Teaching Guide				
Identifying Data				2016/17
Subject (*)	Experimentación en Química Física		Code	610G01019
Study programme	Grao en Química			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Third	Obligatoria	6
Language	SpanishEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Química Física e Enxeñaría Química 1			
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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.			

Study programme competences	
Code	Study programme competences
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

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**	**Ordinary class hours**	**Student?s personal work hours**	**Total hours**
Seminar	A5	4	6	10
Laboratory practice	A17 A18 A19 A22 C1	56	56	112
Supervised projects	A1 A14 A16 A20 B3 B4 B5 C1 C3	0	25	25

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. Some aspects of these experiments are solved in small groups while others are performed individually.
Supervised projects	- The student must analyze the experimental data obtained in the laboratory with the help of software. - Each student has to make their own lab report containing the theoretical concepts, experimental results and answers to several questions about each experiment. This report must be written following the style corresponding to a scientific report.
Mixed objective/subjective test	Evaluation of the contents in the subject. This evaluation will be held upon completion of the practical work.

Personalized attention	
Methodologies	**Description**
Laboratory practice Supervised projects	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**	**Description**	**Qualification**
Laboratory practice	A17 A18 A19 A22 C1	Continuous assessment of the work done by the student in the laboratory, considering both the skills and knowledge acquired. The answers to the questions raised during the development of the experiments and the acquisition and processing of the experimental data, together with a report of practices, constitute 50% of the final mark in the first opportunity.	50
Mixed objective/subjective test	A1 A5 A14 A20 A21 B2 B3 C3	Written test to evaluate the contents in the subject. It will be performed once the laboratory work is finished. It constitutes 50% of the final mark in 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 constitutes 100% of the final mark.	50
Supervised projects	A1 A14 A16 A20 B3 B4 B5 C1 C3	Report of the experiments that must contain the theoretical foundations, analysis of the experimental results and the answers to questions related to the experiments. Report should be written following the style of a scientific report. The lab report together with continuous assessment of laboratory work constitute 50% of the final mark in the first opportunity.	0

Assessment comments

Attendance at all seminars and practices is compulsory for the student to pass the course.
First opportunity assessment:
Continuous evaluation of the work done by the student in the laboratory, considering the skills and knowledge, the answers to questions during the development and elaboration of the experimental data, together with the report of practices, constitute 50% of the final mark. A written test will constitute the 50% remaining.
The course is considered passed if the average of the marks obtained in the different activities reaches a minimum of 5 points out of a maximum of 10 points. To pass the course students must obtain a minimum mark of 3.5 points out of 10 in the written test. If the average is equal to or greater than 5 (out of 10) but this threshold mark was not met, the final mark will be 4.5 (fail).
The final mark could be scaled up to a maximum of 1 point as a result of the evaluation of the overall student's progression.
The qualification "not attended" will only be given to those students who do not engage in any practice session in the lab.
Second opportunity assessement:
Students who have successfully completed the lab must conduct a test in the classroom that will account for 100% of the mark.
Students who have not passed the lab are required to perform a practical test in the laboratory.
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.
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.

Sources of information	
Basic	- Denbigh, K. (1985). Equilibrio Químico . Madrid. AC - 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 - Levine, I.N. (2004). Fisicoquímica . 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 - M. S. Robinson F. L. Stoller, B. Horn, and W. Grabe "Teaching and Applying Chemistry-Specific Writing Skills Using a Simple, Adaptable Exercise" J. Chemical Education, 86, 45, (2009) -D. C. Harris. "Nonlinear least-squares curve fitting with Microsoft Excel Solver" J. Chemical Education, 75, 119 (1998)- M. S. Robinson F. L. Stoller, B. Horn, and W. Grabe "Teaching and Applying Chemistry-Specific Writing Skills Using a Simple, Adaptable Exercise" J. Chemical Education, 86, 45, (2009) -D. C. Harris. "Nonlinear least-squares curve fitting with Microsoft Excel Solver" J. Chemical Education, 75, 119 (1998)
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
Química 4/610G01010 Química Física 3/610G01018 Laboratorio de Química/610G01032
Subjects that are recommended to be taken simultaneously

Química Física 3/610G01018
Subjects that continue the syllabus
Química Física Avanzada/610G01020
Other comments

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.