Subject Guide

1. Information about the subject

SUBJECT	Experimentation in Physical Chemistry I	**CODE**	GQUIMI01-2-004
EDUCATIONAL OFFER	Bachelor´s Degree in Chemistry	**CENTER**	Facultad de Química
TYPE	Compulsory	**N° TOTAL CREDITS**	6.0
PERIOD	Second Semester	**LANGUAGE**	Spanish
COORDINATORS/ES		**EMAIL**	
Flórez Alonso Manuel		mflorez@uniovi.es	
LECTURERS		**EMAIL**	
FRANCISCO MIGUELEZ EVELIO		evelio@uniovi.es	
GARCIA CALZON JOSEFA ANGELA		jagarcia@uniovi.es	
Flórez Alonso Manuel		mflorez@uniovi.es	
COSTALES CASTRO MARIA AURORA		costalesmaria@uniovi.es	(English Group)
LUAÑA CABAL VICTOR		vluana@uniovi.es	

2. Context

Teaching Activity	**Lectrurers**
PA1, PA2 (spanish)	Manuel Flórez Alonso
PA (english)	Mª Aurora Costales Castro
PL1 (spanish)	Mª Isabel Menéndez Rodríguez Josefa Ángela García Calzón Manuel Flórez Alonso
PL2 (spanish)	Evelio Francisco Miguélez
PL3 (spanish)	Josefa Ángela García Calzón
PL4 (spanish)	Víctor Luaña Cabal
PL5 (spanish)	Manuel Flórez Alonso
PL1, PL2 (english)	Mª Aurora Costales Castro

Experiments in Physical Chemistry I (EPCI) is a subject of the second year of the Bachelor in Chemistry, therefore, is included in the Fundamental module. ECPI is the first experimental subject in the field of Physical Chemistry. Teachers belong to the area of Physical Chemistry of the Department of Physical and Analytical Chemistry**.**

The course contents are essentially experiments in chemical thermodynamics. These contents are deeply related to those of the *Physical Chemistry* I course, which provides the theoretical foundations. In a lesser extent, EPCI is also related to first year courses, General Chemistry and Basic Laboratory Operations and Information Technology Tools, and second year one as Analytical Chemistry I and Experiments in Analytical Chemistry I.

It is necessary to pass EQFI in order to pursue the subject Experimentation in Physical Chemistry II fourth grade in

Chemistry.

3. Requirements

Students must have passed the following first-year courses: General Chemistry, Laboratory Basic Operations and Information Technology Tools. General Physics I and II. Mathematics.

4. Competencies and learning results

General Abilities:

- Analysis and synthesis abilities (CG-1).
- Develop critical thinking (CG-17).
- Teamwork (CG-18).

Specific competences and skills:

- The thermodynamic principles and how they are applied in Chemistry. (CE-7).
- Assessing the risks in the use of chemical substances and procedures of laboratory (CE-31).
- Monitoring the observation and measurement of chemical properties, events or changes collecting the appropiated information (CE-27).
- Collecting, processing and rationalizing of the information extracted from observation and experimental measurements (CE-30).
- Present and defend scientific reports in written and oral forms (CE-36).

Learnign outcomes:

- Know and understand the concepts and laws related to chemical thermodynamics.
- Recognize and assess the risks in the use of chemical substances and laboratory procedures.
- Perform laboratory experiments following the experimental procedure and obtain the necessary data.
- Manage computer programs in the field of the thermodynamic chemistry.
- Prepare and defend a report.
- Understanding and use of the bibliographic information

5. Contents

Laboratory experiments outlined below are based on the following contents:

0. Basic Concepts

1. Solutions and phase equilibrium

Determination of the composition of solutions. Partial molar quantities. Electrolitic and non-electrolitic solutions. Coligative properties.

2. Chemical and electrochemical equilibrium

The equilibrium constant. Ionic equilibria in aqueous solutions. Determination of the equilibrium constant. Calorimetry.

Laboratory experiments:

1. Determination of partial molar volumes.

2. Determination of freezing points in aqueous solutions.

3. Determination of standard neutralization entalphies.

4. Determination of the ionization constant of a weak acid.

5. Determination of an association constant.

6. Determination of a solubility constant.

6. Methodology and working plan

The classroom training activities consist of: (i) Classroom sessions or seminars (6 hours), (ii) Laboratory sessions (66 hours), and (iii) Examination (3 hours).

In the classroom sessions, the instructor will present the theoretical foundations of each experiment and their relation to the experimental procedure to be performed in the laboratory. The instructor will also remember the main safety rules to consider in the laboratory.

The methodology to be used in Laboratory sessions is based on teamwork within the lab (teams of two or three people) and, predominantly, in individual work outside the lab. In each experiment, the following steps shall be followed: (1) Indiviual study by the student of the script of the practice the instructor has been provided with; (2) Explanation by the teacher of the most important aspects of experiment, safety precautions to consider, and the most relevant and operational aspects; (3) Development of the experimental part of the experiment by the students, with a description of the objectives, a summary of its theoretical foundation, and a complete recording of the material and reactants used and the results obtained; (4) analysis of the results, making the necessary calculations, construction of tables and/or relevant graphs, answer to the issues raised in the script, comparison with bibliographic information, and drawing conclusions by the student; (5) Preparing a report that includes the work performed by the student, the results and conclusions obtained, etc. At the end of each experiment, a group discussion will be held concerning the most important aspect of it.

The timing of the activities is listed below, indicating the number of hours of each classroom and non-clasroom training activity associated to each of the topics that make up the contents of the subject.

Content: 0 1 2

Classroom sessions: 1 + 1 + 4 = 6

Laboratory sessions: 3 + 27 + 36 = 66

Evaluation: = 3

75

Individual work (out of class): 4 + 22 + 32 = 58

Teamwork (out of class): 0 + 7 + 10 = 17

---

7. Evaluation of the student's learning results

Attendance at laboratory sessions is compulsory.

The global grade of ordinary call (May) will be based on: a) evaluation of the work of students in the laboratory (40% of the final grade), in which three different aspects will be assessed: i) direct observation of the way of working by the student, ii.) the report made about each experiment and iii) answer to the questions asked by the instructor; b) written exam (60 % of the final grade) which consists of questions related to the different aspects of the experiments carried out: objectives, theoretical concepts, experimental procedure, recording and analysis of data, etc. To pass the course in the ordinary call, it is necessary to obtain a note equal or greater than 5 out of 10 points in each of the two aspects evaluated (evaluation of the student in the laboratory and in the final written exam).

The global grade of the extraordinary call (July) will be based on: a) practical exam in the laboratory, (40% of the final grade), b) written final exam (60 % of the final grade) which consists of questions related to the different aspects of the experiments carried out: objectives, theoretical concepts, experimental procedure, recording and analysis of data, etc. If the student has passed one of the parts in the ordinary call, the grade in this part will be the same as in the ordinary call except that the student request by writing to the instructor will be evaluated again. In such case, the request must be made at least seven days before the date of the exam. To pass the course in the extraordinary call, it is necessary to obtain a note equal or greater than 5 out of 10 points in each of the two aspects evaluated.

The global grade of the extraordinary call (January) will be based on: a) practical exam in the laboratory, (40% of the final grade), b) written final exam (60 % of the final grade) which consists of questions related to the different aspects of the experiments carried out: objectives, theoretical concepts, experimental procedure, recording and analysis of data, etc. To pass the course in the extraordinary call, it is necessary to obtain a note equal or greater than 5 out of 10 points in each of the two aspects evaluated.

8. Resources, bibliography and complementary documentation

The materials that are used in the development of classroom sessions as well as the laboratory experimental procedures will be available to students through the Virtual Campus. In the experimental procedure of each session is described, among other things, the objectives, the theoretical foundation, its experimental procedure and related bibliography. Other useful references for the development of the course are listed below along with journals such as Journal of Chemical Education and Journal of Chemical Thermodynamics. In the first reference listed below you can find additional information about the each of the experiment, theoretical information which can be complemented with the rest of the references of the first block, while in the second block references additional information on experimental procedures appears.

- I. N. Levine, Physical Chemistry, 6th edition, McGraw-Hill International Editions. 2009.
- K. Denbigh, The principles of chemical equilibrium. Cambrigde University Press.1981.
- M. W. Zemansky y R. H. Dittman, Heat and Thermodynamics. McGraw-Hill. 1997.
- M. L. McGlashan, *Chemical Thermodynamics*. Academic Press, Londres 1979.
- S. Glasstone, *Thermodynamics for Chemists.* Red Books. 2007.
- J. A. Rodríguez Renuncio, J. J. Ruiz Sánchez y J. S. Urieta Navarro, *Termodinámica Química*. Editorial Síntesis, Madrid 2000.
- M. Criado-Sancho y J. Casas-Vázquez, *Termodinámica Química y de los Procesos Irreversibles*. Addison Wesley Iberoamericana, Madrid 1998.
- ---
- C. W. Garland, J. W. Nibler y D. P. Shoemaker, *Experiments in Physical Chemistry*. McGraw-Hill, New York .2009.
- H. D. Crockford y J. W. Nowell, *Laboratory Manual of Physical Chemistry*. John Wiley & Sons, New York. 1956.
- F. Daniels, R. A. Alberty, J. W. Williams, C. D. Cornwell, P. Bender y J. E. Harriman, *Experimental Physical Chemistry*. McGraw-Hill. 1972.
- J. M. Wilson, R. J. Newcombe, A. R. Denaro y R. M. W. Rickett, *Manipulations de Chimie Physique*.

Gauthier-Villars Éditeur, Paris 1964.