Bachelor in Physics
(Academic Year 2026-27)

Chemistry				Code	808253	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

Specific course contents
General concepts of Chemistry. Atomic structure. Chemical bonding. Stoichiometry. Chemical reactions. Solutions. Chemical kinetics: reaction rate, Arrhenius equation. Fundamentals of chemical equilibrium. Acid–base equilibrium. Solubility equilibrium. Stoichiometry. Organic chemistry..
Prerequisites
Completed studies in Chemistry, Physics and Mathematics is recommended.

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	Rubén Ahijado Guzmán	46	T/P	QF

T: Theory, P: Problems

Office hours

Group	Professor	Schedule	E-mail	Location
B	Rubén Ahijado Guzmán	Monday, Tuesday, Thursday: 11:00-13:00	rahijado@ucm.es	QB233

Laboratory Schedule			No. of sessions:	4
Group	Days-Hors	Professor	email	
LB1	15:00h-18:00h 02-10-2026, 09-10-2029, 16-10-2026, 23-10-2026	Niccolò Casseli	ncaselli@ucm.es	
		Pedro Recio	pedrecio@ucm.es	

LB2	15:00h-18:00h 06-11-2026, 10-11-2026, 20-11-2026, 27-11-2026	Niccolò Casseli	ncaselli@ucm.es
		Rubén Ahijado	ahijado@quim.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. **Atomic structure**. Notions of quantum mechanics. Quantum numbers and atomic orbitals. Electronic configurations. Periodic table. Periodic properties.	1.5
2. **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
3. **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
4. **Chemical kinetics.** Reaction rate. Rate law. Reaction orders and molecularity. Integrated rate equations. Arrhenius equation. Reaction mechanisms.	1.0
5. **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
6. **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
7. **Solubility equilibria.** Solubility and precipitation. Solubility product constant. Common ion effect. Fractional precipitation. Solubility and pH. Complex ion equilibria and solubility.	1.5
8. **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
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

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%

Midterm exam: Yes Eliminatory: Yes Minimum grade foe elimination: $N_{Midterem} \geq 4$

Midterm weight: 50%

Final exam:

- If $N_{Midterem} \geq 4$: Take an exam covering only the content taught in the second part of the course, on the same date and time as the final exam. Your grade will be $N_{Final2ndPart}$, between 0 and 10. In this case, the final grade for this component will be the average of the marks obtained in the midterm and in this exam, provided that the mark on this second exam $N_{Final2ndPart} \geq 4$.

  If $N_{Midterm} < 4$: It will cover all the course content. The grade will be N_{Final}, between 0 and 10.

Final grade for the exam-taking section, NExam:
If $N_{Midterm} \geq 4$ and $N_{Final2ndPart} \geq 4$: $N_{Exam} = 0.5\ N_{Midterm} + 0.5\ N_{Final2ndPart}$
If $N_{Midterm} < 4$: $N_{Exam} = N_{Final}$

Each exam will consist of a series of exercises combining theory and problems that assess the ability to apply fundamental concepts to problems encountered in Chemistry.

100 % of the exam will be shared by all groups.

Other Activities	Weight	30%

- Compulsory Lab sessions (20%). A basic knowledge test will be given before each session. The laboratory mark, N_{labo} 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. The mark will be N_{EvCont}

The final grade for this section will be $N_{OtherActiv} = 0{,}667N_{labo} + 0{,}333N_{EvCont}$ and will range from 0 to 10.

Final Mark

Final mark:

$$C_{Final} = 0.7N_{Exam} + 0.3N_{OtherActiv}$$

Minimum final exam mark for weighting: $N_{Exam} \geq 4$

If $N_{Exam} < 4$ the mark of the course wil be $C_{Final} = 0.3N_{OtherActiv}$

The final mark criterion will be maintained in the exam of the extraordinary call.

Learning and Training Outcome (according to the Degree's Verification Document)

- CON01: Identify the physical, mathematical, experimental and computational basis of the different fields in Modern Physics.
- HD02: Apply experimental and computational techniques for the analysis and interpretation of physical phenomena.
- HD03: Evaluate the limits of experimental results due to the approximations performed and to neglected effects.
- HD04: Elaborar modelos para describir fenómenos físicos mediante aproximaciones bien definidas.
- HD06 Apply critical thinking to problem analysis and resolution.
- HD07: Produce projects and reports on topics of interest in Physics geared towards research or technological development, including team working when necessary.
- HD08: Organize time and resources autonomously to acquire new knowledge.