(*)Facultade de Química

Presentation

The studies of Chemistry have a large tradition at the University of Vigo, where it has been taught during more than 30 years. The stablisment of the Universitary System of Galicia in the 90s and the current process of implantation of the European Space of Higher Education (EEES) modified the offer of degrees, but no the pioneering spirit of the chemists in research of in the quest for a better service to the society.

Degrees given in the Faculty

Degree in Chemistry

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

Web page

Information about the Faculty of Chemistry:

http://quimica.uvigo.es

(*)Grao en Química

Subjects

Year 3rd

Code	Name	Quadmester	Total Cr.
V11G200V01501	Structural Determination	1st	6
V11G200V01502	Chemical engineering	1st	9
V11G200V01503	Analytical chemistry II	1st	9
V11G200V01504	Organic chemistry II	1st	6
V11G200V01601	Analytical chemistry 3	2nd	6
V11G200V01602	Biological chemistry	2nd	9
V11G200V01603	Physical chemistry III	2nd	9
V11G200V01604	Inorganic chemistry II	2nd	6

IDENTIFYING DATA				
Structural Determination				
Subject	Structural Determination			
Code	V11G200V01501			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	Spanish Galician			
Department	Inorganic Chemistry Organic Chemistry			
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	
A1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
C4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances
C8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy
C12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C24	Recognize and analyze new problems and plan strategies to solve them
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself
D16	Develop an ethical commitment

Learning outcomes		
Expected results from this subject	Training and Learning Results	
Describe the fundamental concepts of the methods for structural elucidation	A1	C4 C8 C12

Analyse the information that the different methods offer on the molecular structure elucidation, and understand their advantages and limitations.	A2 A3	C8 C12 C20	D3 D4 D7 D8 D9 D14
Predict the basic features of a given spectrum for a particular compound.	A2 A3	C4 C8 C12 C20	D3 D4 D7 D9 D14
Understand the information provided by the different methods of X-ray diffraction.	A2 A3	C4 C12	D3 D4 D9 D13 D14 D15 D16
Design the rational process to obtain key structural information of a chemical compound.	A2 A3	C4 C8 C24	D3 D4 D7 D9 D13 D14
Determine the molecular structure of a simple compound from the analysis of its spectroscopic data (IR, UV, MS, NMR, etc.).	A2 A3 A4	C4 C8 C12 C19 C20	D1 D3 D4 D5 D7 D9 D12 D14 D16
Observe the presence of defects and disorder in solids.	A1	C4	

Contents

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

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	13	26	39
Problem solving	24	48	72

Laboratory practice	3	15	18
Essay	1	20	21

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

Methodologies

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

Personalized attention

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

Assessment

	Description	Qualification	Training and Learning Results		
Problem solving	In the different classes (lectures, seminars) the students will be given handouts with problems and/or exercises that will be used for their evaluation. Learning outcomes: (1). Describe the fundamental concepts of the methods for structural determination. (2). Analyse the information that, on the molecular structure, provide the different methods and understand their main limitations. (3). Predict the basic features of a particular spectrum for a given compound.	20	A1 A2 A3	C4 C8 C12 C19 C20 C24	D7 D8 D13 D15
Laboratory practice	There will be two short tests of about 2 hour duration in which the students will be asked to obtain structural information from experimental data (spectra and other physical data). The first tests covers chapters 1-3 (10% of qualification), and the second chapter 4 (20% of qualification). Learning outcomes: (1). Analyse the information that, on the molecular structure, provide the different methods and understand their main limitations. (2). Predict the basic features of a particular spectrum for a given compound. (3) Design the basic process to obtain a particular structural information of a compound. (4). Solve the molecular structure of a simple compound from its spectra (UV, IR, MS, NMR, X-Ray, etc). Further, there will be a final test that covers all chapters (30% of qualification)	60	A1 A2 A3 A4	C8 C12 C19 C20 C24	D3 D7
Essay	The students will carry out a small project proposed by the professors of multidisciplinary spectroscopic nature. The results will be presented as a written report. Learning outcomes:(1). Solve the molecular structure of a simple compound from its spectra (UV, IR, MS, NMR, X-Ray, etc).	20	A1 A2 A3 A4	C4 C8 C12 C19 C20 C24	D1 D4 D5 D9 D12 D14 D16

Other comments on the Evaluation

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

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

- All the short tests.

- The final report.

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

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

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

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

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

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

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

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

Sources of information

Basic Bibliography

Complementary Bibliography

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

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

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

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

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

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

Recommendations

Subjects that it is recommended to have taken before

Geology: Geology/V11G200V01205
Chemistry: Chemistry 1/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

IDENTIFYING DATA

Chemical engineering

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

Competencies

Code	
C1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.
C16	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles and procedures in chemical engineering
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C21	Recognize and implement good scientific practices for measurement and experimentation
C22	Process and perform computational calculations with chemical information and chemical data
C23	Present oral and written scientific material and scientific arguments to a specialized audience
C25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use
C27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way
C28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory
C29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D10	Work at a national and international context
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself

Learning outcomes

Expected results from this subject	Training and Learning Results

Know the different unit systems.	C1 C19	D7
Interpret the flow charts of chemical processes.	C16 C19 C20	
Differentiate the steady, non-steady, continuos and batch operations	C16 C19 C20	D3 D7 D9
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	C16 C19 C20	D3 D9
Know and know how to apply the mass, energy and momentum conservation laws	C16 C19 C20	D3 D7 D9
Pose and solve the design equations to the ideal chemical reactors.	C16 C20 C23	D3 D4 D5
Differentiate the heat transfer mechanisms	C16 C19 C20	D3 D4 D6 D7 D9
Calculate the heat transferred by conduction and convection in simple systems and the heat transferred in shell and tube type heat interchanger.	C16	D4
Identify the different operation units and their application.	C16 C19 C20	D7
Elaborate and interpretate vapour-liquid, liquid-liquid and gas-liquid flow diagrams.	C21 C22 C23 C25 C27 C28 C29	D1 D6 D8 D10 D12 D13 D14 D15
Solve mass balances for flash and batch distillation, liquid-liquid and solid-liquid extraction and absorption.	C21 C22 C23 C25 C27 C28 C29	D6 D8 D10 D12 D13 D14 D15
Determine the number of theoretical stages in separation units for simple mixtures.	C16 C19 C20	D7
Carry out and monitor separation processes in operation units at laboratory level.	C21 C22 C23 C25 C27 C28 C29	D1 D6 D8 D12 D13 D14 D15
Determine experimentally some properties of interest from the point of view of transport phenomena: viscosity, coefficients of convection, density.	C16 C20 C21 C22 C23 C25 C27 C28 C29	D1 D4 D5 D7 D8 D10 D12 D13 D14 D15

Work with continuous and batch chemical reactors at laboratory level.	C16 C21 C22 C25 C27 C28 C29	D1 D4 D5 D6 D7 D8 D12 D13 D14 D15

Contents

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

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	13	30	43
Problem solving	25	50	75
Laboratory practices	40	3	43
Autonomous problem solving	0	10	10
Presentation	5	5	10
Supervised work	1	10	11
Short answer tests	2	8	10
Essay questions exam	3	20	23

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

Methodologies

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

Supervised work	The students will have to write an individual report about one subject related to Chemical Engineering. The teacher will indicate them the main points of the subject that they will have to develop and the recommended literature.

Personalized attention

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

Assessment

	Description	Qualification	Training and Learning Results	
Laboratory practices	The qualification will depend on the laboratory work and the laboratory report made by the students. Laboratory sessions are mandatory.	10	C21 C22 C23 C25 C27 C28 C29	D1 D6 D8 D10 D12 D13 D14 D15
Autonomous problem solving	The students will have to deliver, in the terms indicated, the problems proposed of each subject.	5	C1 C16 C19 C22	D3 D7 D9
Presentation	The students will make an oral presentation related to laboratory work.	5	C16 C20 C23	D4 D5 D7 D8 D14
Supervised work	The students will realise, and will deliver in the date indicated, an individual work on a subject proposed to the start of course.	5	C1 C16 C20 C23	D1 D3 D14
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	C1 C16 C19	D1 D6 D7 D9
Essay questions exam	At the end of the course the students have to do an exam related to all the subjets.	55	C1 C16 C19	D1 D6 D7 D9

Other comments on the Evaluation

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

Sources of information

Basic Bibliography

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

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

Complementary Bibliography

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

C.J. Geankoplis, **Procesos de transporte y principios de procesos de separación**, Grupo editorial patria. México, 2007
José Felipe Izquierdo y otros, **Introducción a la Ingeniería Química. Problemas resueltos de balances de materia y energía**, Reverté, 2015

Recommendations

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

Competencies	
Code	
C4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances
C8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy
C17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management
C18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C21	Recognize and implement good scientific practices for measurement and experimentation
C22	Process and perform computational calculations with chemical information and chemical data
C23	Present oral and written scientific material and scientific arguments to a specialized audience
C25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use
C26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work
C27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way
C28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory
C29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself
D17	Develop concern for environmental aspects and quality management

Learning outcomes	
Expected results from this subject	Training and Learning Results

Justify the basic principles of the instrumental analysis and his field of application in base to the characteristics of the *analito and of application	C4	D1 D3 D6 D9 D12
Appropiated instrumental technique selection depending the phisycochemicals properties of the analytes.	C4 C19 C20 C22	D1 D4 D6 D9 D12 D13
Description the quality parameters of an analytical method.	C4 C17 C19 C29	D1 D3 D4 D5 D6 D9
Adavances in principles of: internal standard, external standard addition, standard solutions preparation, calibration and its applications in different instrumentl equipments.	C19 C21 C25 C26 C27 C28 C29	D1 D3 D4 D5 D6 D7 D8 D12 D13 D14
Estimation, interpretation and understand the different calibrations parameters of an instrumental method.	C17 C19 C20 C21 C26 C28 C29	D3 D4 D5 D6 D7 D8 D9 D12 D13 D14
Spectroscopic, electrochemical and separation (chromatographic and electrophoretic) techniques basis and its applications	C4 C8 C18 C19	D1 D3 D4 D7 D8 D9 D14
Instrumental equipment description and its functions required for spectroscopic, electrochemical measurements and separations techniques.	C4 C8 C18 C21 C26 C27	D1 D3 D4 D7 D9 D12 D13
Classify and proposes different applications fields of spectroscopic, electrochemical techniques and separation	C4 C8 C18 C19 C23	D1 D3 D4 D7 D8 D9 D13 D14

Implementation and application of spectroscopic and electrochemical techniques to carry out the determination of differents analytes	C4 C18 C19 C21 C23 C25 C26 C27 C28 C29	D1 D4 D5 D6 D7 D8 D12 D13 D14 D15 D17
Implementation and application of chromatographic techniques with different detection modes for the separation, identification and quantification of differents analytes	C4 C21 C23 C25 C26 C27 C28 C29	D1 D4 D5 D6 D7 D8 D12 D13 D14 D15 D17

Contents	
Topic	
General Introduction	Subject (QAII) description
1-Introduction to the instrumental technicians	Introduction Classification of the instrumental techniques Quality parameters Instrumental methodology analysis Calibration Molecular absorption spectrophotometry UV-VIS: Principels, Instrumentation and applications
2- Luminescent techniques	Basic principles Relation between fluorescense intensity and concentration Instrumentation Applications
3- Atomic Absorption Spectrometry	Basic principles Atomization systems, Flame, graphite furnace, hydrides generation and cold steam. Instrumentation Applications
4- Emision Atomic Spectrometry	Basic principles Emisión sources. Flame and plasma. Plasma-Mass coupling Applications
5- Electroanalyticals Techniques	Basic principles Classification Potentiometry: Ion Selective Electrode Voltammetry Conductimetry Coulometry Applications
6- Chromatographic methods	Basic principles Chromatographic modes Gas Chromatography Instrumentation Applications
7- Liquid Chromatography	Liquid chromatography: Normal, reverse phase and ionic Instrumentation Applications
8- Electrophoretic Techniques	Principles High resolution capillary Electrophoresis basic and theory Electrophoretic Techniques Classification Instrumentation Applications

Planning

	Class hours	Hours outside the classroom	Total hours
Problem solving	26	26	52
Laboratory practices	45.5	7	52.5
Lecturing	26	26	52
Practices report	0	38	38
Short answer tests	3.55	12.9575	16.5075
Essay questions exam	3.5	10.5	14

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

Methodologies

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

Personalized attention

Methodologies	**Description**
Problem solving	
Laboratory practices	
Tests	**Description**
Practices report	

Assessment

	Description	Qualification	Training and Learning Results	
Problem solving	The teacher will monitor the exercises given to students in seminars class. Scientific publication, pratical situations will be discussed in seminars sessions and supervised by the teacher	10	C4 C8 C18 C29	D1 D6
Laboratory practices	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	C20 C21 C25 C26 C27 C28	D4 D7 D8 D13
Practices report	The student will prepare lab reports, which reflects the work performed in the laboratory. These reports must be submitted by the deadline and will be corrected by the teacher.	10	C17 C19 C20 C28 C29	D1 D4 D6 D7 D14
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. Labotory test for each student will be made to asses their skills in the development of an experiment. This test is performed at the end of the lab sessions and it contribute 10% to the final score.	20	C4 C8 C18 C19 C20 C21 C25 C26 C27 C28 C29	D1 D3 D6 D7 D9

Essay questions exam	The exam (the test) will be performed at the end of the semester and contains a theoretical and theoretical-practical aspects. For compensation of subject , students must achieve at least 4.0 minimum score (4.0 minimum score in each part of the test). ATTENTION: 3.0 is the minimal requirement in the final results achieve by the student for each long test corresponding to each teacher participate in the subject in order to carry out the weighting of overall examination. If you do not get this rating, the end result is FAIL	45	C4 C8 C17 C18 C19	D1 D3 D6 D9

Other comments on the Evaluation

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

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

Sources of information

Basic Bibliography

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

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

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

Complementary Bibliography

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

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

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

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 1/V11G200V01103
Chemistry, physics and geology: Integrated laboratory 2/V11G200V01202
Chemistry: Chemistry 1/V11G200V01105
Chemistry: Chemistry 2/V11G200V01204
Numerical methods in chemistry/V11G200V01402
Analytical chemistry 1/V11G200V01302

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

Competencies	
Code	
A1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
C2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics
C8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy
C10	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: properties of aliphatic, aromatic, heterocyclic and organometallic compounds
C11	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: nature and behavior of functional groups in organic molecules
C12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry
C13	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main synthetic routes in organic chemistry, including interconversions of functional groups and the formation of carbon-carbon and carbon-heteroatom bonds
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C23	Present oral and written scientific material and scientific arguments to a specialized audience
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D8	Teamwork
D9	Work independently
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions

Learning outcomes	
Expected results from this subject	Training and Learning Results

Explain the reactivity of the organic compounds through the different mechanisms of reaction: replacement, elimination, addition and addition-elimination.	A1 A2 A3 A5	C2 C10 C11 C12 C13	D1 D3 D4 D5 D9 D12 D13 D14
Describe in detail the mechanisms of transformation of the organic compounds using the formalism of arrows.		C2 C11	D1 D3 D4 D5 D8 D9 D12 D13 D14
Complete diagrams of reaction of organic compounds adding reactive and/or the conditions of reaction.		C2 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14
Propose sequences of simple reaction.		C12 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14
Differentiate, according to the conditions of reaction and the *sustratos used, the mechanisms of replacement *nucleófila *SN1 and *SN2.		C2 C11 C12 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14
Apply the processes of replacement *nucleófila on carbons *sp3 in the obtaining of organic compounds with simple links.		C2 C11 C12 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14
*Predecir The possible competition between the processes of replacement *nucleófila and elimination for a *sustrato given.		C11 C12 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14

Apply the reactivity of *enoles and *enolatos.	C11 C12 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14
Apply the processes of elimination in the preparation of organic compounds with multiple links.	C11 C12 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14
Apply the reactivity of the composed alpha-*dicarbonílicos (*enolización, acidity, *alquilación in alpha, *alquilación in beta, *descarboxilación) in organic synthesis.	C10 C11 C12 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14
Design the synthesis of compounds *bifuncionales using the reaction of condensation *aldólica, the reaction of *Reformatsky and the condensation of *Claisen.	C11 C12 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14
Apply the reaction of *Knoevenagel and the procedures of synthesis *acetilacética and synthesis *malónica.	C11 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14
Design the synthesis of derivatives of the compounds *carbonílicos alpha,beta-*insaturados by means of reactions of addition 1,2 and 1,4.	C11 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14
Apply the basic reactivity of the organic radicals.	C2 C11 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14

Apply the reactions *pericíclicas to the organic synthesis.	C2 C11 C13	D1 D3 D4 D5 D8 D9 D12 D13 D14
(*)Characterize *compuestos organic *sencillos from *sus *datosespectroscópicos.	C8 C11 C19 C20 C23	D1 D3 D4 D5 D8 D12 D13 D14

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Supervised work	2	2	4
Lecturing	24	0	24
Seminars	24	0	24
Short answer tests	4	0	4
Essay questions exam	3	8	11
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Supervised work	The student, of individual form or in group, will prepare a short exhibition on a subject *realacionado with the matter. This activity includes the research of information, editorial and presentation of the work.

Lecturing	The sessions *magistrales will consist in the exhibition by part of the professor of the fundamental appearances of each subject. Before each session, the student will have to work the material that the professor will facilitate him through the platform FEAR, related with the content that will treat in each session.
Seminars	The students, with the support of the professor, will resolve exercises and questions previously proposed in Bulletins, related with the theoretical contents. A selection of the exercises will be delivered regularly to the professor for his evaluation.

Personalized 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.
Supervised work	The students will realise a work on a subject that *eligirán of a series proposed by the professors, once finalised, in hours of seminar will expose it and will answer to the questions that formulate him the professors and/or the students. The professors will be able to *asesorar to the student in the election and development of the subject, in the distribution, *busqueda bibliographic and presentation

Assessment

	Description	Qualification	Training and Learning Results	
Supervised work	It will value the preparation and presentation of a work on a subject proposed by the professor related with the theoretical content of the *asignatura.	5	C2 C8 C10 C11 C12 C13 C19 C20 C23	D1 D3 D4 D5 D9 D12 D13 D14
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	C2 C8 C10 C11 C12 C13 C19 C20 C23	D1 D3 D4 D5 D8 D9 D12 D13 D14
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	C2 C8 C10 C11 C12 C13 C19 C20 C23	D1 D3 D4 D5 D9 D12 D13 D14
Essay questions exam	It will consist in a global proof on all the contents of the matter. It will be necessary to reach a minimum of 4 points on 10 in this proof to surpass the matter and to take into account the rest of the elements of evaluation. It will realise when finalising he *cuatrimestre.	45	C2 C8 C10 C11 C12 C13 C19 C20 C23	D1 D3 D4 D5 D9 D12 D13 D14

Other comments on the Evaluation

IMPORTANT NOTES:

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

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

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

EVALUATION IN THE ANNOUNCEMENT OF JULIO:

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

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

2. Proof written: Máximo 7.0 points.

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

Sources of information

Basic Bibliography

Complementary Bibliography

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

Wade, L.G., **Química Orgánica**, 5ª,

Yurkanis Bruice, P., **Química Orgánica**, 5ª,

Ege, S., **Organic Chemistry: Structure and reactivity**, 5ª,

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 1/V11G200V01105
Chemistry: Chemistry 2/V11G200V01204
Organic chemistry I/V11G200V01304

IDENTIFYING DATA

Analytical chemistry 3

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

Competencies

Code	
A1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
C4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances
C8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy
C17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management
C18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C22	Process and perform computational calculations with chemical information and chemical data
C24	Recognize and analyze new problems and plan strategies to solve them
C29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D17	Develop concern for environmental aspects and quality management

Learning outcomes

Expected results from this subject	Training and Learning Results		
1. Select and apply distinct technical *quimiométricas to the resolution of practical cases and justify the utilisation of the same.	A1 A2 A3	C17 C19 C20 C22	D1 D3 D5 D6 D7 D9 D13 D14 D17
2. Use the experimental design like tool for the optimisation of an analytical method.	A1	C17 C19 C22	D1 D3 D5 D6 D7 D9 D13 D14
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.	A1 A2	C4 C17 C19 C20 C29	D1 D3 D5 D6 D7 D8 D9 D14 D17
3. Evaluate and interpret the analytical results of systems *multicomponentes and *multivariables.	A1 A2 A3	C4 C17 C20 C22	D1 D3 D5 D6 D7 D8 D9 D13 D17
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.	A1 A2	C4 C19 C20	D1 D3 D4 D7 D9 D12 D13 D14 D17
5. Describe the planning of the sampling and the factors that take part in him for the analysis of trace.	A1	C4 C17 C24	D1 D3 D4 D6 D7 D9 D12 D13 D17
7. Compare and value the different methods of existent extraction in the actuality, like the extraction by fluent *supercríticos, in solid phase, *microextracción, etc.	A1 A2	C4 C19 C20	D1 D3 D8 D9 D12 D14 D17
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.	A1	C4 C8 C18 C19	D1 D3 D4 D8 D9

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.	A1 A2	C4 C17 C20	D1 D3 D4 D5 D8 D9 D17
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.	A1 A2 A3	C4 C17 C20	D1 D3 D4 D8 D9 D12
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.	A1	C4 C17 C19 C20	D1 D3 D4 D5 D8 D9 D14 D17
12. Explain the construction of analytical tools in miniature and his applications.	A1	C4 C17 C19	D1 D3 D4 D5 D9 D12 D14

Contents

Topic	
SUBJECT 1. Analysis of trace	Concept and importance of the analysis of trace. Sources of pollution in the laboratory. Experimental methods in analysis of trace. Sampling. Methods of decomposition in analysis of trace inorganic. Methods of extraction in analysis of trace organic. Technicians selected of analysis of trace.
SUBJECT 2. Automation	Automation in the laboratory of analysis: generalities. Automatic analysers. Discontinuous analysers, continuous and *robotizados. Analysers of injection in flow and flow *segmentado: characteristics. Phenomena of dispersion. Characteristics of the signal of injection in flow. Technicians 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 *muestrales 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
Supervised work	0	9	9

Lecturing	26	52	78
Short answer tests	2	4	6
Short answer tests	2	4	6
Essay questions exam	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.
Supervised work	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.
Lecturing	The professor will develop the contents of the program from the proportionate material to the student through the platform FEAR. In the sessions *magistrales, the professor will present the fundamental appearances of the matter that will have to complement by means of the bibliography recommended.

Personalized attention

Methodologies	Description
Lecturing	The professor will resolve the doubts of personalised way on any one of the activities proposed (masterclasses, seminars, works *tutelados, resolution of problems/exercises and proofs). To such end, the professor will inform the available schedule in the presentation of the matter.
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	Training and Learning Results		
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	A1 A2 A3	C4 C8 C17 C18 C19 C20 C22	D6 D7 D9 D12 D14
Supervised work	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	A1 A2 A3	C4 C8 C17 C18 C19 C20 C24	D1 D3 D4 D5 D7 D8 D9 D14 D17
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	A1 A2 A3	C4 C8 C17 C18 C19 C20	D1 D6 D7 D9 D12 D13 D14
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	A1 A2 A3	C4 C17 C19 C20 C22 C24	D1 D6 D7 D9 D12 D13 D14

Essay questions exam	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	A1 C4 D1 A2 C8 D6 A3 C17 D7 C18 D9 C19 D12 C20 D13 C22 D14 C24

Other comments on the 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. To surpass the short proofs as well as the long proof (final examination), will be necessary that exist a balance in the qualifications of the theoretical part and of the problems.

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) 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

Basic Bibliography

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

C. Cámara, **Análisis químico de trazas**, Síntesis, 2011

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

Complementary Bibliography

S. Mitra, **Sample preparation techniques in analytical chemistry**, Wiley, 2003

B.R. Eggins, **Chemical sensors and biosensors**, Wiley, 2002

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

K.A. Rubinson, **Análisis Instrumental**, Prentice-Hall, 2000

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

Kellner, **Analytical Chemistry**, Wiley-VCH, 2004

M. Valcárcel, M.D. Luque de Castro, **Flow-injection analysis. Principles and applications**, Ellis Horwood, 1987

Recommendations

Subjects that it is recommended to have taken before

Analytical chemistry 1/V11G200V01302

Analytical chemistry II/V11G200V01503

IDENTIFYING DATA

Biological chemistry

Subject	Biological chemistry			
Code	V11G200V01602			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Mandatory	3rd	2nd
Teaching language	Spanish			
Department	Biochemistry, Genetics and Immunology Analytical and Food Chemistry Organic Chemistry			
Coordinator	Teijeira Bautista, Marta			
Lecturers	Calle González, Inmaculada de la Martínez Pérez, Amparo Pérez Cid, Benita Simón Vázquez, Rosana Teijeira Bautista, Marta			
E-mail	qomaca@uvigo.es			
Web				
General description	Introductory course of Biochemistry, global and integrated knowledge of the molecular mechanisms responsible of biological processes.			

Competencies

Code	
A1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A2	Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
C4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances
C15	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: chemistry of biological molecules and their processes
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C21	Recognize and implement good scientific practices for measurement and experimentation
C23	Present oral and written scientific material and scientific arguments to a specialized audience
C25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use
C26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work
C27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way
C28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself

Learning outcomes

Expected results from this subject	Training and Learning Results		
Identify and recognise the structure of the distinct types of *biomoléculas and represent them properly, recognise his properties and his chemical reactivity.	A1 A3	C15	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15
Recognise the distinct biological activities of the diverse types of *biomoléculas	A1 A3	C15	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15
Define the kinetical enzymatic of reactions *catalizadas by enzymes as well as his general mechanisms. Recognise the distinct types of inhibition of the enzymatic activity and his quantification	A1 A3	C4 C15	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15
Relate the vitamins with the corresponding *coenzimas of enzymatic reactions	A1 A3	C15	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15
Explain he concept of *Bioenergética. Reason conceptually the importance of him attachment of the processes *endergónicos and *exergónicos in the biological systems	A1 A3	C15	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15
Enumerate the main structural appearances of the ATP that determine his paper in the transfer of energy. Describe the cycle of the ATP.	A1 A3	C15	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15

Distinguish the metabolic roads of the *biomoléculas, as well as his interrelationships and regulation	A1 A3	C15	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15
Explain the foundations of the current technicians of *proteómica and molecular biology in relation with the isolation, separation, purification, determination, identification and manipulation of proteins and nucleic acids	A1 A2 A3	C4 C15	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15
Apply experimentally some basic technicians in Biochemistry. Justify the application of the distinct instrumental technicians in the analysis of *biomoléculas	A1 A2 A3	C4 C15 C19 C21 C23 C25 C26 C27 C28	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15
Distinguish the main operations involved in the commercial production of *biomoléculas, as well as his foundations. Recognise the possible practical applications of *biomoléculas, with special emphasis in the characteristic operational conditions	A1 A2 A3 A5	C15 C21 C23 C25 C26 C27 C28	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15
Distinguish and pose analytical protocols of application of the previously mentioned technicians to the analysis of *biomoléculas in diverse areas (clinical, pharmaceutical, *biomédica, etc.)	A1 A2 A3 A5	C4 C15 C19 C21 C23 C25 C26 C27 C28	D1 D3 D4 D5 D7 D8 D9 D12 D13 D14 D15

Contents	
Topic	
1.Biomolecules	Structure and structure-function relationship of biomolecules: proteins, carbohydrates, lipids and nucleic acids.
2.Biocatalisis	Structure and function of enzymes. Enzymatic reactions. Enzymatic kinetics.
3.Vitamins and coenzymes	Structure and function of vitamins and coenzymes in metabolic reactions.
4.Metabolism of glucides	Degradative Metabolism of glucides: glycolysis. Metabolic crossroad of pyruvate. Degradative Oxidation of acetil-CoA. Respiratory chain and oxidative phosphorylation. Oxidative Route of the pentoses phosphate. Gluconeogénesis. Metabolism of glycogen.

5. Metabolism of lipids	Degradation of lipids: oxidation of fatty acids. Biosynthesis of fatty acids.
6. Metabolism of proteins	Proteolisis. Degradation of amino acids. Destination of the ion ammonium. Biosynthesis of amino acids.
7.Metabolism of nucleotides	Degradation of nucleic acids and nucleotides. Biosynthesis of nucleotides.
8.Experimental methods in Biochemistry	Techniques for synthesis and isolation of biomolecules. Separation, determination and identification of proteins. Determination and quantification of lipids. Determination and quantification of glycogen. Evaluation of the enzymatic activity. Effect of the temperature and inhibition. Polymerase chain reaction. Use of restriction enzymes.

Planning

	Class hours	Hours outside the classroom	Total hours
Seminars	13	19.5	32.5
Laboratory practices	45.5	68.25	113.75
Problem solving	3	3	6
Lecturing	26	26	52
Short answer tests	6	9	15
Laboratory practice	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 practices	They will propose questions practise, to resolve in the laboratory.
Problem solving	Activity in which they formulate problems and/or exercises related with the matter. The student has to develop the suitable or correct solutions by means of the realisation of routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. It is used to employ as I complement of the magistral lesson.
Lecturing	Exhibition by the professor of the contents on the matter object of study, theoretical bases and/or guidelines of a work, exercise or project to develop by the student.

Personalized attention

Methodologies	Description
Seminars	The professor will resolve the doubts of the students for the good development of the activities proposed
Laboratory practices	The professor will resolve the doubts of the students for the good development of the activities proposed
Problem solving	The professor will resolve the doubts of the students for the good development of the activities proposed

Assessment

	Description	Qualification	Training and Learning Results	
Seminars	Class participation and resolution of proposed problems will be evaluated.	10	C4 C15 C19 C23	D3 D4 D8 D12 D14 D15

Laboratory practices	Assistance to practical classes will be evaluated. Application of instrumental techniques learned in the laboratory sessions and resolution of the proposed problems will be evaluated.	30	A1 A2 A3 A5	C15 C19 C21 C25 C26 C27 C28	D3 D7 D9 D12 D13 D14
Short answer tests	Two short tests (with 25% and 15% values respectively) and one long test will be evaluated.	60	A1 A3	C4 C15	D1 D3 D4 D9 D12 D14

Other comments on the Evaluation

The final grade will be calculated taking into account: seminars (10%), laboratory practices (30%) and tests (60%). The short tests will have eliminatory character, as long as they reach the minimum value each of 5, subtracting its percentage corresponding to the value of the long test.

Attendance at laboratory sessions is mandatory. The lack of assistance, even if justified, will penalize the final grade. An attendance lower than 75% of the laboratory sessions supposes the qualification of suspense.

The non-performance of any test throughout the academic course and the failure to attend the long test will be considered as not presented.

For the evaluation of July, a global test will be carried out, with a value of 70% in the final grade, maintaining the remaining 30% for the qualification obtained in the laboratory practices, if they are approved. If 75% of the laboratory sessions have been completed and the minimum mark has not been achieved, an examination of recovery of the laboratory practices may be carried out in July.

Sources of information

Basic Bibliography

Stryer L., Berg J. M. & Tymoczko J. L., **Bioquímica**, 7ª, Editorial Reverté, 2013

Lehninger, Nelson D. L. & Cox M. M., **Principios de Bioquímica**, 7ª, Macmillan Higher Education, cop. 2017, 2017

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

Complementary Bibliography

Yurkanis Bruice, P., **Química Orgánica**, 5ª, PRENTICE HALL MEXICO, 2007

McKee and McKee, **Bioquímica**, 5ª, Ediciones McGraw Hill, 2014

Andreas Manz, Nicole Pamme, Dimitri Lossifidis, **Bioanalytical Chemistry**, 2ª, Imperial College Press, 2015

Victor A. Gault and Neville H. McClenaghan, **Understanding Bioanalytical Chemistry: principles and Applications**, 1ª, Wiley Blackwell, 2009

Feduchi, Blasco, Romero, Yañez, **Bioquímica**, 2ª, Panamericana, 2015

John Kuriyan, Boyana Konforti, David Wemmer, **The Molecules of Life**, 1ª, Garland Science, 2013

Schlick, Tamar, **Molecular modeling and simulation : an interdisciplinary guide**, 1ª, Springer Science+Business Media,, 2010

Recommendations

Subjects that it is recommended to have taken before

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

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

Competencies	
Code	
C7	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: kinetics of change, including catalysis and reaction mechanisms
C14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C21	Recognize and implement good scientific practices for measurement and experimentation
C22	Process and perform computational calculations with chemical information and chemical data
C23	Present oral and written scientific material and scientific arguments to a specialized audience
C26	Perform common laboratory procedures and use instrumentation in synthetic and analytical work
C27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way
C28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory
C29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself

Learning outcomes		
Expected results from this subject	Training and Learning Results	
Explain the hypotheses, the consequences and the fundamental results of the Molecular Kinetical Theory of the gases	C7 C14 C19 C23	D1 D3 D4 D9
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.	C7 C14 C19 C23	D1 D3 D4 D9

Define with precision, all the basic concepts in Kinetical Chemical, and know the distinct methods of analysis of data to obtain equations of speed.	C7 C19 C23	D1 D3 D4 D9
Establish the kinetical behaviour of complex reactions and apply the most usual approximations in kinetical chemical. Obtain equations of speed of complex processes from the corresponding mechanisms. Distinguish between complexes of Arrhenius and van't Hoff and know realise a kinetical treatment-formal general for both cases.	C7 C14 C19	D1 D3 D4 D9
Describe the foundation of the distinct experimental technicians available for the kinetical study of the chemical reactions.	C20 C27 C28	D1 D3 D4 D9
Be able to carry out the analysis of kinetical data, including the ones of complex reactions and relate the same with the mechanisms of reaction.	C7 C19 C27	D1 D3 D4 D7 D9
Explain the fundamental hypotheses of the distinct theories on the chemical change, as well as the results and the limitations of each one of them (Theory of Collisions and Theory of the State of Transition and know apply them like tool in the analysis of kinetical results).	C7 C14 C19	D1 D3 D4 D9
Describe the distinct types of *catálisis, explain the mechanism of the reactions *catalizadas and apply it to concrete cases. Know *particularizar said kinetical treatment-formal to the distinct types of *catálisis	C7 C19	D1 D3 D4 D9
Know the basic structure of the *interfase energised and his applications to the study of the stability of the colloids and of the processes in the *interfases *electródicas.	C7 C14 C19	D1 D3 D4 D9
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.	C14 C19	D1 D3 D4 D9
Explain the nature and structure of the macromolecules in dissolution and the most representative models for his description.	C14 C19	D1 D3 D4 D9
Describe with clarity the nature and the distinct types of systems *coloidales. Comprise the basic appearances of the thermodynamic treatment of the macromolecular dissolutions.	C14 C19	D1 D3 D4 D9
Describe the foundation of the experimental technicians more important for the determination of the structure of *macromoleculas and systems *coloidales.	C14 C27	D1 D3 D4 D9
Describe the structure and explain the causes of the stability of the systems *coloidales as well as recognise his chemical importance.	C14 C19	D1 D3 D4 D9
Know the basic appearances of the structure of the *interfase *electródica, the origin of the distinct types of *sobrepotencial and his application.	C7 C14 C19	D1 D3 D4 D9
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.	C19 C20 C21 C22 C26 C27 C28 C29	D1 D4 D5 D6 D7 D8 D9 D14 D15

Contents

Topic	
(*)Phenomena of transport	(*)Kinetical theory of the gases. Phenomena of transport no electrical. Phenomena of electrical transport: conductivity

(*)Phenomena of surface	(*)Superficial tension. Structure of the solid surfaces. Adsorption on solid surfaces. *Fisisorción And *quimisorción: models. The *interfase energised.
(*)Kinetical formal	(*)Speed of reaction and equations of speed. Analysis of data. Kinetical analysis of complex reactions. Mechanisms. Influence of the temperature in the speed of reaction.
(*)Experimental methods in Kinetical Chemical	(*)Transformation of the equations of speed. Conventional technicians. Experimental technicians for the study of fast reactions.
(*)Theoretical interpretation of the speed of reaction.	(*)Theory of collisions for reactions *bimoleculares. Theory of the state of transition.
(*)Macromolecules.	(*)Structure of the macromolecules. Structural models. Characterisation of macromolecules.
(*)Colloids.	(*)Classification of the systems *coloidales. Synthesis and characterisation of colloids. Stability of systems *coloidales.
(*)*Catálisis.	(*)General mechanism of the *catálisis. *Catálisis *homogénea. *Catálisis Heterogeneous.
(*)Kinetical *electródica.	(*)Stages of a process *electródico. *Sobrepotenciales. *Sobrepotencial Of transfer of load. *Sobrepotencial Of diffusion. *Sobrepotenciales Of reaction and crystallisation. Experimental technicians.
(*)Practical.	(*)Experiences of Kinetical Chemical including *Catálisi, Phenomena of Transport, Electrochemical Macromolecules and Colloids.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	26	0	26
Seminars	13	65	78
Laboratory practices	45.5	32.5	78
Short answer tests	1	5	6
Short answer tests	1	5	6
Essay questions exam	3	15	18
Practices report	0	6	6
Problem solving	0	7	7
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

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

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

Assessment				
	Description	Qualification	Training and Learning Results	
Seminars	Presentation and discussion of exercises prior to the seminar will be evaluated	20	C7 C14 C19 C23	D1 D6 D7 D14

Laboratory practices	It is scored here along with the effort and the attitude, the skills and the competences developed by the student during the accomplishment of the different practices. Attendance at practice sessions is mandatory and, therefore, it is not possible to pass the subject in case it has not taken place.	15	C19 C20 C21 C22 C23 C26 C27 C28 C29	
Short answer tests	Evaluation of acquired knowledge up to date with a small exam (questions, problems)	10	C7 C14 C19 C23	D1 D7
Short answer tests	Evaluation of acquired knowledge up to date with a small exam (questions, problems)	10	C7 C14 C19 C23	D1 D7
Essay questions exam	Final exam. Evaluation of the acquired knowledge: questions and problems	40	C7 C14 C19 C23 C28	D1 D7
Practices report	The presentation and quality of the experimental data obtained in experiments will be evaluated. Reports will necessarily include some discussion on the reported data.	5	C19 C20 C21 C22 C23 C28 C29	

Other comments on the Evaluation

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

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

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

Sources of information

Basic Bibliography

Complementary Bibliography

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

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

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

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

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

S. SENENT, **Química Física II**, 3ª,

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

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

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

Competencies	
Code	
C2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics
C7	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: kinetics of change, including catalysis and reaction mechanisms
C8	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: main techniques for structural determination, including spectroscopy
C9	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: characteristic properties of the elements and their compounds, including group relationships and variations in the periodic table
C12	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: structural features of chemical elements and their compounds, including stereochemistry
C14	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules

Learning outcomes	
Expected results from this subject	Training and Learning Results
Classify ligands and coordination compounds, as well as recognize the presence of isomers.	C12
Define the global and steps thermodynamic stability constants of one complex and describe the chelate, macrocyclic and cryptate effects	C2 C14
Deduce the spectroscopic terms for stable electronic configurations of the transition metals in a coordination compound	C9
Construct and interpret a qualitative energy diagram of molecular orbitals in octahedral complexes	C12 C14
Interpret the electronic spectra of octahedral, tetrahedral and square planar complexes of transition metals and rationalize their magnetic behavior	C8 C14
Describe the different mechanisms of substitution and rationalize the various products obtained in substitution reactions in octahedral and square planar complex.	C7
Describe how you can get metals from their natural resources	C9
Being able to differentiate the behavior between the elements of the first transition series and the second and third.	C9
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.	C9
Rationalize the thermodynamic stability of coordination compounds, depending on the oxidation state of the metal and the type of ligand.	C9 C12 C14

Contents
Topic

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

Planning

	Class hours	Hours outside the classroom	Total hours

Seminars	26	26	52
Lecturing	26	39	65
Short answer tests	2	2	4
Problem solving	0	21	21
Essay questions exam	4	4	8

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

Methodologies

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

Personalized attention

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

Assessment

	Description	Qualification	Training and Learning Results
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	C2 C7 C8 C12 C14
Lecturing	In the lectures they may ask students to solve simple issues that will have to deliver at that time and will serve for the evaluation. The score will be considered only if the test is long reaches a score of 3 or above on 10 points.	5	C2 C7 C8 C12
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	C2 C7 C8 C9 C12 C14
Problem solving	Throughout the course they ask students to do exercises to perform such work. The solutions must be submitted in a timely manner previously established. It is possible that the teacher ask the student to defend his response delivered before proceeding with the assessment. The score will be considered only if the test is long reaches a score greater than or equal to 3 points out of 10.	15	C2 C7 C8 C9 C12 C14
Essay questions exam	There will be a test at the end of the semester in which students must resolve all issues related to the presented contents.	40	C2 C7 C8 C9 C12 C14

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

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

Subjects that it is recommended to have taken before
Chemistry: Chemistry 1/V11G200V01105
Chemistry: Chemistry 2/V11G200V01204
Physical chemistry I/V11G200V01303
Physical chemistry II/V11G200V01403
Inorganic chemistry I/V11G200V01404