COURSE GUIDE 2021/22

Faculty 215 - Faculty of Chemistry **Cycle** Not Applicable

Degree GQUIMI20 - Bachelor's Degree in Chemistry **Year** Second year

COURSE

26117 - Physical Chemistry I **Credits, ECTS:** 9

COURSE DESCRIPTION

Physical Chemistry I provides the students the necessary knowledge to analyze the macroscopic behaviour of matter in terms of Thermochemistry, Kinetics or Electrochemistry. Furthermore, it will allow them to understand the fundamentals and applications of transport and surface phenomena, and complex systems as macromolecules and colloids. Overall, the contents of the subject will reveal the importance of physical chemistry in all the different areas of Chemistry, as well as its impact in the industry and technology-based society we live in.

The course is part of the Fundamental Module of the Chemistry Degree, and it is very closely related to the experimental course Experimental Physical Chemistry. The coordination of this course within the Physical Chemistry Module corresponds to the Chemistry Degree Coordination Comission, designated by the Faculty Council.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Physical Chemistry I, as part of the Fundamental Module, shares the cross skills [M02CM09], [M02CM10] and [M02CM011] with the other courses of the same module. Besides, this course will also develop the specific skill [M02CM01].

M02CM01-Understand and know how to apply the principles of physical chemistry and how they affect chemical processes.

M02CM09- Be able to make verbal and written presentations of phenomena and processes related to chemistry and similar subjects in a comprehensible way.
M02CM10-Be able to search for and select information in the field of chemistry and other sciences through the use of the literature and information technologies.
M02CM11-Be able to relate chemistry with other disciplines and understand its impact on today's society and the importance of the industrial chemical sector.

CONTENIDOS TEÓRICO-PRÁCTICOS

Thermochemistry. Thermodynamic laws. Maxwell’s equations. Enthalpy, entropy, and Gibbs energy: use of thermodynamic tables. Chemical potential. Equilibrium conditions.
Real and ideal solutions. Fugacity of real gas mixtures. Partial molar magnitudes. Activity coefficients. Henry’s law.
Phase equilibria. Pure substance phase diagrams: Clapeyron and Clausius-Clapeyron equations. Multicomponent systems. Liquid-liquid diagrams, liquid-vapor diagrams: azeotropes. Solid-liquid diagrams: eutectics.
Chemical equilibria. Progress of a reaction, free energy and chemical equilibrium in real gas reactions. Equilibrium constants. Heterogeneous equilibria. Equilibria in non-ionic solutions.
Electrochemical equilibria. Ionic solutions. Mean ionic activity. Debye - Hückel limiting law. Electrochemical systems. Electrochemical potential. Electrochemical cells. Standard electrode potential. Determination of thermodynamic magnitudes. Batteries and combustion cells.
Surface phenomena. Surface tension. Capillarity. Adsorption: chemisorption and physisorption. Adsorption isotherms.
Transport phenomena. Kinetic model of gases and transport properties. Thermal conductivity. Viscosity. Diffusion. Electrical conductivity on ionic solutions.
Macromolecules and colloids. Polymers and polymerisation. Average molar mass and determination methods. Conformation and configuration. Colloids: classification and preparation. Structure and stability. Micelle formation. Double electric layer.
Chemical and electrochemical kinetics. Formal kinetics. Reaction mechanisms. Reversible, branched and consecutive reactions. Chain reactions. Explosions. Collision theory. Reactions in solution. Homogeneous, heterogeneous, and enzymatic catalysis. Electrode kinetics.

TEACHING METHODS

The content has been classified in four different modules, which will be evaluated in separate written tests.
1. Chemical thermodynamics.
2. Solutions, phase equilibria and chemical equilibria.
3. Electrochemical equilibria, surface phenomena, transport phenomena, macromolecules and colloids.
4. Kinetics.

Lectures will typically consist of an explanation about the theoretical contents by the professor. Practical classes, will

generally be employed for the students to analyse and solve practical problems presented by the profesor. The students will also have the opportunity of taking quizzes in order to asses their advances on the subject. Finally, in the seminar activities, the students will have a leading role and will present a subject related to the contents of the course and previously agreed with the professor.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	45	5	40						
Horas de Actividad No Presencial del Alumno/a	67,5	7,5	60						

Legend: M: Lecture-based | S: Seminar | GA: Applied classroom-based groups
GL: Applied laboratory-based groups | GO: Applied computer-based groups | GCL: Applied clinical-based groups
TA: Workshop | TI: Industrial workshop | GCA: Applied fieldwork groups

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Exercises, cases or problem sets 15%
- Oral presentation of assigned tasks, Reading¿ 15%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The student will have to participate in all the following activities in order to pass the course, with the continuous assessment system: 4 written tests, seminars, practical class work.

The first three written tests will be carried out approximately in October, January and March. The student who passes a written examen will not have to take it again, and the mark will be saved for the ordinary and extraordinary calls. Those who do not pass the first written test, will have another opportunity in January. The final test for the 2nd part, in case of not passing it in January, will take place together with the 3rd part. Finally, the fourth written test, together with the 3rd (for those who have to repeat it), will take place at the ordinary call in June. When calculating the final mark obtained in these exams, a score of at least 4.5 will be required in each part of the exam for the student to pass the subject. The final mark will have to be at least 5. This test will evaluate the specific skill [M02CM01], and will account for the 70% of the final mark.

The 30 % of the final mark will be the average of the results obtained in the following activities:
1. Seminars 15%.
2. Practical class work 15%

The skills assessed will be: [M02CM01], [M02CM09], [M02CM10] and [M02CM011] in Seminars; [M02CM01], [M02CM09], [M02CM10] y [M02CM011] in practical classes. This is applicable to both the ordinary and extraordinary calls.

Given the continuous assessment system, the student who does not participate in the compulsory activities will fail the course. The evaluation of the ordinary call will be "not presented" only in these cases:

The student has carried out none of the compulsory activities.
The student has previously required the final assessment system and has not taken the exam.
The student has previously required the "not presented" evaluation to the professor, at least one month before the last compulsory activity is carried out.
If the final exam accounts for more than 40% , it will be enough for the student not to take that exam for being qualified as "not presented". If it accounts for less than the 40%, the students who want such a qualification will have to require it to the professor more than a month before the end of the term.

The final assessment system will have to be required before the 18th week. The final exam will consist of a written exam, a presentation englobing the activities carried out in the practical classes, and an exposition on one of the subjects studied in the seminars. The percentage of these activities on the final mark will be the same as in the continuous assessment system. In these activities the student will have to prove to master the skills [M02CM01], [M02CM09], [M02CM10] and [M02CM011].

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The extraordinary call exam will consist of a written exam about the four parts of the subjects. Those positive results

obtained in the ordinary call will be maintained. The written exam will account for the 70% of the final mark. The student who has not carried out one of the compulsory activities will be required to do so within 15 days of the written exam.

If the final exam accounts for more than 40% , it will be enough for the student not to take that exam for being qualified as "not presented". If it accounts for less than the 40%, the students who want such a qualification will have to require it to the professor more than a month before the end of the term.

For those students who have chosen the final assessment system, the conditions will be the same as for the ordinary call final assessment system.

MANDATORY MATERIALS

A scientific calculator is needed for the successful development of the subject and exams.

BIBLIOGRAFÍA

Basic bibliography

Robert A. Alberty, Robert J. Silbey: Physical Chemistry, 2nd edn., Wiley, New York, 1997,
Ira R. Levine. Physical Chemistry, 6th ed. Ed. McGraw-Hill,New York, 2009.
P. Atkins, J. de Paula. Physical Chemistry Oxford University Press, 10th ed, 2014.

Detailed bibliography

J. Bertrán, J. Núñez (coords.). Química Física, 1. eta 2. bol.. Ariel Ciencia, 2002.
J. A. Rodríguez Renuncio, J. J. Ruiz Sánchez, J. S. Urieta Navarro. Termodinámica Química. Ed. Síntesis, 1999.
S. R. Logan, Fundamentos de Cinética Química, Ed. Addison Wesley-Iberoamericana, 2000.

Journals

Journal of Physical Chemistry
Journal of Chemical Physics
Journal of Chemical Education

Web sites of interest

http://riodb01.ibase.aist.go.jp/sdbs/cgi-bin/cre_index.cgi
http://webbook.nist.gov/chemistry
http://www1.lsbu.ac.uk/water/water_phase_diagram.html

OBSERVATIONS

The students will find helpful material in the course's virtual classroom eGela.