Teaching Guide				
Identifying Data				2022/23
Subject (*)	Experimental Physical Chemistry		Code	610G01019
Study programme	Grao en Química			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Third	Obligatory	6
Language	SpanishEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Química			
Coordinador	Vilariño Barreiro, Maria Teresa		E-mail	teresa.vilarino@udc.es
Lecturers	Barriada Pereira, José Luis Herrero Rodriguez, Roberto Rodriguez Barro, Pilar Vilariño Barreiro, Maria Teresa		E-mail	jose.barriada@udc.es r.herrero@udc.es pilar.rbarro@udc.es teresa.vilarino@udc.es
Web	campusvirtual.udc.es			
General description	Integrated laboratory with special emphasis on applications of the main instrumental techniques. The course explores the experimental methodology of Physical Chemistry and it is intended to enable students to interpret the experimental results from the theoretical models developed in the previous course of Physical Chemistry 3. The development of critical thinking that allows integrating the theoretical experiment is a very important aspect in the overall education of a chemist. Moreover, it introduces students to the management of the most common instrumental techniques in any chemistry laboratory. (English lecturers: Teresa Vilariño/José Luis Barriada)			

Study programme competences / results	
Code	Study programme competences / results
A1	Ability to use chemistry terminology, nomenclature, conventions and units
A5	Understanding of principles of thermodynamics and its applications in chemistry
A14	Ability to demonstrate knowledge and understanding of concepts, principles and theories in chemistry
A16	Ability to source, assess and apply technical bibliographical information and data relating to chemistry
A17	Ability to work safely in a chemistry laboratory (handling of materials, disposal of waste)
A18	Risk management in relation to use of chemical substances and laboratory procedures
A19	Ability to follow standard procedures and handle scientific equipment
A20	Ability to interpret data resulting from laboratory observation and measurement
A21	Understanding of qualitative and quantitative aspects of chemical problems
A22	Ability to plan, design and develop projects and experiments
B2	Effective problem solving
B3	Application of logical, critical, creative thinking
B4	Working independently on own initiative
B5	Teamwork and collaboration
C1	Ability to express oneself accurately in the official languages of Galicia (oral and in written)
C3	Ability to use basic information and communications technology (ICT) tools for professional purposes and learning throughout life

Learning outcomes	
Learning outcomes	Study programme competences / results

To acquire practical skills needed for experimental quantification of the thermodynamic and electrochemical properties of chemical systems.	A17 A18 A19 A22	B2 B3	C3
To acquire skills in the treatment of the measurements in the laboratory and skill in the use of software to carry out the analysis of experimental data.	A20 A21 A22	B2 B3	
To acquire practical skills in the application of instrumental techniques most commonly used in chemistry to the study of systems of physicochemical interest.	A19 A22	B2 B3	
To analyze and interpret the result of a chemical experiment from fundamental theoretical concepts of Physical Chemistry.	A5 A14 A20 A21 A22	B2 B3	
To write a comprehensive report of experimental work using appropriate scientific language.	A1 A16 A20	B3 B4	C1 C3
To learn how to search, use and cite required bibliographic information.	A16	B4 B5	C3

Contents	
Topic	**Sub-topic**
Chemical Thermodynamics practical demonstrations that do not require instrumental techniques	1. Partial molal volumes of a binary mixture. 2. Molecular masses by cryoscopy measurements. 3. Activity of an electrolyte by cryoscopy measurements. 4. Molecular masses by distillation of mixture of two immiscible liquids. 5. Phase diagram of a ternary system. 6. Determination of the equilibrium constant. 7. Determination of heat of solution for benzoic acid by solubility measurements. 8. Partition coefficient. Application to the calculation of an equilibrium constant. 9. Determination of the solubility of a compound sparingly soluble in several saline media. Common ion effect and salting effect. 10. Chemical equilibrium. Determination of DG0, DH0 and DS0. 11. Diagram of solid-liquid phase of a binary system.
Chemical Thermodynamics practical demonstrations that incorporate instrumental techniques	12. Determination of the phase diagram of a vapor-liquid binary system. 13. Spectrophotometric determination of the equilibrium constant of an indicator. 14. Characterization of a coordination compound by spectrophotometric measurements. 15. Potentiometric determination of the dissociation product of water by Gran's method. 16. Dye adsorption isotherms.

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
Seminar	A5	4	3	7
Laboratory practice	A1 A14 A16 A17 A18 A19 A20 A22 B3 B4 B5 C1 C3	56	84	140

Mixed objective/subjective test	A1 A5 A14 A20 A21 B2 B3 C3	3	0	3
Personalized attention		0		0
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	**Description**
Seminar	Practical experiments to perform are proposed. These experiments are related to the theoretical contents of Physical Chemistry 3 subject. Different experimental methodologies are proposed and a specific experimental procedure is discussed.
Laboratory practice	Each student is assigned a certain number of practical experiments to be performed individually. The experiments will be indicated in advance in order to prepare both the theoretical background and experimental procedure before going into the lab. During the laboratory work, the student must show a responsible attitude in relation with both the safety regulations and the methodology and rigour of the scientific method. The experimental results of each experiment should be analyzed and discussed adequately, being neccesary the use of computer resources. Each student must hand in a written report of each of the experiments done. This report must contain all the experimental data, its analysis and the critical discussion of the results obtained. The report must be written following the guidelines of a scientific report.
Mixed objective/subjective test	Assessment of all the contents worked on the subject, both the theoretical background and the experimental contents, related with the procedure, the analysis of data and the discussion of the results.

Personalized attention	
Methodologies	**Description**
Laboratory practice	Solving any doubts individually and guiding the student in relation to course content. Part-time students and those with special academic leave permission could ask for presential or email tutorials when necessary.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Laboratory practice	A1 A14 A16 A17 A18 A19 A20 A22 B3 B4 B5 C1 C3	The assessment of laboratory practices includes: 1) Continuous assessment of the work done by the student in the laboratory, considering the skills and knowledge achieved, the answers to the questions made during the lab, as well as the experimental data, its analysis and discussion. The lack of knowledge and/or attitude during the experimental work in the lab will be reason for expulsion from the lab. It is compulsory to complete the whole period of laboratory sessions to pass the subject. 2) The report prepared for each one of the experiments carried out, which must include all the experimental data, its analysis and the critical discussion of the results obtained. In addition, the report must be written following the guidelines of a scientific report.	50

Mixed objective/subjective test	A1 A5 A14 A20 A21 B2 B3 C3	Written test to evaluate the contents of the subject, both the theoretical background of the experiments and the analysis and discussion of the experimental results. It constitutes 50% of the final grade at the first opportunity, but students must obtain a minimum of 3.5 points out of 10 in the written test to pass the course. In the second opportunity, the written test will represent 100% of the final grade.	50

Assessment comments

Attendance at all seminars and practices is compulsory for the student to pass the course.
First opportunity assessment:
The
student pass the subject when the average of the marks obtained in the different methodologies of assessment is equal to or greater than 5.0 points out of 10 and the mark obtained in the written test is equal or greater than 3.5 points out of 10.
The student fail the subject in case of not achieving the minimum mark in the written test
(3.5), although the average of the assessment methodologies was equal to or
greater than 5.0. The subject appears as failed (4.5).
The final mark could be scaled up to a maximum of 0.5 points as a result of the evaluation of the overall student's progression.
A grade of NP ("absent") will only be given to the students who do not engage in any practice session in the lab.
Second opportunity assessement:
Students who do
not pass the continuous assessment of the practical work in the
laboratory must pass an experimental test at the lab.
The
students who pass the continuous assessment of the practical work in
the laboratory will have to pass a test in the classroom that will represent 100% of the final grade.
Students evaluated in the "second opportunity" will only be eligible for
Honors if the maximum number of licenses for the corresponding course
has not been fully covered in the "first opportunity"
Should it be more candidates to honors grade than licenses available, allocation of licenses could be done through a extraordinary exam.
The teaching-learning process, including assessment, refers to an
academic course and, therefore, will restart as new with every new
academic year, including all activities and assessment procedures
scheduled for that course.
Early examination call of December
- To pass the course, it is compulsory for students to have attended all the practical sessions in a previous academic year.
- The examination will consist on a practical exam in the lab and it will epresent the 100% of the final grade. To pass the course, the score of the exam must be equal to or greater than 5.0 (out of 10).
Part-time students and students with special academic permission (according to the rules of the UDC):
Being an experimental subject, assistance to all activities is mandatory. As far as possible, it will be tried to fit the schedule of the practical sessions to the availability of students.
The evaluation criteria for both the first and the second opportunity, will be the same as for the rest of the students.
Any fraudulent performance in any evaluation activity, once verified, will directly involve the qualificaction of fail (0) in the subject in the corresponding call, thus invalidating any mark obtained in the continuous assessment for any resit.

Sources of information

Basic	- Matthews, G.P (1985). Experimental Physical Chemistry. Boston. Oxford Science Pub - Shoemaker, D.P.; Garland, G.W.; Nibler, J.W. (2009). Experiments in Physical Chemistry 8ª ed.. McGraw-Hill - Sime, R.J (1990). Physical Chemistry: Methods, techniques, experiments.. Philadelphia. Saunders College Publishing - Ruix Sánchez, J.J.; Rodríguez Mellado, J.M.; Muñoz Gutiérrez, E., Sevilla Suárez de Urbina, J.M. (2003). Curso experimental en Química Física. Síntesis - Denbigh, K. (1985). Equilibrio Químico . Madrid. AC - Levine, I.N. (2004). Fisicoquímica . McGraw-Hill - Levine, I.N. (2014). Principios de Fisicoquímica. McGraw-Hill
Complementary	- Sime, R.J. (2005). Physical chemistry calculations with Excel, Visual Basic, Visual Basic with applications, Mathcad, Mathmatica. San Francisco: Pearson

Recommendations
Subjects that it is recommended to have taken before
Chemistry Laboratory 1/610G01010 Physical Chemistry 3/610G01018 Chemistry Laboratory 2/610G01032
Subjects that are recommended to be taken simultaneously
Physical Chemistry 3/610G01018
Subjects that continue the syllabus
Advanced Physical Chemistry/610G01020
Other comments
Green Campus Faculty of Sciences ProgramTo achieve an immediate sustainable environment and comply with point 6 of the "Environmental Declaration of the Faculty of Sciences (2020)",the documentary works carried out in this subject: a) They will be requested mainly in virtual format and computer support. b) If done on paper: - Plastics will not be used. - Double-sided prints will be made. - Recycled paper will be used. - Drafts will be avoided.