the contents on the matter object of study, theoretical bases and/or guidelines of a work, exercise or project to develop by the student.

### Personalized attention

Methodologies	Description
Seminars	The professor will resolve the doubts of the students for the good development of the activities proposed
Laboratory practises	The professor will resolve the doubts of the students for the good development of the activities proposed
Troubleshooting and / or exercises	The professor will resolve the doubts of the students for the good development of the activities proposed

### Assessment

	Description	Qualification Evaluated	Competencess
Seminars	It will value the participation in the seminars and in the discussions that propose in him	20	CE4 CE15 CE19 CE23 CT3 CT4 CT8 CT12 CT14 CT15

Laboratory practises	It will value the assistance to practise them, the development of the same, the delivery of a memory of practise.	35	CB1 CB2 CB3 CB5 CE15 CE19 CE21 CE25 CE26 CE27 CE28 CT3 CT7 CT9 CT12 CT13 CT14
Short answer tests	They will realise 2 controls with a value of 15% each one of the proofs and a final examination .	45	CB1 CB3 CE4 CE15 CT1 CT3 CT4 CT9 CT12 CT14

### Other comments and July evaluation

The note of the controls will have eliminatory character, as long as it reach the minimum value of 5.&nbsp;To surpass the matter the professor has to have in time and form of a minimum of 80% of the work requested to the student. It will be necessary to take out a 5 in the theoretical proofs of the matter to be able to take into account the rest of the elements of evaluation in the matter. In case of not reaching the necessary minimum, the final note will be the note that appears in the final examination. The no realisation of any control along the course and the no assistance to the final examination will be considered how no presented. The final qualification of the students approved will be able to be normalised, so that the qualification but high will be of until 10 points. The professor will realise a follow-up of the experimental work realised by the student in the sessions of laboratory; as well as of the fascicle/ inform elaborated. The assistance to practices is compulsory. An inferior assistance to 75% of the practical sessions supposes the qualification of suspense in the matter. For the evaluation of Julio will realise one tests writing that will be he 45% of the evaluation of the matter, will keep the qualification obtained so much in practices as in seminars.

### Sources of information

Stryer L., Berg J. M. & Tymoczko J. L. , Bioquímica, Editorial Reverté 7ª edición, 2012  
 Lehninger, Nelson D. L. & Cox M. M., Principios de Bioquímica, Editorial Omega 4ª edición, 2009  
 McKee and McKee , Bioquímica, Ediciones McGraw Hill 5ª edición, 2014  
 Vollhardt, K.P.C., Schore, N.E., Química Orgánica, 5ª, 2008  
 Andreas Manz, Nicole Pamme, Dimitri Lossifidis, Bioanalytical Chemistry, Imperial College Press, 2004  
 Victor A. Gault and Neville H. McClenaghan, Understanding Bioanalytical Chemistry: principles and Applications, Wiley Blackwell, 2009  
 Feduchi, Blasco, Romero, Yañez, Bioquímica, Panamericana, 2010  
 John Kuriyan, Boyana Konforti, David Wemmer, The Molecules of Life, Garland Science, 2012

### Recommendations

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

---

Analytical chemistry I/V11G200V01302

Organic chemistry I/V11G200V01304

Organic chemistry II/V11G200V01504

---

IDENTIFYING DATA				
Physical chemistry III				
Subject	Physical chemistry III			
Code	V11G200V01603			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	3rd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Bravo Díaz, Carlos Daniel			
Lecturers	Bravo Díaz, Carlos Daniel Fernández Nóvoa, Alejandro			
E-mail	cbravo@uvigo.es			
Web	<a href="http://fatic.uvigo.es/">http://fatic.uvigo.es/</a>			
General description	The matter provides training in applications of Physical Chemistry of great importance, like Chemical Kinetics, including Catálisis, surface phenomena, Macromolecules and Colloids as well as some foundations of Electrochemistry.			

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

Learning outcomes	
Learning outcomes	Competences



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

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

## Contents

### Topic

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

(*)Theoretical interpretation of the speed of reaction.	(*)Theory of collisions for reactions *bimoleculares. Theory of the state of transition.
(*)Macromolecules.	(*)Structure of the macromolecules. Structural models. Characterisation of macromolecules.
(*)Colloids.	(*)Classification of the systems *coloidales. Synthesis and characterisation of colloids. Stability of systems *coloidales.
(*)Catálisis.	(*)General mechanism of the *catálisis. *Catálisis *homogénea. *Catálisis Heterogeneous.
(*)Kinetical *electrónica.	(*)Stages of a process *electrónico. *Sobrepotenciales. *Sobrepotencial Of transfer of load. *Sobrepotencial Of diffusion. *Sobrepotenciales Of reaction and crystallisation. Experimental technicians.
(*)Practical.	(*)Experiences of Kinetical Chemical including *Catálisi, Phenomena of Transport, Electrochemical Macromolecules and Colloids.

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	26	0	26
Seminars	13	65	78
Laboratory practises	45.5	32.5	78
Short answer tests	1	5	6
Short answer tests	1	5	6
Long answer tests and development	3	15	18
Reports / memories of practice	0	6	6
Troubleshooting and / or exercises	0	7	7

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

## Methodologies

	Description
Master Session	Lesson by the method *expositivo *desarrollada in a classroom. They can pose simple exercises *directamente related *on the explanation.
Seminars	Approach, analysis and discussion of problems and questions of some complexity.
Laboratory practises	Practices of laboratory in the usual format

## Personalized attention

Methodologies	Description
Master Session	Resolution of doubts on the proportionate explanations in classes.
Seminars	Resolution of doubts on the proportionate explanations in classes.
Laboratory practises	Resolution of doubts on the proportionate explanations in classes of laboratory

Tests	Description
Reports / memories of practice	Resolution of doubts on the preparation and preparation of reports of laboratory.
Troubleshooting and / or exercises	Resolution of doubts on the *problemas and/or questions provided in classes.

## Assessment

	Description	Qualification Evaluated	Competences
Seminars	It values presentation and discussion of exercises *entregables	20	CE7 CE14 CE19 CE23 CT1 CT6 CT7 CT14

Laboratory practises	Realisation of practices of laboratory; when finalising the practices will realise a short proof on the concepts in which they base the same.	15	CE19 CE20 CE21 CE22 CE23 CE26 CE27 CE28 CE29
Short answer tests	Qualification of consistent short proof in questions or short problems	10	CE7 CE14 CE19 CE23 CT1 CT7
Short answer tests	Qualification of the second consistent short proof in questions or short problems.	10	CE7 CE14 CE19 CE23 CT1 CT7
Long answer tests and development	Qualification of the final examination. Questions and numerical problems.	40	CE7 CE14 CE19 CE23 CE28 CT1 CT7
Reports / memories of practice	Qualification of the report of practices, calculations, presentation of results and discussion of the same.	5	CE19 CE20 CE21 CE22 CE23 CE28 CE29

#### Other comments and July evaluation

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

The notes of the seminars and practical of laboratory will keep for the second evaluation. Under special circumstances, could require the preparation of "entregables" to improve the qualification obtained during the first evaluation.

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

#### Sources of information

I.N. LEVINE, Physical Chemistry, 6ª, 2009

P.W. ATKINS y J. DE PAULA, Physical Chemistry, 10ª, 2014

T. ENGEL y P.J. REID, Physical Chemistry, 3ª, 2014

K. J. LAIDLER, Chemical Kinetics, 3ª, 1987

A. HORTA, Macromoléculas (2 vols), 2ª, 1984

S. SENENT, Química Física II, 3ª, 2000

J. Bertrán y J. Núñez (coords.), Química Física (2 vols), 1ª, 2002

---

## **Recommendations**

### **Subjects that are recommended to be taken simultaneously**

Analytical chemistry 3/V11G200V01601

Inorganic chemistry II/V11G200V01604

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

Physical chemistry I/V11G200V01303

Physical chemistry II/V11G200V01403

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

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

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

Rationalize the thermodynamic stability of coordination compounds, depending on the oxidation state of the metal and the type of ligand.

CE9  
CE12  
CE14

## Contents

### Topic

Subject 1: Introduction to the Chemistry of the transition metals.	Physical properties. Electronic configuration. multielectronic systems Spectroscopic terms. Reactivity and properties
Subject 2: Coordination chemistry.	Coordination numbers and geometries. Type of ligands. Isomers in coordination chemistry. Nomenclature.
Subject 3: Bonding in the coordination compounds (I):	Crystal field theory. Weak and strong field complexes in octahedral complexes. Tetrahedral square-plane complexes.
Subject 4: Bonding in the coordination compounds (II):	Molecular orbital theory in octahedral complexes. The metal-ligand interaction.
Subject 5: Spectroscopical and magnetic properties in metal complexes.	Energy states. Selection rules. Characteristics of the electronic spectra, Magnetic behavior.
Subject 6: Thermodynamic properties of the coordination compounds.	Stability constants and factors that affect them. Chelate, macrocycle and cryptate effect.
Subject 7: Mechanisms of reaction in coordination compounds.	Substitution reactions of *sustitución in square-plane and octahedral complexes. Electronic transfe.
Subject 8: Chemistry of the transitional metals	Global aspects. Frost diagrams. General methods of obtention and purification of the metals.
Subject 9: Chemistry of the 3 and 5 groups metals.	Extraction and uses. Oxidation states. Representative compounds of titanium: halides, oxides and mixed oxides. Coordination Compounds.
Subject 10: Chemistry of the 5 group metals.	Extraction and uses. Oxidation states. Representative compounds of vanadium: halides, oxides and oxoanions. Coordination Compounds.
Subject 11: Chemistry of the 6 group metals.	Extraction and uses. Oxidation states. Representative compounds of chromium: halides, oxides and oxoanions. Coordination Compounds.
Subject 12: Chemistry of the 7 group metals.	Extraction and uses. Oxidation states. Representative compounds of manganese: halides, oxides and oxoanions. Coordination Compounds. Bioinorganic chemistry of the manganese and technetium.
Subject 13: Chemistry of the 8 group metals.	Extraction and uses. Oxidation states. Representative compounds of iron: halides, oxides and mixture oxides. Coordination Compounds. Bioinorganic chemistry of iron.
Subject 14: Chemistry of the 9 group metals.	Extraction and uses. Oxidation states. Representative compounds of cobalt: halides, oxides and coordination compounds. Bioinorganic chemistry of cobalt.
Subject 15: Chemistry of the 10 group metals.	Extraction and uses. Oxidation states. Representative compounds of nickel: halides, oxides and coordination compounds. Bioinorganic chemistry of platinum.

Subject 16: Chemistry of the 11 group metals.	Extraction and uses. Oxidation states. Representative compounds of copper: halides, óxides and coordination compounds. Bioinorganic chemistry of copper and gold.
Subject 17: Chemistry of the 12 group metals.	Extraction and uses. Oxidation states. Representative compounds of zinc and mercury: halides, oxides and coordination compounds. Bioinorganic chemistry of the elements of the group.

Planning			
	Class hours	Hours outside the classroom	Total hours
Seminars	26	26	52
Master Session	26	39	65
Short answer tests	2	2	4
Troubleshooting and / or exercises	0	21	21
Long answer tests and development	4	4	8

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

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

Personalized attention	
Methodologies	Description
Master Session	Throughout the educational period students can consult any doubts on the matter tutorials or previous appointment.
Seminars	Throughout the educational period students can consult any doubts on the matter tutorials or previous appointment.

Assessment			
	Description	Qualification	Evaluated Competencess
Master Session	In the lectures they may ask students to solve simple issues that will have to deliver at that time and will serve for the evaluation. The score will be considered only if the test is long reaches a score of 3 or above on 10 points.	5	CE2 CE7 CE8 CE12
Seminars	In the lectures they may ask students to solve simple issues that will have to deliver at that time and will serve for the evaluation. The score will be considered only if the test is long reaches a score of 3 or above on 10 points.	10	CE2 CE7 CE8 CE12 CE14
Short answer tests	There will be two short tests throughout the school period of 1-2 hours each. The score will be considered only if the test is long reaches a score greater than or equal to 3 points out of 10.	30	CE2 CE7 CE8 CE9 CE12 CE14



Troubleshooting and / or exercises	Throughout the course they ask students to do exercises to perform such work. The solutions must be submitted in a timely manner previously established. It is possible that the teacher ask the student to defend his response delivered before proceeding with the assessment. The score will be considered only if the test is long reaches a score greater than or equal to 3 points out of 10.	15	CE2 CE7 CE8 CE9 CE12 CE14
Long answer tests and development	There will be a test at the end of the semester in which students must resolve all issues related to the presented contents.	40	CE2 CE7 CE8 CE9 CE12 CE14

### Other comments and July evaluation

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

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

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

A student who performs over 20% of the total planned work or take any of the tests will be graded in accordance with the current regulations and, therefore, may not be in the act of qualifying NOT PRESENTED.

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

The final of the students, to be more than 7 points can be normalized so that the highest score can be up to 10 points.

### Sources of information

Housecroft, C.E. e Sharpe, A.G., Inorganic chemistry, 3<sup>rd</sup> Ed.,

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

Housecroft, Catherine E., The Heavier d-block metals : aspects of inorganic and coordination chemistry , Oxford : Oxford University Press, 1999 ,

Atkins, Peter, Inorganic Chemistry, Oxford : Oxford University Press, 2010,

Housecroft, C.E. e Sharpe, A. G., Inorganic chemistry , 4<sup>th</sup> ed.,

### Recommendations

#### Subjects that continue the syllabus

Materials chemistry/V11G200V01702

Inorganic chemistry III/V11G200V01703

#### Subjects that it is recommended to have taken before

Chemistry: Chemistry I/V11G200V01105

Chemistry: Chemistry 2/V11G200V01204

Physical chemistry I/V11G200V01303

Physical chemistry II/V11G200V01403

Inorganic chemistry I/V11G200V01404

IDENTIFYING DATA				
Project				
Subject	Project			
Code	V11G200V01701			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	Spanish			
Department				
Coordinator	González de Prado, Begoña			
Lecturers	González de Prado, Begoña			
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		Typology
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	- know - Know How
CE20	Evaluate, interpret and synthesize data and chemical information	- know - Know How
CE22	Process and perform computational calculations with chemical information and chemical data	- Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	- Know How
CE24	Recognize and analyze new problems and plan strategies to solve them	- know - Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know How
CT3	Learn independently	- Know How
CT4	Search and manage information from different sources	- Know How
CT5	Use information and communication technologies and manage basic computer tools	- Know How
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations	- know - Know How
CT7	Apply theoretical knowledge in practice	- know - Know How
CT8	Teamwork	- Know How
CT9	Work independently	- Know How
CT12	Plan and manage time properly	- Know How
CT13	Make decisions	- Know How
CT14	Analyze and synthesize information and draw conclusions	- Know How
CT15	Evaluate critically and constructively the environment and oneself	- Know How - Know be
CT16	Develop an ethical commitment	- Know be
CT17	Develop concern for environmental aspects and quality management	- Know be
CT18	Generate new ideas and show initiative	- Know How

Learning outcomes	
Learning outcomes	Competences

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

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

## Contents

### Topic

Subject 1. The projects in chemistry	Professional competitions of the chemists. Definition and aims of a Project. *Características. Stages and classification of a Project. Organisation. Norms, regulations and legislation
Subject 2. Design of a project	*Análisis 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
Master Session	13	22	35
Seminars	22	58	80
Troubleshooting and / or exercises	2	7	9
Presentations / exhibitions	2	5	7
Multiple choice tests	0	4	4
Long answer tests and development	3	8	11
Jobs and projects	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
Master Session	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.
Troubleshooting and / or exercises	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.
Presentations / exhibitions	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
Master Session	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.
Troubleshooting and / or exercises	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.
Presentations / exhibitions	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
Multiple choice tests	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.
Long answer tests and development	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.

Jobs and projects	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 Evaluated	Competences
Troubleshooting and / or exercises	The students will have to deliver, in the terms indicated, the problems proposed	5	CE19 CE20 CE22 CE24 CT3 CT4 CT6 CT7 CT8 CT9 CT12 CT14 CT15 CT18
Presentations / exhibitions	The students will realise an exhibition of the project realised	10	CE23 CT1 CT3 CT5 CT8 CT9 CT12 CT14
Multiple choice tests	They will realise two test type test along the course. One when finalising the two first subjects and the another when finalising the subject 3. The length of the same will be between 20 minutes and 1 hour	10	CE19 CT3 CT7 CT9 CT12 CT14
Long answer tests and development	It will realise a long proof of all the matter of the *asignatura	35	CE19 CT3 CT7 CT9 CT12 CT14

Jobs and projects	The students will realise and will deliver in the dates indicated, all the parts of the project that proposes him to principle of course	40	CE20 CE22 CE24 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15 CT16 CT17 CT18
-------------------	--	----	--

#### Other comments and July evaluation

FIRST ANNOUNCEMENT 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 more sessions of seminar & it will involve the condition of presented and therefore

the allocation of a qualification;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

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

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

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

#### Recommendations

##### Subjects that continue the syllabus

Industrial chemistry/V11G200V01904

##### Subjects that it is recommended to have taken before

Chemical engineering/V11G200V01502

IDENTIFYING DATA				
<b>Materials chemistry</b>				
Subject	Materials chemistry			
Code	V11G200V01702			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Rodríguez Arguelles, María Carmen			
Lecturers	Pastoriza Santos, Isabel Rodríguez Arguelles, María Carmen			
E-mail	mcarmen@uvigo.es			
Web				
General description	"Machine translation into english of the original teaching guide" Structure, properties and application of the different types of materials. Characterization techniques and degradation processes will be also studied.			

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

Learning outcomes	
Learning outcomes	Competences
Differentiate between *conductividade electric and *iónica. Distinguish the *semiconductores *intrínsecos of the *extrínsecos.	CE5 CE19 CE20 CT1 CT7 CT9



Differentiate go in the #cooperative magnetism and the no #cooperative.	CE5 CE19 CE20 CT1 CT9
#Analyze the characteristics of metals and *alixes through essays of traction and *compresión.	CE5 CE19 CE20 CT1 CT7 CT9
Recognize hard magnetic materials and *blandos to split of the his cycle of *histéresis	CE5 CE19 CE20 CT1 CT9
Recognize the types of superconductividade and the relation with the naturaize of the material.	CE5 CE19 CE20 CT1 CT9
Describe the *aplicacions of the optical but important #phenomenon.	CE5 CE19 CT1 CT9
Describe the optical properties of the metals and no metals	CE5 CE19 CT1 CT9
Explain the thermal but important properties of the material.	CE5 CE19 CE20 CT1 CT9
Describe the properties of the different ceramic materials and *polímeros.	CE5 CE20 CT1 CT7 CT9
#Analyze and describe the characteristics of the *alixes in function of the his *diagramas of phases	CE5 CE19 CE20 CT1 CT7 CT9 CT12 CT13 CT14
Describe the basic processes stop the *obtención of the material.	CE5 CE20 CE23 CT1 CT3 CT4 CT7 CT8 CT9 CT13 CT15

Describe the general characteristics of the material compounds.	CE20 CE23 CT1 CT3 CT4 CT5 CT8 CT12 CT14 CT15
Justify and enter the need of new materials and *nanomaterials.	CE20 CE23 CT1 CT3 CT4 CT5 CT8 CT12 CT14 CT15
Board the basic techniques of study of the surfaces of the material.	CE8 CE23 CT1 CT3 CT4 CT5 CT8 CT12 CT14 CT15
#Analyze the *corrosión of metals and ceramic and the degradation of the *polímeros.	CE18 CT1 CT8 CT14

## Contents

Topic	
Subject 1. *Introducción	Historical perspective. Ranking of the material.
Subject 2. Properties of the material	Mechanics. Electric. Magnetic. @Óptico. Thermal
Subject 3. Metallic materials	General characteristics. *Estructura. Alloys. *Aplicacions
Subject 4. Ceramic materials	General characteristics. Structures. Properties. *Aplicacions
Subject 5. Materials *polímeros	Structures. Properties. Applications
Subject 6. Compound materials	General characteristics. Ranking. Material reinforced with: particles, fibres and structural compounds
Subject 7. Degradation of materials	*Oxidación Metallic and *pasivación. Methods of protection against it *corrosión. *Corrosión Of ceramic materials and *polímeros. Methods of *autoreparación
Subject 8. *Nanomaterials	*Nanociencia *y *nanotecnología. *Metodos Of preparation. Properties to wool *nanoescala.
Subject 9. Characterization of materials	*Microscopías Of vicinity and electronic, *espectroscopía *fotoelectrónica.

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	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
-------------

Master Session	The students in one only group will receive 26 hours of kinds *expositivas that will devote to the presentation of the fundamental aspects of each subject. Wool platform of *teledocencia used to provide the material related that subject
Seminars	*Plantearanse *cuestiones And enabling problems understanding and *profundizar in the theoretical aspects presented in the *sesiones *maxistrales. Besides the students presented subjects related with the subject.

### Personalized attention

Methodologies	Description
Seminars	During all the teaching period the students will be able to consult all type of doubts related with the subject how in the tutorías

### Assessment

	Description	Qualification Evaluated	Competencess
Seminars	It will value the assistance, realisation and discussion of the *cuestiones posed by the professor. Also the preparation and exhibition by part of the students of subjects related with the matter	40	CE5 CE8 CE19 CE20 CE23 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Short answer tests	They will realise two short proofs. The first of them will suppose 36% of the final note whereas second will suppose 24% of the final note. To surpass the matter is necessary to reach a minimum of a 4 in each one of the short proofs.	60	CE5 CE8 CE18 CE19 CE20 CT1 CT7 CT12 CT13

### Other comments and July evaluation

It is compulsory the assistance to all the planned activities that comport 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 no presented.

Evaluation of July: The students that do not surpass the matter at the end of the \*cuatrimestre will have to do a proof written \*q1\*ue consisted of two part that correspond with the evaluated in the two short proofs realised during the course. It will not be necessary to realise the part of the proofs \*cortacuya qualification was equal or upper to 4 on 10 keeping the qualification obtained. \*Estan. This proof will have a value of 60% and will substitute the results of the short proofs. The remaining elements of evaluation are not recoverable and the qualifications obtained added to the quoted proof whenever the qualification obtained was equal or upper to 4 on 10. In case to obtain a lower qualification will be this the one who appear like final qualification in the record.

### Sources of information

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

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

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

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

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

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

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

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

---

## **Recommendations**

### **Subjects that are recommended to be taken simultaneously**

Inorganic chemistry III/V11G200V01703

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

Physical chemistry III/V11G200V01603

IDENTIFYING DATA				
<b>Inorganic chemistry III</b>				
Subject	Inorganic chemistry III			
Code	V11G200V01703			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	4th	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Bravo Bernárdez, Jorge			
Lecturers	Bravo Bernárdez, Jorge Carballo Rial, Rosa García Martínez, Emilia Pérez Lourido, Paulo Antonio Pino Cuevas, Arantxa Valencia Matarranz, Laura María			
E-mail	jbravo@uvigo.es			
Web				
General description	<p>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.</p> <p>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.</p> <p>In the laboratory will be realised experiences of synthesis and characterisation of coordination compounds, organometallic compounds and inorganic solids.</p>			

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

CT8 Teamwork	- Know be
CT9 Work independently	- Know be
CT12 Plan and manage time properly	- Know How
CT13 Make decisions	- Know be
CT14 Analyze and synthesize information and draw conclusions	- know
CT15 Evaluate critically and constructively the environment and oneself	- Know be

### Learning outcomes

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

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

Carry out in the laboratory the preparation, characterisation and the study of some physical and chemical properties of the metals and their compounds.

CE2  
CE10  
CE14  
CE20  
CE25  
CE26  
CE27  
CE28  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT12  
CT13  
CT14  
CT15

## Contents

Topic	
Subject 1. 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 2. 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 3. Defects and stoichiometry in the solids.	Types of defects. Ionic conductivity. Solid electrolytes. Non-stoichiometric compounds. Solids of different dimensionality. Diffusion.
Subject 4. Methods of preparation of solids.	Ceramic methods. Microwave methods. Sol-gel method. Precursor method. Hydrothermal methods. Chemical vapor deposition and chemical vapor transport (CVD and CVT), etc.
Subject 5. Organometallic chemistry of the main groups elements.	Introduction. Synthesis, properties and applications of the organometallic compounds of Li, Mg, B and Al.
Subject 6. Organometallic chemistry of the transition metals (I)	Introduction. Types of ligands. Bonding. Characterisation.
Subject 7. Organometallic chemistry of the transition metals (II)	Types of organometallic reactions: substitution, oxidative addition, reductive elimination, insertion, reactions of coordinated ligands, etc.
Subject 8. Organometallic chemistry of the transition metals (III)	Reactivity of organometallic compounds: carbonyl, olefin, carbene, and cyclopentadiene complexes.
Subject 9. Organometallic catalysis.	Introduction. Olefin metathesis. Alkene hydrogenation. Carbonylation of methanol. Hydroformylation of alkenes.
Subject 10. Metallic clusters	Introduction. Types. Structure. Properties.
Practices of the chemistry of the coordination compounds (5 sessions)	Preparation and characterisation of some coordination compounds.
Practices of inorganic solids (4 sessions)	Preparation and study of the properties of some inorganic solids.
Practices of organometallic chemistry (4 sessions)	Preparation and characterisation of some organometallic compounds.

## Planning

	Class hours	Hours outside the classroom	Total hours
Seminars	13	42	55
Laboratory practises	45.5	20.5	66
Master Session	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 practises	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.
Master Session	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 practises	The students will be able to consult all type of doubts related with the matter in the scheduled tutorials.

### Assessment

	Description	Qualification Evaluated	Competences
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	CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT14
Laboratory practises	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	CE25 CE26 CE27 CE28 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT12 CT13 CT14 CT15
Short answer tests	The students will realise two 2-hours written proofs.	45	CB5 CE2 CE10 CE12 CE14 CE20 CT1 CT14

---

**Other comments and July 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**

---

W. D. Callister, Introducción a la Ciencia e Ingeniería de los Materiales, , Reverté, 2009

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

L. Smart, E. Moore, Solid State Chemistry. An introduction, 4, CRC, 2012

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

G. O. Spessard, G. L. Miessler, Organometallic chemistry, 2, 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				
<b>Organic chemistry III</b>				
Subject	Organic chemistry III			
Code	V11G200V01704			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Mandatory	4th	1st
Teaching language				
Department				
Coordinator	Rodríguez de Lera, Angel			
Lecturers	Álvarez Rodríguez, Rosana Fall Diop, Yagamare Rodríguez de Lera, Angel Tojo Suárez, Emilia			
E-mail	qolera@uvigo.es			
Web				
General description	This subject will integrate all the previous knowledge of Organic Chemistry, in particular regarding organic synthesis and his consequences in the creation of new stereogenic elements. For this, will use the tools of rethrosynthetic analysis , paying particular attention to the analysis of synthetic proposals that take place with selectivity (chemo-, regio- and stereoselectivity).			

Competencies		
Code		Typology
CB1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study	- know
CB2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study	- Know How
CB4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences	- Know be
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	- Know How
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	- know
CE10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds	- know
CE11	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: nature and behavior of functional groups in organic molecules	- know
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry	- know
CE13	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main synthetic routes in organic chemistry, including interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds	- know
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	- Know How
CE20	Evaluate, interpret and synthesize data and chemical information	- Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	- Know be
CE24	Recognize and analyze new problems and plan strategies to solve them	- Know How
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use	- Know How
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work	- Know How
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way	- Know How
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory	- Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know be

CT3	Learn independently	- Know be
CT4	Search and manage information from different sources	- Know How
CT5	Use information and communication technologies and manage basic computer tools	- Know How
CT7	Apply theoretical knowledge in practice	- Know How
CT8	Teamwork	- Know be
CT9	Work independently	- Know be
CT13	Make decisions	- Know be
CT14	Analyze and synthesize information and draw conclusions	- Know be
CT15	Evaluate critically and constructively the environment and oneself	- Know be
CT18	Generate new ideas and show initiative	- know

### Learning outcomes

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

4. Design synthetic sequences to target molecules.

CB1  
CB2  
CB5  
CE2  
CE10  
CE11  
CE12  
CE13  
CE20  
CT1  
CT3  
CT4  
CT5  
CT7  
CT9  
CT13  
CT18

---

5. Value the use of structure-simplifying reactions.

CB1  
CB2  
CB5  
CE2  
CE10  
CE11  
CE12  
CE13  
CE20  
CE24  
CT1  
CT3  
CT4  
CT7  
CT9  
CT13  
CT14  
CT18

---

6. Recognise relationships between functional groups of target molecules.

CB1  
CB2  
CB5  
CE2  
CE10  
CE11  
CE12  
CE13  
CE20  
CE24  
CT1  
CT3  
CT4  
CT7  
CT9  
CT13  
CT18

---

7. Use properly the functional groups interconversions.

CB1  
CB2  
CB5  
CE2  
CE10  
CE11  
CE12  
CE13  
CE20  
CE24  
CT1  
CT3  
CT4  
CT5  
CT7  
CT9  
CT13  
CT14  
CT18

---

8. Propose synthesis of carbocyclic and heterocyclic compounds.

CB1  
CB2  
CB5  
CE2  
CE10  
CE11  
CE12  
CE13  
CE20  
CE24  
CE25  
CE26  
CE27  
CE28  
CT1  
CT3  
CT4  
CT7  
CT9  
CT13  
CT14  
CT18

---

9. Know the reactivity of heterocyclic compounds.

CB1  
CB2  
CB5  
CE2  
CE10  
CE11  
CE12  
CE13  
CE20  
CE24  
CE26  
CE27  
CE28  
CT1  
CT3  
CT4  
CT7  
CT9  
CT13  
CT14  
CT18

---

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

## Contents

Topic

1. THE DESIGN OF ORGANIC SYNTHESIS. RETROSYNTHETIC ANALYSIS	1.1. Introduction to target-oriented synthesis. 1.2. Retrosynthetic 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 and 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 difunctionalized 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 practises	45.5	32.5	78
Master Session	13	17	30
Short answer tests	3	27	30
Long answer tests and development	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 practises	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.
Master Session	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
Master Session	Resolution of quiz questions and exercises 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	Resolution of quiz questions and exercises 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 practises	Resolution of quiz questions and exercises 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.

### Tests

	Description
Short answer tests	Resolution of quiz questions and exercises 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.
Long answer tests and development	Resolution of quiz questions and exercises 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.

### Assessment

Description	Qualification Evaluated Competences
-------------	-------------------------------------

Seminars	The resolution of problems and questions posed in the seminar classes, as well as the homework carried out by the students in those tasks of personal work entrusted by the teachers will be valued. Results of the learning: All the indicated, since the seminars will take place along the course.	20	CB1
			CB2
			CB4
			CB5
			CE2
			CE10
			CE11
			CE12
			CE13
			CE19
			CE20
			CE23
			CE24
			CT1
			CT3
			CT4
			CT5
			CT7
			CT8
			CT9
			CT13
			CT14
			CT15
			CT18
Laboratory practises	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 (33 % of the final note). 2.- The laboratory notebook (27 % of the final note). 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 (40 % of the final note).  To pass the lab course it is mandatory to have passed each one of the three parts evaluated. Those students who passed the lab course in the academic year 2014-2015 are entitled to keep that grade in the present academic year.  In the extraordinary exam the student will answer the written examination and will deliver a new laboratory notebook if required, keeping the qualifications obtained during the course in the others parts of the subject. Results of the learning: 1. Recognise structural elements in the organic molecules. 2. Design alternative synthetic sequences. 3. Handle reactions of functional groups interconversions. 4. Propose synthesis of carbo- and heterocyclic molecules. 5. Recognise selective reactions. 6. Recognise the importance of organic synthesis to the advancement of society.	30	CB1
			CB2
			CB4
			CE25
			CE26
			CE27
			CE28

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

### Other comments and July 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**

Warren, S.; Wyatt, P. , Organic Synthesis: The Disconnection Approach, , : Chichester, 2008.

Wyatt, P.; Warren, S. , Organic Synthesis: Strategy and Control, , John Wiley and Sons: Chichester, 2008

Zweifel, G. S.; Nantz, M. H. , Modern Organic Synthesis: An Introduction, , W. H. Freeman and Co.: New York, 2007

Clayden, J.; Greeves, N.; Warren, S., Organic Chemistry, 2nd ed., , Oxford University Press: New York, 2012

Starkey, L. S., Introduction to strategies for organic synthesis, , 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 I/V11G200V01103

Chemistry, physics and geology: Integrated laboratory II/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	Type	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish English			
Department				
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	Typology
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances
CE17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management
CE18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry
CT1	Communicate orally and in writing in at least one of the official languages of the University
CT3	Learn independently
CT4	Search and manage information from different sources
CT5	Use information and communication technologies and manage basic computer tools
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
CT7	Apply theoretical knowledge in practice
CT8	Teamwork
CT9	Work independently
CT10	Work at a national and international context
CT12	Plan and manage time properly
CT13	Make decisions
CT14	Analyze and synthesize information and draw conclusions
CT15	Evaluate critically and constructively the environment and oneself
CT16	Develop an ethical commitment
CT17	Develop concern for environmental aspects and quality management

Learning outcomes	
Learning outcomes	Competences

Describe the cycles of the matter in the environment, deepening in the one of the carbon and the one of the water

CE2  
CE17  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT10  
CT12  
CT13  
CT14  
CT15  
CT16  
CT17

Describe the main chemical processes that occur in each layer of the atmosphere. Describe the mechanisms of production and destruction of ozone. Explain the greenhouse effect

CE2  
CE17  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT10  
CT12  
CT13  
CT14  
CT15  
CT16  
CT17

Describe the composition and properties of the natural waters

CE2  
CE17  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT10  
CT12  
CT13  
CT14  
CT15  
CT16  
CT17

Explain the exchange of matter between the distinct environmental compartments. Time of residence

CE2  
CE17  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT10  
CT12  
CT13  
CT14  
CT15  
CT16  
CT17

Explain the main causes of the corrosion and how minimise it	CE2 CE18 CT3 CT4 CT5 CT6 CT7 CT9 CT10 CT14 CT16 CT17
Identify the main pollutants present in the natural media and the main pollutants according to the different environmental rules	CE2 CE4 CE17 CT3 CT4 CT5 CT6 CT7 CT9 CT10 CT13 CT14 CT16 CT17
Recognise the different types of chemical reactions that experience the pollutants in the natural medias	CE2 CE4 CE17 CT3 CT4 CT5 CT6 CT7 CT10 CT14 CT16 CT17
Estimate the harmful effects for the environment of the diverse types of pollutants	CE2 CE4 CE17 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT13 CT14 CT16 CT17
Describe the sampling, pre-treatment and preparation of sample for the analysis of environmental pollutants	CE4 CE17 CT3 CT4 CT5 CT6 CT7 CT8 CT10 CT13 CT14 CT16 CT17

Select the appropriate analytical techniques and the concrete methods for its determination in the atmosphere, waters, floors, sediments and biota

CE4  
CE17  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT10  
CT13  
CT14  
CT15  
CT16  
CT17

Describe the main available technologies for the treatment of the pollution and evaluate its applicability in diverse cases

CE4  
CT1  
CT4  
CT5  
CT6  
CT7  
CT8  
CT10  
CT12  
CT13  
CT14  
CT15  
CT16  
CT17

Know the fundamental methodologies for the evaluation of the environmental impact and the rule related

CE4  
CE17  
CT1  
CT4  
CT5  
CT6  
CT7  
CT8  
CT10  
CT12  
CT13  
CT14  
CT15  
CT16  
CT17

## Contents

### Topic

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

## Planning



	Class hours	Hours outside the classroom	Total hours
Seminars	10	25	35
Presentations / exhibitions	4	14	18
Teaching and/or informatives events	3	4.5	7.5
Workshops	0	12	12
Master Session	22	33	55
Short answer tests	2	9	11
Long answer tests and development	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.
Presentations / exhibitions	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
Teaching and/or informatives 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
Master Session	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 Evaluated	Competences
Presentations / exhibitions	The presentations and other activities associated (ACS Webinars, conferences and Meeting/Symposiums) until arriving to the defence of the work.	20	CE17 CT1 CT3 CT4 CT5 CT8 CT9 CT10 CT14 CT16 CT17
Short answer tests	They will realise two short proofs of one or two hours of length, C1 and C2, along the quadrimester in which it gives the matter and whose dates will be fixed in the chronogram to the start of the course. They are eliminatory.	30	CE2 CE4 CE18 CT1 CT3 CT6 CT7 CT12 CT13 CT14 CT15 CT16
Long answer tests and development	The long proof will have until three hours and in her will go in all the subjects given of the matter and the activities associated to them.	50	CE2 CE4 CE18 CT1 CT3 CT6 CT7 CT12 CT13 CT14 CT15 CT16

### Other comments and July 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**

---

P.W. ATKINS, Química Física, , Omega

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

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

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

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

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

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

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

, ISI WEB OF KNOWLEDGE, , Thomson Reuters

, Scifinder, , CAS-ACS

, Environmental Sciences Category, , RSC, ACS y otras

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

---

---

**Recommendations**

---

**Subjects that continue the syllabus**

---

Degree thesis/V11G200V01991

---

**Subjects that are recommended to be taken simultaneously**

---

Industrial chemistry/V11G200V01904

Degree thesis/V11G200V01991

---

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

---

Analytical chemistry I/V11G200V01302

Physical chemistry I/V11G200V01303

Physical chemistry II/V11G200V01403

Analytical chemistry II/V11G200V01503

Analytical chemistry 3/V11G200V01601

Physical chemistry III/V11G200V01603

---

IDENTIFYING DATA				
Pharmaceutical chemistry				
Subject	Pharmaceutical chemistry			
Code	V11G200V01903			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Terán Moldes, María del Carmen			
Lecturers	Deive Herva, Francisco Javier Terán Moldes, María del Carmen			
E-mail	mcteran@uvigo.es			
Web				
General description	The matter is allocated to contribute to the students basic knowledges of Pharmaceutical Chemistry, a science *interdisciplinary to horse between distinct disciplines of chemical content and of biological content, whose aim is the study of the compounds *bioactivos and in particular his discovery, development, identification and mechanism of action to molecular level.			

Competencies		
Code		Typology
CB1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study	- know
CB3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues	- know
CB4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences	- Know How
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	- Know be
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature	- Know How
CE20	Evaluate, interpret and synthesize data and chemical information	- know
CE22	Process and perform computational calculations with chemical information and chemical data	- Know How
CE23	Present oral and written scientific material and scientific arguments to a specialized audience	- Know How
CT1	Communicate orally and in writing in at least one of the official languages of the University	- Know How
CT3	Learn independently	- Know be
CT4	Search and manage information from different sources	- Know How
CT5	Use information and communication technologies and manage basic computer tools	- Know How
CT7	Apply theoretical knowledge in practice	- know
CT8	Teamwork	- Know How
CT9	Work independently	- Know How
CT10	Work at a national and international context	- Know How
CT12	Plan and manage time properly	- Know be
CT13	Make decisions	- Know How
CT14	Analyze and synthesize information and draw conclusions	- know
CT15	Evaluate critically and constructively the environment and oneself	- Know be
CT16	Develop an ethical commitment	- Know be
CT17	Develop concern for environmental aspects and quality management	- Know be

Learning outcomes	
Learning outcomes	Competences

Diferenciate and understand the concepts: droga, fármaco, medicamento and diana farmacológica	CB4 CE20 CE23 CT1 CT4 CT5 CT14
Differentiate the types of receptors, as well as a drug *agonista of an antagonist.	CB4 CB5 CE20 CE23 CT1 CT3 CT4 CT5 CT7 CT9 CT13 CT14
Relate the physical properties-chemical of the drugs with his properties *farmacocinéticas.	CB1 CB3 CB5 CE19 CE20 CE22 CE23 CT1 CT3 CT5 CT7 CT8 CT14
Differentiate the technicians of *farmacomodulación.	CB3 CB5 CE19 CE20 CE23 CT1 CT4 CT5 CT7 CT8
Differentiate an agent *quimioterápico of an agent *farmacodinámico	CB3 CB4 CB5 CE19 CE20 CE23 CT1 CT3 CT4 CT7 CT9
Familiarise with the most recent tools in the design of drugs: combinatory chemistry and computer-aided design (methods *QSAR and *Docking)	CB3 CB5 CE19 CE20 CE22 CE23 CT1 CT3 CT4 CT5 CT8 CT12 CT13 CT15 CT16

Describe the methods of structural analysis *involucrados in the design of drugs and differentiate the type of information that provide	CB3 CB5 CE19 CE20 CE22 CE23 CT1 CT3 CT5 CT7 CT9 CT14 CT15
Identify the different forms of *vehiculización of drugs and his foundation	CB1 CB3 CB4 CB5 CE19 CE20 CE23 CT1 CT3 CT4 CT9 CT14
Identify the variables of formulation and of composition in the preparation of suspensions and emulsions, and describe his characteristic properties and the phenomena that cause his unsteadiness	CB3 CB5 CE19 CE20 CE23 CT1 CT3 CT9 CT13 CT14
Recognise the main stages of the processes *fermentativos and enzymatic applied to the production of drugs, including so much the phases of production as of purification	CB3 CB5 CE19 CE20 CE22 CE23 CT1 CT3 CT4 CT7 CT8 CT12 CT14 CT15
Apply the basic principles of security and control of the pollution in operations and processes oriented to the production of drugs	CB3 CB5 CE19 CE20 CE23 CT1 CT3 CT5 CT8 CT10 CT13 CT16 CT17

Explain the sampling, \*pretratamiento and preparation of sample, as well as the appropriate instrumental technicians for the analysis of prime matters, pharmaceutical and compound formulations \*bioactivos in biological means

CB3  
CB5  
CE19  
CE20  
CE22  
CE23  
CT1  
CT3  
CT8  
CT13  
CT14

## Contents

Topic	
Subject 1. Introduction: general appearances of Pharmaceutical Chemistry	Definitions, aims and scope of the Pharmaceutical Chemistry. *Nomenclatura Of drugs and systems of classification. Agents *quimioterápicos and agents *farmacodinámicos
Subject 2. Pharmacological targets	Types of pharmacological targets. You interact drug-target. Acids *nucéicos, enzymes and *proteínas like targets of drugs.
Subject 3. Receptors like targets of drugs	Types of receptors. Drugs *agonistas, antagonistic and *agonistas reverse. Measure and expression of the pharmacological effect. Tachyphylaxis and tolerance
Subject 4. *Farmacocinética And appearances related	Absorption and transport through biological membranes, rules of *Lipinski, *biodisponibilidad. Metabolism, *profármacos. Excretion. Roads of administration and pharmaceutical forms.
Subject 5. Discovery, design and development of drugs	Strategies of research of heads of series, *serendipia, sifted systematic, rational design. *Farmacomodulación. Patents. Essays *preclínicos and clinical. Chemical development.
Subject 6. Strategies of design of drugs	*Modelado Molecular, indirect methods (*QSAR, design of *fármacóforo), direct methods (*docking).
Subject 7. Preparation, analysis and purification of drugs	Production in the pharmaceutical industry. Processes *fermentativos. Processed of drugs.

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	26	52	78
Seminars	13	39	52
Outdoor study / field practices	3	3	6
Short answer tests	2	4	6
Long answer tests and development	2	6	8

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

## Methodologies

	Description
Master Session	In these classes the professor/to will present of form structured the general contents of the program, doing emphasis in the appearances but important or of but difficult understanding. Besides, the professor/to will put to disposal of the *alumnado, with *antelación and through the platform *Tem@, the material that will use in said sessions. It recommends to the *alumnado that work previously this material and that consult the bibliography recommended to complete the information. With the end to realise a *seguimiento of the process of study and understanding of the matter, will realise periodic controls during some sessions *magistrales, that will be determined in advance
Seminars	They will devote to argue the most complicated appearances of the subjects treated, to use programs of *modelado molecular that will allow to work with diverse *biomoléculas *cocrystalizadas with distinct *ligandos, and also to the presentation of works, investigations, summaries etc., realised by the students/ace and related with the content of the matter

Outdoor study / field practices	It will visit a company of the sector *farmacéutico in which it will be able to appreciate the process of production in all his phases. After the visit the students will have to answer, in schedule of class, to a questionnaire related with the same.
---------------------------------	--

### Personalized attention

#### Methodologies Description

Seminars	Time devoted by the *profesorado to attend the needs and queries of the *alumnado related with the study of the matter and with the activities developed. The *profesorado will inform in the presentation of the matter on the available schedule.
----------	---

### Assessment

	Description	Qualification Evaluated	Competences
Master Session	They will evaluate the contents developed in the *temario (subjects 1-6 ) by means of questions that will pose *verbalmente or by writing in the classroom. The questions that formulate by writing will be referents to the contents treated in the two or three previous weeks.	7	CB1 CB3 CE19 CE23 CT14 CT15 CT16
Seminars	It will value the assistance and the participation in the classes, the resolution of exercises and questions, the presentation and exhibition of reports, of summaries and of works	23	CB1 CB3 CB4 CB5 CE19 CE20 CE22 CE23 CT1 CT3 CT4 CT5 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT16
Outdoor study / field practices	It will value the assistance and active participation in the visit, and the result obtained in the realisation of a questionnaire on the same.	10	CB3 CE20 CT14 CT15 CT17



Short answer tests	*relizarán 2 short proofs, of 1 *h of length. The first in the week 6 and in her will go in the contended of the *temario explained until this moment. The second when finalising the subject 7 and in her will go in exclusively the contended of the subject 7.	30	CB1 CB3 CB5 CE19 CE20 CT7 CT12 CT13 CT14
Long answer tests and development	Finalised the 6 first subjects will realise a global proof to evaluate the competitions purchased. It is indispensable requirement to surpass the matter reach a minimum of 50% in the proofs written.	30	CB1 CB3 CB5 CE19 CE20 CT7 CT12 CT13 CT14

### Other comments and July evaluation

The participation of the \*alumnado in any of the acts of \*evaluación of the matter will involve the condition of presented and therefore the allocation of a qualification. They consider acts of evaluation the assistance to seminars (4 or but), as well as the realisation any of the 3 proofs written. To be able to approve the matter the student has to have a note \*mínima in some of the distinct sections in which \*desglosa the evaluation. This minimum note has to be of 3,5 in the second proof of short answer, and of 4 in the proof of long answer,&\*nbsp; in the assessment of the seminars and in the assessment of the exit of studies.Evaluation of the announcement of July1. Punctuation obtained by the students/ace during the course: maximum 4 pointswill conserve the punctuation \*obtenida in&\*nbsp; the questions \*plantadas in the sessions \*magistrales (maximum 0,7 points), in the activities related with the visit (maximum 1 point), and in participation in the seminars (maximum 2,3 points).2. Work realised by the students: maximum 2 points Finished the process of evaluation of June, the \*profesorado will propose to the students/ace that have not surpassed the matter the realisation of an individual work that allow them purchase the competitions of which will be evaluated in July. This work will have to be delivered and defended by the students before the official examination of this announcement.&\*nbsp; Tests writtenThe students/ace will realise a proof written similar to the one of June in which they will be able to obtain a maximum of 4 points

### Sources of information

A. Delgado C. Minguillón y J. Juglar, Introducción a la Química Terapéutica , 2ª Edición 2003, Diaz de Santos  
G. L. Patrick, An introduction to Medicinal Chemistry, 5th Edition 2013, Oxford University Press  
C. G. Wermuth, 4. The Practice of Medicinal Chemistry, 3rd Edition 2008, Academic Press Elsevier  
R. Renneberg, Biotecnología para principiantes, 2004, Reverté

### 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	Type	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Rodríguez Rodríguez, Ana María			
Lecturers	Deive Herva, Francisco Javier Gago Martínez, Ana Rodríguez Rodríguez, Ana María			
E-mail	aroguez@uvigo.es			
Web				
General description	<p>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.</p> <p>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.</p>			

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

CT7 Apply theoretical knowledge in practice	- know - Know How - Know be
CT8 Teamwork	- know - Know How - Know be
CT9 Work independently	- know - Know How - Know be
CT10 Work at a national and international context	- know - Know How - Know be
CT12 Plan and manage time properly	- know - Know How - Know be
CT13 Make decisions	- know - Know How - Know be
CT14 Analyze and synthesize information and draw conclusions	- know - Know How - Know be
CT15 Evaluate critically and constructively the environment and oneself	- know - Know How - Know be

### Learning outcomes

Learning outcomes	Competences
(*) To know different techniques to minimize the generation of by-products and wastes	CE16 CE19 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT15
(*)To acquire habilities on process flowsheet diagrams interpretation and design on the basis of real processes.	CE16 CE20 CE23 CT1 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT12 CT13 CT14 CT15

(*) To identify generic systems for quality management in laboratories and to know the required essential documentation	CE16
	CE19
	CE20
	CE23
	CT1
	CT3
	CT4
	CT5
	CT6
	CT7
	CT8
	CT9
	CT10
	CT12
	CT13
	CT14
	CT15
(*)To establish analytical methodology suitable for warranting the quality of raw materials and products, as well as the pollution derived from the industrial process.	CE16
	CE19
	CE20
	CE22
	CE23
	CT1
	CT3
	CT4
	CT5
	CT6
	CT7
	CT8
	CT9
	CT10
	CT12
	CT13
	CT14
	CT15
(*)To integrate automatized and miniaturized systems on the control of industrial processes.	CE16
	CE19
	CE22
	CE23
	CT1
	CT3
	CT4
	CT5
	CT6
	CT7
	CT8
	CT9
	CT10
	CT12
	CT13
	CT14
	CT15

(\*)To acquire the ability of designing a process for the production of biofuels or biocatalysts at laboratory scale, on the basis of the process flowsheet diagrams.

CE16  
CE19  
CE20  
CE22  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT10  
CT12  
CT13  
CT14  
CT15

To understand the role of bioengineering as an environmentally sustainable alternative to obtain products with commercial interest

CE16  
CE19  
CE20  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT9  
CT10  
CT12  
CT13  
CT14  
CT15

(\*)To evaluate the economic viability of industrial processes by using basic tools such as the Net Present Value, the Internal Rate of Return of the Return of Investment

CE20  
CE22  
CE23  
CT1  
CT3  
CT4  
CT5  
CT6  
CT7  
CT8  
CT14  
CT15

New

CE16  
CE19  
CE20  
CT4  
CT5  
CT7  
CT8  
CT9

New

CE16  
CE20  
CT4  
CT8  
CT9  
CT10  
CT12  
CT13

## Contents

Topic

Subject 1. Introduction to processes in Industrial Chemistry	General aspects of chemical processes. Characteristics and sectorial structure 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.- Biotechnological 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
Master Session	26	52	78
Troubleshooting and / or exercises	5	13	18
Tutored works	5	10	15
Presentations / exhibitions	3	6	9
Outdoor study / field practices	3	6	9
Short answer tests	1	4	5
Long answer tests and development	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
Master Session	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 the topic prior to the presentation in class.
Troubleshooting and / or exercises	After each subject, the most relevant aspects will be tackled by means of problem and questions solving.
Tutored works	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.
Presentations / exhibitions	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
Outdoor study / field practices	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
Master Session	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.
Troubleshooting and / or exercises	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.
Tutored works	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.

Presentations / exhibitions	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.
Outdoor study / field practices	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.

<b>Assessment</b>			
	Description	Qualification Evaluated	Competences
Troubleshooting and / or exercises	Different troubleshooting will be solved by the students at the framework of their tutored works	10	CE16 CE19 CE22 CT3 CT5 CT6 CT7 CT9 CT14
Tutored works	A work focused on the design of an industrially relevant process flowsheet diagram will be carried out during the term.	20	CE16 CE20 CE22 CE23 CT1 CT4 CT5 CT6 CT7 CT8 CT10 CT12 CT13 CT14 CT15
Presentations / exhibitions	The tutored works will be defended against a jury composed of lecturers from the Departments of Chemical Engineering and Analytical Chemistry and/or professionals from the chemical industry.	10	CE16 CE23 CT1 CT5 CT8 CT12 CT13 CT14
Outdoor study / field practices	The students must unavoidably attend the outdoor studies in order to get a deeper insight into the processes tackled during the master sessions. A report about questions on the plants will be done by them after each visit.	5	CE20 CE22 CT7 CT8 CT14 CT15

Short answer tests	Short tests will be performed in the middle and at the end of the course. Students will be encouraged to relate new ideas with their own views, and to solve problems based on the new knowledge acquired	10	CE16 CE19 CE20 CE22 CE23 CT3 CT7 CT9 CT12 CT13 CT14
Long answer tests and development	A final long answer test will be done at the end of the course, and the students will have to have a minimum of 5 out of 10 to pass the course.	45	CE16 CE19 CE20 CE22 CE23 CT3 CT7 CT12 CT13 CT14

### Other comments and July evaluation

In order to pass the subject, at least 5 points out of 10 should be achieved in each of the evaluated 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 maintained.

### Sources of information

M.M Camps, Los Biocombustibles, Mundi-Prensa, 2002  
G.T. Austin, Manual de Procesos Químicos en la Industria, McGraw Hill, 1993  
M. Díaz, Ingeniería de bioprocesos, Paraninfo, 2012  
J.H.Gary, Refino de petróleo: tecnología y economía, Reverté, 1980  
J. Happel, Economía de los procesos químicos, Reverté, 1981  
M.A. Ramos Carpio, Refino de petróleo, gas natural y petroquímica, Fomento Innovación Industrial, 1997  
A. Vian Ortuño, Introducción a la Química Industrial, Reverté, 1996  
G. Ramis Ramos et al., Quimiometría, Síntesis, 2001  
W. Wegscheider, Quality in Chemical Measurements, Training Concepts and Teaching Materials, Springer, 2001  
D. Hoyle, ISO 9000 Quality Systems Handbook, Elsevier, 2009  
J.M. de Juana, Energías renovables para el desarrollo, Thompson, 2003

Atkins, J.W. "Making pulp and paper", (Recurso electrónico) Tappi Press (USA) 2004.

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

Casey, J.P. "Pulpa y papel: química y tecnología química", Ed. Noriega, 1991.

Díaz, M. "Ingeniería de bioprocesos", Ed. Paraninfo, 2012.

Duda W.H. "Manual tecnológico del cemento", Ed. Reverté, 1995.

El-Mansi E.M.T. "Fermentation microbiology and biotechnology", Ed. CRC/Taylor & Francis, 2007.

Gani, M.S.J. "Cement and concrete", Ed. Chapman & Hall, 1997.

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

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

Herranz Agustín, C. "Química para la ingeniería", Ed. UPC, 2010.

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



Rodríguez Jiménez, J. "Los controles en la fabricación de papel", Ed. Blume, 1970.  
Shuler, M.L. "Bioprocess engineering: basic concepts", Prentice Hall, 2002.  
Vian Ortuño, A. "Introducción a la Química Industrial", Ed. Reverté, 1996. Quimiometría de Guillermo Ramis Ramos, M<sup>a</sup> Celia Gracia Álvarez-Coque. Editorial Síntesis S. A., 2001, Madrid, España.  
Quality in Chemical Measurements, Training Concepts and Teaching Materials. Wolfhard Wegscheider Chemie, Springer Verlag, 2001, Germany.  
ISO 9000 Quality Systems Handbook, David Hoyle, 6<sup>a</sup> Edición, 2009, Elsevier, Amsterdam.

---

---

## **Recommendations**

---

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

---

Chemical engineering/V11G200V01502  
Project/V11G200V01701

---

IDENTIFYING DATA				
Degree thesis				
Subject	Degree thesis			
Code	V11G200V01991			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Type	Year	Quadmester
	18	Mandatory	4th	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Pérez Juste, Ignacio			
Lecturers	Pérez Juste, Ignacio			
E-mail	uviqpij@uvigo.es			
Web	<a href="http://quimica.uvigo.es/decanatoquimica/traballo-fin-de-grao.html">http://quimica.uvigo.es/decanatoquimica/traballo-fin-de-grao.html</a>			
General description	<p>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.</p> <p>The objective of the subject is to offer the students the opportunity to apply the knowledges, skills and competences acquired during the Degree studies.</p> <p>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.</p>			

Competencies		
Code		Typology
CB1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study	- know
CB2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study	- Know How
CB3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues	- Know How
CB4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences	- Know How
CB5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	- Know be
CE1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.	
CE2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics	
CE3	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: principles of quantum mechanics and its application in the description of the structure and properties of atoms and molecules	
CE4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances	
CE5	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Characteristics of the different states of matter and the theories used to describe them	
CE6	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: principles of thermodynamics and their applications in chemistry	
CE7	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: kinetics of change, including catalysis and reaction mechanisms	
CE8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy	
CE9	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: characteristic properties of the elements and their compounds, including group relationships and variations in the periodic table	

CE10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds
CE11	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: nature and behavior of functional groups in organic molecules
CE12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry
CE13	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main synthetic routes in organic chemistry, including interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds
CE14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules
CE15	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: chemistry of biological molecules and their processes
CE16	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles and procedures in chemical engineering
CE17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management
CE18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry
CE19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
CE20	Evaluate, interpret and synthesize data and chemical information
CE21	Recognize and implement good scientific practices for measurement and experimentation
CE22	Process and perform computational calculations with chemical information and chemical data
CE23	Present oral and written scientific material and scientific arguments to a specialized audience
CE24	Recognize and analyze new problems and plan strategies to solve them
CE25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use
CE26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work
CE27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way
CE28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory
CE29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy
CT1	Communicate orally and in writing in at least one of the official languages of the University
CT2	Communicate at a basic level in English in the field of chemistry
CT3	Learn independently
CT4	Search and manage information from different sources
CT5	Use information and communication technologies and manage basic computer tools
CT6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
CT7	Apply theoretical knowledge in practice
CT8	Teamwork
CT9	Work independently
CT10	Work at a national and international context
CT11	Adapt to new situations
CT12	Plan and manage time properly
CT13	Make decisions
CT14	Analyze and synthesize information and draw conclusions
CT15	Evaluate critically and constructively the environment and oneself
CT16	Develop an ethical commitment
CT17	Develop concern for environmental aspects and quality management
CT18	Generate new ideas and show initiative

## Learning outcomes

Learning outcomes	Competences
-------------------	-------------

(\*)Todos os da titulación

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

## Contents

Topic

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

## Planning

	Class hours	Hours outside the classroom	Total hours
Projects	160	256	416
Jobs and projects	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
Projects	Individual work done by the students under the supervision of one or two tutors. The assignment of the subject will be done following the TFG norms approved by the Faculty of Chemistry.

### Personalized attention

Methodologies	Description
Projects	

### Assessment

Description	Qualification Evaluated Competences
-------------	-------------------------------------

Projects	Evaluation by the tutor of the competences achieved during the realization of the work assigned, in accordance with the criteria established and published previously.	30	CB1 CB2 CB3 CB4 CB5 CE1 CE2 CE3 CE4 CE5 CE6 CE7 CE8 CE9 CE10 CE11 CE12 CE13 CE14 CE15 CE16 CE17 CE18 CE19 CE20 CE21 CE22 CE23 CE24 CE25 CE26 CE27 CE28 CE29 CT1 CT2 CT3 CT4 CT5 CT6 CT7 CT8 CT9 CT10 CT11 CT12 CT13 CT14 CT15 CT16 CT17 CT18
----------	--	----	---

Jobs and projects	Evaluation by a jury in public session, in accordance with criteria established and published previously.	70	CB1
			CB2
			CB3
			CB4
			CB5
			CE1
			CE2
			CE3
			CE4
			CE5
			CE6
			CE7
			CE8
			CE9
			CE10
			CE11
			CE12
			CE13
			CE14
			CE15
			CE16
			CE17
			CE18
			CE19
			CE20
			CE21
			CE22
			CE23
			CE24
			CE25
			CE26
			CE27
			CE28
			CE29
			CT1
			CT2
			CT3
			CT4
			CT5
			CT6
			CT7
			CT8
			CT9
			CT10
			CT11
			CT12
			CT13
			CT14
			CT15
			CT16
			CT17
			CT18

---

**Other comments and July 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**

---

---

**Recommendations**

---

---

**Subjects that are recommended to be taken simultaneously**

---

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

---