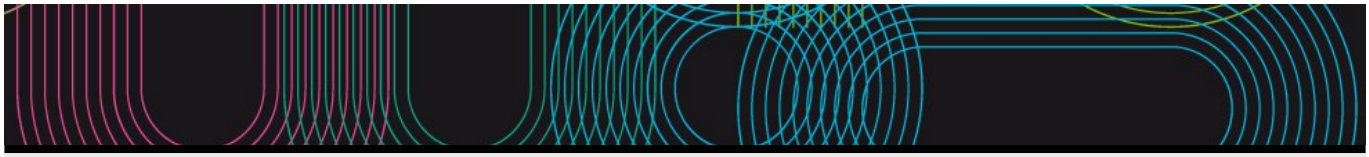

IDENTIFYING DATA				
Analytical chemistry I				
Subject	Analytical chemistry I			
Code	V11G200V01302			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Mandatory	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Pérez Cid, Benita			
Lecturers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

Competencies	
Code	
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
C1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.
C2	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: types of chemical reactions and its main characteristics
C4	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Basics and tools for solving analytical problems and characterization of chemical substances
C17	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories in: metrology of chemical processes including quality management
C18	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles of electrochemistry
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
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
D16	Develop an ethical commitment

Learning outcomes

Expected results from this subject		Training and Learning Results	
Recognise the importance of the Analytical Chemistry in function of its aims.		C4 C19	D4 D14
Identify the fundamental stages of the analytical process like methodology for the resolution of analytical problems and select the appropriate analytical method.	A5	C4 C19	D4 D14
Describe the basic analytical properties (accuracy, precision, sensitivity and selectivity) and the types of errors that can affect to the experimental results.		C19 C20	D1 D4 D6 D14
Describe the fundamentals of sampling and sample preparation for the determination of different analytes.		C4 C19	D1 D4 D14
Calibration, use and cleaning of the material used in the analytical laboratory.	A5	C21 C26	D7 D9 D12
Prepare solutions of exact concentration (primary pattern) and approximate (secondary and reactive pattern auxiliaries) in function of its purpose and handle properly the concentration units.	A5	C1 C17 C21 C25	D6 D7 D9 D12 D13
Explain and interpret the basic knowledges of the separation and identification of chemical species in solution using a systematic separation approach.	A5	C2 C4 C19 C21 C26	D3 D7 D9 D12 D13 D14
Describe the principles of the quantitative chemical analysis (volumetric and gravimetric) and its experimental limitations.		C2 C4 C19	D1 D14
Identify and evaluate the possible interaction between concurrent reactions: acid-base, complexes, precipitation and redox.	A5	C2 C18 C19 C20	D7 D9 D12 D14
Elaborate and interpret titration curves of acid-base, complexes, precipitation and redox and know select the most suitable indicators.	A5	C2 C18 C19 C20	D5 D7 D9 D12 D14
Describe the foundations of the gravimetric analysis and the factors that influence the purity of precipitates.		C2 C20	D1 D4 D14
Carry out, in the laboratory, the precipitation and the separation by filtration in gravimetric analysis.		C2 C17 C19 C21 C25 C26 C28	D7 D8 D12
Use properly the gravimetric and volumetric techniques, including the suitable handling of the necessary equipment.	A5	C17 C19 C21 C26 C27	D7 D9 D12 D14

Handle the systematic calculation in the volumetric (direct, indirect and back titrations) and gravimetric analysis and learn how to interpret the results obtained.	A5	C20 C22 C28 C29	D6 D7 D14 D15 D16

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	26	33	59
Troubleshooting and / or exercises	26	36	62
Laboratory practises	45.5	12.5	58
Reports / memories of practice	0	6	6
Short answer tests	4	11	15
Long answer tests and development	3.5	12	15.5
Practical tests, real task execution and / or simulated.	3.5	6	9.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies
Description

Master Session	They are theoretical classes (two hours each week) in which the professor will offer a global vision of each one of the subjects of the program, specially in the most relevant issues and in those with more difficulty for the student. Classroom sessions will develop in an interactive way with the students, commenting with them the on-line material (available in the platform Tem@) and the most adapted bibliography for the preparation, in depth, of each subject.
Troubleshooting and / or exercises	Two hours per week will be devoted to problems and/or exercices solving (seminars) aimed at reinforcing the knowledges acquired during the classroom sessions. In some sessions the professor will explain to the students the problems-type that allow them to solve the worksheet exercises. Instead, in other sessions, the own students will solve and will explain in the blackboard the exercises proposed (on-line material). Will be able to request to the students that deliver, of individual form, some of these solved exercises , that will be corrected by the professor.
Laboratory practises	Students will do experiments in the laboratory, in an individual way, in 3.5 hours per session. The student will have the scripts of the practices in the platform Tem@, so that they can have a previous knowledge of the experiments to perform. During the development of the practices the student will elaborate a notebook in which they will annotate all the relative to the experiment carried out (reactions, procedures, observations, results, etc.).Those students who have approved the laboratory practices in the academic year 2015-16, do not need to repeat them. In this case, marks reached in the laboratory sessions will be maintained.

Personalized attention

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

Assessment

	Description	Qualification		Training and Learning Results	
Troubleshooting and / or exercises	The teacher will evaluate the exercices/problems included in the worksheets and solved by students.	8		C1 C2 C4 C18 C19 C22	D4 D5 D6 D7 D9 D14
Laboratory practises	The teacher will carry out a follow-up the performance of students in the laboratory sessions (skills acquired). It is important to indicate that it is COMPULSORY the assistance to all the laboratory sessions. If the number of absences is equal or upper than 25 % of the laboratory sessions, students will not be allowed to pass the course.	15	A5	C1 C2 C4 C17 C18 C19 C20 C21 C22 C25 C26 C27 C28 C29	D6 D7 D8 D9 D12 D13 D14 D15 D16
Reports / memories of practice	During the laboratory sessions, students will elaborate a noteboodk in which reflects the experimental work performed (reactions, procedures, observations, results, etc.). This notebook will be evaluated by the professor.	5		C20	D1 D3 D6 D9 D12 D14 D15 D16

Short answer tests	Students will carry out a first short proof about formulation of chemical compounds and calculation of concentrations that will represent a 7 % of the final mark. Students will carry out a second short exam corresponding to the four first subjects of the program (20% of the final mark). If students pass this exam, they only need to pass the examination corresponding to the rest of subjects in the final exam.	27	A5	C1 C2 C4 C19 C20 C22	D1 D3 D4 D5 D6 D7 D9 D12 D13 D14 D16
Long answer tests and development	Students will carry out a final written exam corresponding to the four last subjects of the program. Students who have not passed the exam corresponding to the first four subjects, will need to pass the examination of the whole course.	30	A5	C1 C2 C4 C18 C19 C20 C22	D1 D3 D4 D5 D6 D7 D9 D12 D13 D14 D16
Practical tests, real task execution and / or simulated.	At the end of the laboratory sessions, students will carry out a exam so that practical skills acquired can be evaluated. It is mandatory to overcome this examination to pass the practical part of the course.	15	A5	C28 C29	D1 D3 D6 D7 D9 D12 D13 D15 D16

Other comments on the Evaluation

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

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

Sources of information

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

D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, **Fundamentos de Química Analítica**, 9ª Ed., Thompson, Madrid,

D.C. Harris, **Análisis Químico Cuantitativo**, 3ª Ed., Reverté, Barcelona,

Gary D. Christian, **Química Analítica**, 6ª Ed., McGraw-Hill,

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

F. Burriel, S. Arribas, F. Lucena y J. Hernández, **Química Analítica Cualitativa**, 18ª Ed., Paraninfo, Madrid,

D. Harvey, **Química Analítica Moderna**, McGraw-Hill, Madrid,

M. Valcárcel, **Principios de Química Analítica**, Springer,

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

P. Yañez-Sedeño Orive, J.M. Pingarrón Carrazón, F.J. Manuel de Villena Rueda, **Problemas Resueltos de Química Analítica**, Síntesis,

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

Recommendations

Subjects that continue the syllabus

Analytical chemistry II/V11G200V01503

Analytical chemistry 3/V11G200V01601

Subjects that are recommended to be taken simultaneously

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

Subjects that it is recommended to have taken before

Chemistry, physics and biology: Integrated laboratory I/V11G200V01103
Chemistry, physics and geology: Integrated laboratory II/V11G200V01202
Chemistry: Chemistry I/V11G200V01105
Chemistry: Chemistry 2/V11G200V01204