Bachelor in Physics
(Academic Year **2021-22**)

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	55	25	30

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
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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	3	Tuesday, Wednesday	9:30-11:00 11:00-13:00	Eduardo Santiago Sanz García	42	T/P	QF

T: Theory, P: Problems

Office hours

Group	Professor	Schedule	E-mail	Location
B	Eduardo Santiago Sanz García	M,W 9:30-11:00	esa01@ucm.es	QB256

Laboratory Teaching Staff	
Afternoon Sessions	
To be determined	

Teachers have still not been assigned to each subgroup.

Nº sessions: 4				
group (seats)	**sessions**	**group** (seats)	**sessions**	**Schedule**
D1 (20)	Oct: 7, 8, 14, 15	**E2** (20)	Nov: 5, 12, 19, 26	M: 9:30–12:30
D2 (20)	Nov: 4, 11, 18, 25	**F1** (20)	Oct: 4, 6, 13, 18	
E1 (20)	Nov: 3, 10, 17, 24	**F2** (20)	Nov: 2, 16, 23, 30	
A1 (20)	Oct: 5, 8, 15, 19	**B2** (20)	Nov: 2, 16, 23, 30	T: 15:00–18:00
A2 (20)	Nov: 3, 10, 17, 24	**C1** (20)	Nov: 4, 11, 18, 25	
B1 (20)	Oct: 4, 6, 13, 18	**C2** (20)	Nov: 5, 12, 19, 26	
NP	No sessions			

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.
Students who request the validation of credits of the Chemistry course, must choose groups that start in November (A2, B2, C1, C2 in the afternoon).

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. Mole and molar volume. Avogadro's constant. Stoichiometry. Determination of chemical formulas and limiting reagent. Calculation of concentrations. Gases in chemical reactions.	1.0
2. **Fundamentals of chemical equilibrium**. Enthalpy: Hess's law. Spontaneity. Chemical equilibrium. Effect of a change in conditions on some chemical equilibria: Le Châtelier's principle. Relationship between Gibbs free energy equilibrium constant K. The effect of temperature on the equilibrium constant K.	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. Dissolution of precipitates.	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. Electric Battery. Corrosion. Electrolysis.	2.0
6. **Chemical kinetics.** Reaction rate: factors that modify it. Reaction orders and molecularity. Integrated speed equations. Arrhenius equation. Reaction mechanism	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. Covalent bond. Lewis Model, VSEPR theory. Bond Polarity. Electronegativity. Resonance. Introduction to the valence bond	2.5

method. Hybridization. Molecular Orbital Theory. Metallic bond. Intermolecular forces. Ionic bonding. Reticular energy. Born-Haber cycle. Different types of solids.	
9. **Organic chemistry**. Organic compounds and their structures. Hydrocarbons. Chemical nomenclature. Different 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
On-campus teaching 100% (Scenario 0)

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 assesment.

Laboratory: The students will carry out the experiments described in the practice script (virtual campus). The students will reproduce the measured data and describe the results in the practice report (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).

Methodology
Semi-online teaching (Scenario 1)

The following training activities will be developed:
- Recorded lessons: Students will prepare the topics using the material that the teacher will make available on the Virtual Campus. This material will include illustrative videos on each topic.
- Classroom lessons: These lessons will be devoted to solving doubts, related to the recorded lessons, problems solving and practical lessons. The subgroups will rotate weekly and the classroom lessons will be repeated for each one of them.
-Laboratory: It will be in classroom. The students will carry out the experiments described in the

practice script (Virtual Campus). The students will reproduce the measured data and describe the results in the practice report (Virtual Campus). The practice reports will be collected on the day of the laboratory exam.

On-campus teaching 100% (Scenario 2)

The following training activities will be developed:
- Recorded lessons: Students will prepare the topics using the material that the teacher will make available on the Virtual Campus. This material will include illustrative videos on each topic.
- Online lessons: The tools (MS teams, Google Meets, etc.) that UCM makes available to the university community will be used. These lessons will be devoted to solving doubts, related to the recorded lessons, problems solving and practical lessons. These lessons will be recorded, and the recordings will be available on the Virtual Campus.
- Laboratory: It will be a virtual laboratory. Student will carry out the exercises proposed in the practice script (Virtual Campus) making used of the material made available to the students by the teacher. Student will described the results in the practice report (Virtual Campus). The practice reports will be send to the teacher.

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 will consist of a theoretical (70%) and a practical part (30%) that will assess the ability of the student to apply the fundamental concepts to real problems.

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

Other Activities	**Weight**	30%

- Attendance and participation (10%).
- 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.

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, and the mark calculated by taking the sum of the exam score weighted at 80% and the laboratory score weighted at 20%.

To apply the previous criteria, it is mandatory to have a minimum mark of 4 in each exam and to have passed the laboratory practices (the laboratory mark is valid for two school years).

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 failed it.