Bachelor in Physics
(Academic Year **2024-25)**

Chemistry		**Code**	800495	**Year**	1º	**Sem.**	1º
Module	Basic Core	**Topic**	Chemistry		**Character**	Obligatory	

	Total	**Theory**	**Problems/Laboratory**
ECTS Credits	5.8	4.6	1.2
Semester hours	58	46	12

Learning Objectives (according to the Degree's Verification Document)

- To understand the general concepts in Chemistry.
- To know the most relevant mechanisms involved in the chemical transformation of matter.
- To become familiar with the main chemical structures and basic notions of chemical, kinetic and electrochemical equilibrium.
- To assimilate those aspects of Chemistry related to Physics.

Brief description of contents

Chemical reactions, Chemical kinetics, Chemical equilibrium, Electrochemistry, Chemical bonding, Organic Chemistry.

Prerequisites

Completed studies in Chemistry, Physics and Mathematics is recommended.

Related Subjects

Thermodynamics; Materials Physics; Atmospheric Physics; Atomic and Molecular Physics…

Coordinator	Jesús Fernández Castillo			**Dept.**	QF
	Room	QA241	**e-mail**	jfernand@ucm.es	
Laboratory Coordinator	Cristina Díaz Blanco			**Dept.**	QF
	Room	QA508	**e-mail**	crdiaz08@ucm.es	

Theory/Problems – Schedule and Teaching Staff

Group	**Lecture Room**	**Day**	**Time**	**Professor**	**Hours**	**T/P**	**Dept.**
B	7	Tuesday Wednesday	9:30-11:00 11:00-13:00	Helena Gavilán Rubio	46	T/P	QF

T: Theory, P: Problems

Office hours				
Group	**Professor**	**Schedule**	**E-mail**	**Location**
B	Helena Gavilán Rubio	W,T: 11:00-14:00	hgavilan@ucm.es	QA247B

Horarios de Laboratorios			Nº sesiones:	4
Grupo	**Días- Horas**	**Profesores**	**email**	
LB1	15:00h-18:00h 09-10-2024, 16-10-2024, 23-10-2024, 30-10-2024	Rubén Ahijado	ahijado@quim.ucm.es	
		Carlos Vega	cvega@quim.ucm.es	
LB2	15:00h-18:00h 06-11-2024, 13-11-2024, 20-11-2024, 27-11-2024	Rubén Ahijado	Ahijado@ucm.es	
		Alfredo Casasnovas	acasasno@ucm.es	

Students who have previously passed the laboratory, must choose group NP (non-attendance: the previous grade of the lab is maintained) unless they justify the need to repeat the laboratory.

Sessions: Four three-hour sessions

Location: Laboratorio Integrado de Experimentación en Química (Facultad de CC Químicas. Planta Baja: Lab. Química General)

Syllabus	Weeks*
1. **Stoichiometry.** Atomic mass. The Mole concept. Avogadro's constant. Determination of chemical formulae. Chemical reactions and the chemical equation. The limiting reagent. Solutions. Gases in chemical reactions.	1.5
2. **Fundamentals of chemical equilibrium**. Thermochemistry. Spontaneity. Chemical equilibrium. Relationship between Gibbs free energy and the equilibrium constant. The effect of temperature on the equilibrium constant. Effect of a change in conditions on the chemical equilibria: Le Châtelier's principle.	2.0
3. **Acid-base equilibria.** Concept of acids and bases. pH scale. Relative strengths of acids and bases. Hydrolysis. Buffer solutions. Acid-base indicators. Titration.	1.5
4. **Solubility equilibria.** Solubility and precipitation. Solubility product constant. Common ion effect. Fractional precipitation. Solubility and pH. Complex ion equilibria and solubility .	1.0
5. **Electrochemistry**. Oxidation-reduction processes. Balancing oxidation-reduction equations. Electrochemical cells. Electrode potentials. Nernst's equation. Connection between cell potential and equilibrium constant. Electrolysis.	2.0
6. **Chemical kinetics.** Reaction rate. Rate law. Reaction orders and molecularity. Integrated rate equations. Arrhenius equation. Reaction mechanisms.	1.5
7. **Atomic structure**. Notions of quantum mechanics. Quantum numbers and atomic orbitals. Electronic configurations. Periodic table. Periodic properties.	1.5
8. **Chemical bonding.** Different types of bonds. Lewis Model, Covalent bond. Bond Polarity. Electronegativity. Resonance. VSEPR theory. Introduction to the valence bond method. Hybridization. Molecular Orbital Theory. Metallic bond. Intermolecular forces. Ionic bonding. Reticular energy. Born-Haber cycle. Different types of solids.	2.5
9. **Organic chemistry**. Organic compounds and their structures. Hydrocarbons. Chemical nomenclature. Main functional groups.	0.5
*: Aproximated number of weeks per topic.	

Laboratory Exercises	Sessions
• Acid-base: pH measurement.	1

● Preparing solutions. Reaction kinetics.	1
● Acid-base titration. Solubility.	1
● Electrochemistry.	1

Bibliography

Basic

- General Chemistry: Principles and modern applications, by RALPH H. PETRUCCI; WILLIAM S. HARWOOD; GEOFFREY HERRING.
- General Chemistry: The Essential Concepts, by Raymond Chang.

Complementary

- Chemistry by Raymond Chang
- J. Casabó, Enlace Químico y Estructura de la Materia (Reverté, 1996).
- J. Keeler y P. Wothers, Why chemical reactions happen? (Oxford University Press, 2003).

Online Resources

Virtual Campus

Methodology

On-campus teaching 100%

In each lesson the following training activities will be developed:

- A presentation of the subject, with emphasis on the most important points.
- Some exercises will be solved by the teacher in class, discussing the relevant steps. Other problems will be solved by the students. The mark got by the volunteer will be included in his/her final assessment.

Laboratory: The students will carry out the experiments described in the practice script (available at the virtual campus). The students will reproduce the measured data and describe the results in the practice report (template available at virtual campus). The practice reports will be collected on the day of the laboratory exam.

Questions will be answered in the teacher's office during the stated office hours.

It is strongly recommended to take advantage of these personal tutorials.

The teaching materials will be available to students via the Virtual Campus (CV).

Evaluation Criteria

Exams	**Weight**	70%

A midterm exam and a second partial exam or, alternatively, a final exam.

Note: The material covered in the midterm exam will not be tested again if the student's mark is higher than 4.

Each exam consists of exercises that will be a combination of theoretical questions and problems that will assess the ability of the student to apply the fundamental concepts to solve Chemistry problems.

In this section, the final mark will be the one calculated by taking the average of the scores obtained in the two partial exams or the one obtained in the final exam if the student does the final exam.

Other Activities	**Weight**	30%

- Compulsory Lab sessions (20%). A basic knowledge test will be given before each session. The laboratory mark will be the average between the exam score, the practice report score and the on-site assessments. The laboratory mark is valid for two school years
- Continuous evaluation (10%): Attendance and participation. Short questionaries during the classes.

Final Mark

The final mark is the score of the sum of the numerical scores of the previous sections, weighted by the coefficients indicated in each case: Exams 70% + Other activities 30%.

If the mark of the exams sections is less than 4 over 10, it will contribute to the final mark with 0.

The extraordinary June call will follow the same procedure for the calculation of the final mark.