Universitat Autònoma de Barcelona

2019/2020

Chemistry for Physicists

Code: 100147
ECTS Credits: 6

Degree	Type	Year	Semester
2500097 Physics	FB	1	1

Contact

Name: Miquel Moreno Ferrer
Email: Miquel.Moreno@uab.cat

Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Ricard Gelabert Peiri
Miquel Moreno Ferrer
Mireia García Viloca
Aleix Comas Vives

Prerequisites

There are no official prerequisites, however, it is highly advisable that the student has taken chemistry during high school.

Objectives and Contextualisation

The general goal of the subject is that students gain interest in natural chemical phenomena, i. e. in the study of matter and its transformations and the notion that these processes are based on general laws of physics.

In addition, another goal is to widen the acquired knowledge and hence the job perspectives.

The partial goals of the subject are the following ones:

1) Understand the chemical change, its characteristics and the ability to determine the direction of its spontaneous evolution.

2) Understand the importance of kinetics in the chemical change and to know its variables and the laws that determine it.

3) to know the main principles of the structure of matter and its relation to the actual position of the atoms within the periodic table.

Competences

- Develop critical thinking and reasoning and know how to communicate effectively both in the first language(s) and others
- Develop independent learning strategies
- Develop strategies for analysis, synthesis and communication that allow the concepts of physics to be transmitted in educational and dissemination-based contexts
- Develop the capacity for analysis and synthesis that allows the acquisition of knowledge and skills in different fields of physics, and apply to these fields the skills inherent within the degree of physics, contributing innovative and competitive proposals.
- Respect the diversity and plurality of ideas, people and situations
- Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments

Learning Outcomes

1. Apply knowledge of the structure of matter to explain the properties and reactivity of simple and complex substances.
2. Apply the principles of thermodynamics and kinetics in chemical processes.
3. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
4. Develop independent learning strategies.
5. Identify different types of chemical reactions and determine the concentrations of the substances involved in the equilibrium.
6. Identify the factors determining the speed of chemical reactions.
7. Manage the information, planning and organization of individual and cooperative work in solving chemical problems.
8. Present and discuss with colleagues the same ideas on the nature of chemical processes studied.
9. Respect diversity in ideas, people and situations.
10. Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments

Content

Bloc 1: Fundamentals of Chemical Thermodynamics

Energy. Thermodynamics systems. Thermodynamics laws.

Forms of energy transfer: heat and work. Internal energy and enthalpy. Heat capacity at constant volume and constant pressure. Reversible and irreversible processes. Ideal gas. Application to chemical reactions (Thermochemistry).

Distribution of energy and spontaneous processes. Entropy. Microscopic Interpretation of Entropy. Spontaneous and equilibrium criteria in a fixed composition system. Gibbs' energy. Application to chemical reactions.

Bloc 2: Fundamentals of Chemical Equilibrium.

Phase change processes. Criteria for phase equilibrium. Clapeyron and Clausius-Clapeyron equations. Phase diagrams.

Solutions. Partial molar properties. Chemical potential. Raoult Law. Henry Law.

Chemical equilibrium. Thermodynamics. Equilibrium Constant. Displacement of chemical equilibrium.

Examples of chemical equilibrium: a) Acid-base reactions. b) Precipitation reactions. c) Electrochemical reactions.

Bloc 3: Fundamentals of Chemical Kinetics.

Elementary or complex reaction. Reaction rate definition. Rate equation. Determination of order and rate constant. Temperature effect on rate constant.

Reaction mechanisms. Approximations of steady-state and equilibrium. Catalysis.

Bloc 4: Structure of Matter.

Wave nature of matter. Wave Function. Hydrogen Atom. Atomic Orbitals. Polyelectronic atoms. Periodic Table.

Methodology

The center of the learning process is the student's work. The student learns by working, and the mission of the teaching staff is to help him/her in this task (1) by providing information or showing him/her the sources where they can be obtained and (2) by accompanying his/her steps so that the learning process can be carried out effectively. In line with these ideas, and in accordance with the objectives of the subject, the development of the course is based on the following activities:

Theoretical classes:

The student acquires the scientific-technical knowledge of the subject by attending classes and participating in the construction of their own knowledge. In these, the explanations on the part of the teacher will alternate with posing questions and fostering discussion between the students. In order to complement them, it is necessary to study the topics of the subject.

Classes of problems and exercises:

These sessions have a double mission, on the one hand, the scientific-technical concepts previously worked on in the theoretical classes are complemented by means of the resolution of problems. On the other hand, from the critical discussion of the exercises carried out, these classes are the natural forum in which to discuss the development of the work carried out by the student contributing the necessary knowledge to carry it out, or indicating where and how they can be acquired. The mission of the problem class is to act as a bridge between theoretical classes and autonomous work, promoting the capacity for analysis, critical reasoning, and problem-solving.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problems classes	15	0.6	1, 2, 6, 10
Theory classes	30	1.2	3, 5, 6, 10, 9
Type: Supervised			
Preparation of theory contents	6	0.24	4, 8, 7
Type: Autonomous			
Problem solving	39.5	1.58	1, 2, 7, 5, 6, 10
Study of theory fundamentals	50.5	2.02	4, 7

Assessment

In this subject, there will be a continuous evaluation. The final grade will be distributed among the following concepts:

- Work to be delivered 20% (not recoverable)

- Partial Exams 80% (2 in total)

In order to pass the subject, the weighted mean of the two partial exams and the work to be done must be at least equal to 5.0. In addition, a minimum of 3.5 to each of the two partial exams is needed have presented all the works.

- Final examination of recovery 80%. Optional. It includes the whole subject matter, with the aim of recovering the subject or improving the final grade. The grade of the final exam will replace the grade obtained from the combination of the two partial exams. It should be noted that only 80% of the subject can be recovered, corresponding to the grade of partial examinations. The marks of the works to be delivered cannot be recovered. In order to take the final exam, the student must have taken at least 1 partial exam and all the works must have been handed in.

Non-evaluated result

A student will be considered to have obtained the non-evaluated qualification if the number of activities carried out during the whole subject is less than 50% of all the programmed activities of the subject.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam	80%	3	0.12	1, 2, 3, 10
Homeworks	20%	0	0	4, 3, 8, 7, 10, 9
Partial exams	80%	6	0.24	1, 2, 5, 6

Bibliography

Thermodynamics, Kinetics, and Structure of Matter

Chang, R. *Physical Chemistry for the Biosciences.* University Science Books, 2004

Atkins, P. W. *The Elements of Physical Chemistry*, Oxford University Press, 1996

Levine, I. N. *Physical Chemistry* 6th Edition, McGraw Hill, 2009.

Chang, R. *Physical Chemistry for chemical and biological sciences*, University Science Books, 2000.

Atkins, P. W. *Physical Chemistry,* 8th Edition, Oxford University Press (2006)