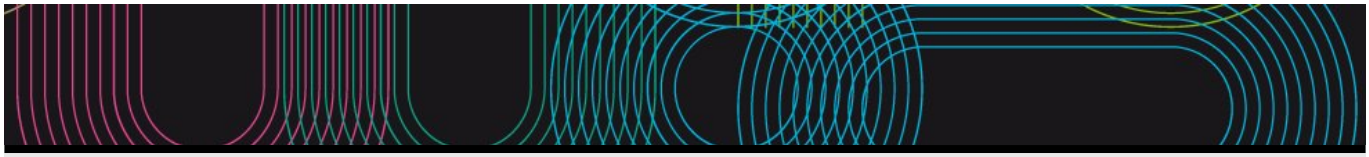

IDENTIFYING DATA				
Analytical Chemistry I: Principles of Analytical Chemistry				
Subject	Analytical Chemistry I: Principles of Analytical Chemistry			
Code	V11G201V01202			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Pérez Cid, Benita			
Lecturers	Calle González, Inmaculada de la Pena Pereira, Francisco Javier Pérez Cid, Benita			
E-mail	benita@uvigo.es			
Web				
General description	The main objective of this matter is that the students achieve the competences to be able to handle volumetric and gravimetric chemical analysis, both in the theoretical and applied aspects. The theory classes are complemented with seminars and laboratory practices.			

Training and Learning Results	
Code	
A1	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
B4	Ability for analysis and synthesis
C6	Know the basics and tools for resolution of analytical problems and characterization of chemical substances
C26	Perform correctly usual procedures in the laboratory, including the use of standard chemical instrumentation for synthetic and analytical work
C29	Demonstrate ability for numerical calculations and interpretation of experimental data, with correct use of units and estimation of uncertainty
D1	Ability to solve problems

Expected results from this subject	Training and Learning Results			
Describe the fundamental steps of the analytical process like methodology for the resolution of analytical problems.	A3	B4	C6	D1
Identify basic analytical properties and errors that can affect analytical results.	A3	B4	C6 C29	D1
Solve the possible interaction between concurrent reactions in solution (acid-base, complexes, precipitation and redox).	A1	B4	C6 C29	D1
Construct and interpret titration curves (acid-base, complex, precipitation and redox) and select the most appropriate indicators in each case.	A3	B4	C6 C29	D1
Handle the systematic calculation in volumetric and gravimetric analysis and interpret the results.	A3	B4	C6 C26 C29	D1

Experimentally apply volumetric and gravimetric analysis procedures and correctly express the results obtained.	A1 A3	B4	C6 C26 C29	D1
Appropriately handle the material used in the analytical laboratory and apply the safety standards required.	A1		C26	D1

Contents	
Topic	
Subject 1: Analytical Chemistry and analytical process	Analytical chemistry as a metrological science. Classification of analytical methods. The analytical process: stages.
Subject 2. Evaluation of the analytical results	Analytical properties. Errors in Analytical Chemistry: Classification. Basic statistics applied to the expression of the analytical results. Comparison and rejection of results.
Subject 3: Introduction to volumetric and gravimetric quantitative analysis	Volumetric reactions. Standard solutions. Direct, indirect and back titrations. Formation, properties and purity of precipitates. Calculations of gravimetric and volumetric analysis.
Subject 4: Acid-base titrations	Behavior of monoprotic, polyprotic and amphoteric species. Titration curves. End point detection: acid-base indicators. Titran reagents. Analytical applications.
Subject 5: Complexometric titrations	Stability of the complexes. Masking reactions. Titration curves. Detection of the end point: metallochromic indicators. Analytical applications.
Subject 6: Precipitation titrations.	Factors affecting the solubility of precipitates. Titration curves. Detection of the end point: Mohr, Volhard and Fajans methods. Analytical applications.
Subject 7: Redox titrations	Factors influencing the redox potential. Titration curves. Detection of the end point: redox and specific indicators. Analytical applications.
Gravimetric analysis (Laboratory)	Gravimetric determination of nickel with dimethylglyoxime. (1 session)
Acid-base titrations (Laboratory)	Determination of the acidity of a vinegar sample. (1 session) Determination of acetylsalicylic acid in analgesics (1 sesion)
Complexation titrations (Laboratory)	Determination of the hardness of a water sample . (1 session)
Precipitation titrations (Laboratory)	Determination of chloride in seawater using the Mohr method. (1 session)
Redox titrations (Laboratory)	Determination of wealth in oxygen in a hydrogen peroxide sample. (1session) Determination of active chlorine in a bleach sample. (1 session)
Resolution of a practical case (Laboratory)	Analysis of a problem sample of unknown composition. (1 session)

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	24	24	48
Seminars	12	24	36
Laboratory practical	24.5	12	36.5
Essay questions exam	2	7	9
Essay questions exam	0	12	12
Laboratory practice	3.5	5	8.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	They are theoretical classes in which the professor will explain each one of the topics of the program, emphasizing in the most relevant aspects and in those with more difficulty for the student. The classes will be developed interactively with the students, commenting the on-line material (available in Moovi) and the most appropriate bibliography for the preparation, in depth, of each topic.
Seminars	In the seminars, numerical exercises will be solved to reinforce the knowledge acquired in the theoretical classes. These exercises will be available in Moovi, as worksheets. The teacher may request the students to provide, individually, some of the proposed exercises to be reviewed and evaluated.

Laboratory practical	Laboratory experiments will be carried out in sessions of 3.5 h each. The students will have the guidelines of practices with sufficient anticipation (on-line material), so that they can have a previous knowledge of the experiments to performe. 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 passed the laboratory practices in the academic years 2021-22 and 2022-23, do not need to repeat them. In this case, the marks reached in the laboratory sessions will be maintained.

Personalized assistance

Methodologies	Description
Seminars	Time dedicated by the professor to attend to all the doubts and questions made by the student during the course. The available time will be informed in the presentation of the course.
Lecturing	Time dedicated by the professor to attend to all the doubts and questions made by the student during the course. The available time will be informed in the presentation of the course.
Laboratory practical	Time dedicated by the professor to attend to all the doubts and questions made by the student during the course. The available time will be informed in the presentation of the course.

Assessment

	Description	Qualification	Training and Learning Results
Seminars	It will value the resolution, by part of the students, of some of the problems and/or exercises proposed in the worksheets, that have to be delivered to the professor.	15	A1 C6 D1 A3 C29
Laboratory practical	The professor will made an evaluation of the experimental work carried out by the students in the laboratory sessions, evaluating the skills acquired as well as the results of each experiment. It is important to indicate that it is COMPULSORY the assistance to all the laboratory sessions. The lack of assistance will penalize the mark and when the number of absences is upper than 25 % of the laboratory sessions, students will not be allowed to pass the practical part of the course.	15	A1 C6 D1 A3 C26 C29
Essay questions exam	SHORT PROOF: A first written proff will be held when the first part of the programme has been given, in which the competences acquired up to that point will be assessed. This exam will not eliminate subject matter and will be carried out on the date indicated in the academic programme of the course, approved by the Faculty Meeting.	15	A1 C6 D1 A3 C29
Essay questions exam	FINAL EXAM: At the end of the course there will be a written proof consisting of theoretical questions and numerical exercises. In order to average both parts it will be necessary to achieve a minimum mark of 3 points out of 10 in each of them. In addition, the student must achieve in this exam a minimum mark of 4 points out of 10 to be added to the rest of the evaluation elements. This test will be carried out on the date indicated in the academic programme of the course, approved by the Faculty Meeting.	40	A1 C6 D1 A3 C29
Laboratory practice	In the last laboratory session, it will make a laboratory proof that will allow to evaluate all the competences and skills acquired by the student during the laboratory sessions. It is mandatory to overcome this exam, with a minimum mark of 5 points out of 10, to pass the practical part of the course.	15	A1 C6 D1 A3 C26 C29

Other comments on the Evaluation

First opportunity (continuous evaluation): 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 achieve a minimum mark of 4 points out of 10 in the final exam (at the end of the course) and 5 points out of 10 in the laboratory proof. The mark corresponding to the practical part of the curse (laboratory) will be only taken into account in the final mark once the theory has been passed. The participation of the student in written exams and the assistance to laboratory sesions (two or more) will involve the condition of presented and, therefore, the assignment of a mark.

Second opportunity (continuous evaluation): In the second opportunity (July) the student may repeat those exams (theory and/or laboratory) that have not passed in the first opportunity. It will be preserved the mark reached by the student, during the course, in the laboratory practicals (15%). In this announcement, the exam corresponding to the theoretical part of the course will represent the 70% of the final mark and the laboratory proof the 15%, always following the same considerations established for the first opportunity.
Global evaluation mode (non-continuous): Students who wish to use this evaluation mode must inform by writing to the

coordinatorof the course , during the first month after the start of the course. In this case, the evaluation will consist of the following parts: laboratory practices (30%) and global evaluation exam (70%) and it will be necessary to achieve a minimum mark of 5 points out of 10 in each of the proofs (theory and laboratory) in order to pass the course.

Sources of information

Basic Bibliography

D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, **Fundamentos de Química Analítica**, 9ª Ed., Cengage Learning, 2015

Gary D. Christian, **Química Analítica**, 6ª Ed., McGraw-Hill, 2009

D.C. Harris, **Análisis Químico Cuantitativo**, 3ª Ed., Reverté, 2007

F. Burriel, S. Arribas, F. Lucena y J. Hernández, **Química Analítica Cualitativa**, 18ª Ed., Paraninfo, 2002

J.N. Miller y J.C. Miller, **Estadística y Quimiometría para Química Analítica**, 4ª Ed., Prentice Hall, 2002

P. Yañez-Sedeño Orive, J.M. Pingarrón Carrazón, F.J. Manuel de Villena Rueda, **Problemas Resueltos de Química Analítica**, 1ª Ed., Síntesis, 2003

J. Guiteras, R. Rubio, G. Fonrodona, **Curso Experimental en Química Analítica**, 1ª Ed., Síntesis, 2003

Complementary Bibliography

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

D. Harvey, **Química Analítica Moderna**, 1ª Ed., McGraw-Hill, 2002

J. A. López Cancio, **Problemas Resueltos de Química Analítica**, 1ª Ed., Paraninfo, 2005

Recommendations

Subjects that continue the syllabus

Analytical Chemistry II: Optical Methods of Analysis/V11G201V01207

Subjects that are recommended to be taken simultaneously

Physical chemistry I: Chemical thermodynamics/V11G201V01203
Inorganic chemistry I/V11G201V01204
Organic chemistry I/V11G201V01205

Subjects that it is recommended to have taken before

Mathematics: Mathematics 1/V11G201V01103
Mathematics: Mathematics 2/V11G201V01108
Chemistry: Chemistry Lab I/V11G201V01105
Chemistry: Chemistry Lab II/V11G201V01110
Chemistry: Chemistry 1/V11G201V01104
Chemistry: Chemistry 2/V11G201V01109