Bachelor in Physics
(Academic Year 2022-23)

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

	Total	Theory	Problems / Laboratory
ECTS Credits	6	3	3
Semester hours	58	26	20 / 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	Eduardo Santiago Sanz García	46	T/P	QF

T: Theory, P: Problems

Office hours

Group	Professor	Schedule	E-mail	Location
B	Eduardo Santiago Sanz García	M,W 15:30-16:30	esa01@ucm.es	QB256

Horarios de Laboratorios			Nº sesiones:	4
Grupo	**Días- Horas**	**Profesores**	**email**	
LA1	15:00h-18:00h 04-10-2022, 11-10-2022, 18-10-2022, 25-10-2022	Olivia Borrel	oborrel@ucm.es	
		Carlos Montero	c_montero@ucm.es	
LA2	15:00h-18:00h 06-10-2022, 13-10-2022, 20-10-2022, 03-11-2022	Niccolò Caselli	ncaselli@ucm.es	
		Rubén Ahijado	ahijado@quim.ucm.es	
LB1	15:00h-18:00h 05-10-2022, 19-10-2022, 26-10-2022, 02-11-2022	Niccolò Caselli	ncaselli@ucm.es	
		Carlos Montero	c_montero@ucm.es	
LB2	15:00h-18:00h 07-10-2022, 14-10-2022, 21-10-2022, 04-11-2022	Cristina Díaz	crdiaz08@ucm.es	
		Niccolò Caselli	ncaselli@ucm.es	
LC1	15:00h-18:00h 03-10-2022, 10-10-2022, 17-10-2022, 24-10-2022	Carlos Montero	c_montero@ucm.es	
		Helga Karina Ruiz	helgakar@ucm.es	
LC2	15:00h-18:00h 07-11-2022, 16-11-2022, 21-11-2022, 23-11-2022	Niccolò Caselli	ncaselli@ucm.es	
		Sebastián Thompson	sebastian.thompson@imdea.org	
LD1	09:30h-12:30h 04-10-2022, 11-10-2022, 18-10-2022, 25-10-2022	Francisco de Asís Gámez	frgamez@ucm.es	
		Carlos Vega	cvega@ucm.es	
LD2	09:30h-12:30h 06-10-2022, 13-10-2022, 20-10-2022, 03-11-2022	Cristina Díaz	crdiaz08@ucm.es	
		Lucía Labrador	lulabrad@ucm.es	
LE1	09:30h-12:30h 05-10-2022, 19-10-2022, 26-10-2022, 02-11-2022	Lucía Labrador	lulabrad@ucm.es	
		Carlos Vega	cvega@ucm.es	
LE2	09:30h-12:30h 07-10-2022, 14-10-2022, 21-10-2022, 04-11-2022	Lucía Labrador	lulabrad@ucm.es	
		Juan José Omiste	jomiste@ucm.es	
LF1	09:30h-12:30h 03-10-2022, 10-10-2022, 17-10-2022, 24-10-2022	Francisco de Asís Gámez	frgamez@ucm.es	
		Ignacio Solá	isola@quim.ucm.es	
LF2	09:30h-12:30h 07-11-2022, 16-11-2022, 21-11-2022, 23-11-2022	Sebastián Thompson	sebastian.thompson@imdea.org	
		Juan José Omiste	jomiste@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.

NOTE: Los laboratorios se impartirán en español.

Sessions: Four three-hour sessions and an one-hour exam.

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

Examination Dates	
Midterm Exam	https://fisicas.ucm.es/guias-examen
Laboratory Exam (Approximate dates)	To be specified
Final Exam	https://fisicas.ucm.es/guias-examen

Syllabus	Weeks*
1. **Stoichiometry.** Atomic mass. The Mole concept. Avogadro's constant. Chemical reactions. Determination of chemical formulas and limiting reagent. Calculation of concentrations. Gases in chemical reactions.	1.0

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.	2.0
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.	2.0
7. **Atomic structure**. Quantum numbers and atomic orbitals. Electronic configurations. Periodic table. Periodic properties.	1.0
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
• Lab Exam (1 hora)	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

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%). Once finished, there will be an exam that will last for one hour. During the examination the practice script and practice report will be provided. The laboratory mark will be the average between the exam score, the practice report score and the on-site assessment. To pass the laboratory activity is necessary a minimum mark of 5 and 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 best score between the sum of the numerical scores of the previous sections, weighted by the coefficients indicated in each case (Exams 70% + Other activities 30%), and the mark calculated by taking the sum of the exam score weighted at 80% and the laboratory score weighted at 20%.

June-July Call

The exam will account for a 80% of the final mark. The remaining 20% will correspond to the laboratory mark. There will be also a lab make-up exam for those students who had failed it.