COURSE DATA

DATA SUBJECT

Code: 34197
Name: Physical Chemistry Laboratory II
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Facultat de Química	3	Second quarter
1934 - Double Degree Program in Chemistry-Chemical Engineering	Facultat de Química	4	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1110 - Degree in Chemistry	Physical Chemistry	COMPULSORY
1934 - Double Degree Program in Chemistry-Chemical Engineering	Cuarto curso	COMPULSORY

COORDINATION

GARCIA CUESTA INMACULADA

SUMMARY

The *Laboratory of Physical Chemistry II* is a compulsory subject that is taught in the sixth semester during the 3rd year of the degree in Chemistry.

It is a laboratory that makes emphasis on experimentation in chemical thermodynamics of interfaces, spectroscopy, electrochemistry, photochemistry, quantum chemistry, and chemical kinetics. In the laboratory, different instrumental techniques are applied to the study of systems of chemical-physical interest and computers are used for the study of atoms and molecules.

Regarding the Sustainable Development Goals (SDG), it is expected that students will be able to know in this subject how to apply the knowledge learned to guarantee an inclusive, equitable, and quality education and promote learning opportunities for everyone (SDG 4), to acquire a special sensitivity for sustainable management of water (SDG 6), raw materials and energy sources (SDG 7), as well as for an environmentally friendly and sustainable development (SDG 11, 12, 13, 14 and 15), in addition to being able to design, select and/or develop efficient chemical products, processes and/or analytical methodologies (SDG 7) that minimize their impact on the environment (SDGs 14 and 15), using alternative raw materials and reducing

wastes (SDG 11).

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

1110 - Degree in Chemistry

Obligation to take the subject(s) simultaneously	34195 - Physical Chemistry III 36451 - Physical Chemistry II

1934 - Double Degree Program in Chemistry-Chemical Engineering

Obligation to take the subject(s) simultaneously	34195 - Physical Chemistry III 36451 - Physical Chemistry II

OTHER REQUIREMENTS

It is recommended that the student has prior knowledge taught in the subjects Physical Chemistry I, II and III, Physical Chemistry Laboratory I, Chemical Informatics, and Mathematics I and II.

Basic knowledge of Physical Chemistry related to:
Formal kinetics.
Spectroscopy.
Electrochemistry
Kinetic theory of gases.
Thermodynamics of two-phase systems.
Quantum Chemistry of molecular Systems.

And general knowledge of:
Chemical nomenclature and stoichiometric calculations.
Preparation of solutions.
Balance in solution.
Logarithms, exponential, derivatives, integrals and statistics.
Computer Science.
Management of laboratory.

COMPETENCES / LEARNING OUTCOMES

1110 - Degree in Chemistry

Act autonomously in learning, making informed decisions in different contexts, forming judgements based on experimentation and analysis, and transferring knowledge to new situations.

At the end of the course, the student will be able to address new problems and develop strategies to solve them.

At the end of the course, the student will be able to describe the characteristics and behaviour of the different states of matter and the theories used to explain them.

At the end of the course, the student will be able to distinguish between qualitative and quantitative aspects of chemical problems.

At the end of the course, the student will be able to identify chemical processes in everyday life.

At the end of the course, the student will be able to identify the main types of chemical reactions and their key characteristics.

At the end of the course, the student will be able to implement sustainable and environmentally friendly methodologies.

At the end of the course, the student will be able to relate theory and experimentation.

At the end of the course, the student will be able to solve problems effectively.

At the end of the course, the student will be able to state the principles of quantum mechanics and apply them to the description of the structure and properties of atoms and molecules.

At the end of the course, the student will be able to state the principles of thermodynamics and kinetics and apply them in chemistry.

At the end of the course, the student will correctly use chemical terminology, nomenclature, conventions and units.

At the end of the course, the student will demonstrate inductive and deductive reasoning skills.

At the end of the course, the student will demonstrate the ability to analyse, synthesise and apply critical reasoning.

At the end of the course, the student will interpret the relationship between the variation of the characteristic properties of chemical elements and the periodic table.

At the end of the course, the student will relate chemistry to other disciplines.

Collaborate effectively in teams, assuming responsibilities and leadership roles and contributing to collective improvement and development.

Communicate effectively, both orally and in writing, adapting to the characteristics of the situation and the audience.

Contribute to the design, development and implementation of solutions that address social needs, taking the Sustainable Development Goals as a reference.

Demonstrate critical and self-critical reasoning within the field of study, considering aspects such as professional ethics, moral values and the social implications of the different activities undertaken.

Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.

Propose creative and innovative solutions to complex situations or problems within the field of study, in order to respond to diverse professional and social needs.

Understand and recognise, from within the discipline, inequalities based on sex and gender in society; integrate different needs and preferences related to sex and gender into problem-solving and solution design.

DESCRIPTION OF CONTENTS

1. Study of an oscillating reaction: the Belousov-Zhabotinskii reaction

The existence of oscillations in the concentration of some intermediate species involved in the reaction is shown by means of electromotive force measurements. In the experiment, the formation of spatio-temporal figures can also be observed. A model of reaction mechanism to accurately reproduce the oscillations is discussed.

2. Potentiometric and Voltammetric Study of the pair ferricyanide/ferrocyanide in aqueous potassium chloride solution.

The experiment focuses on the electrochemical behaviour of anion ferricyanide in aqueous potassium chloride solution using cyclic voltammetry and potentiometry.

3. Fluorescence spectroscopy. Study of the effect of the molecular structure in the capacity of fluorescent dyes and the transfer of energy of excited molecules of riboflavin

In the first part of the experiment, we obtain the fluorescence, absorption and excitation spectra of a series of dyes from the same family; the intensity of fluorescence will be related to the molecular structure. In the second part, the energy transfer from an excited molecule (riboflavin) to another non-excited (IK) will be analysed.

4. Determination of the surface tension of hydro-alcoholic mixtures

The experiment focuses on the measurement of the surface tension of binary mixtures of an alcohol and water. An equation relating the surface tension with the concentration of alcohol in aqueous solution is established and used for the determination of the surface excess concentration of alcohol.

5. Kinetic study of the triphenylphosphine photochemical oxidation

A kinetic study of the photochemical oxidation of triphenylphosphine in organic medium is performed by measuring the remaining fraction of triphenylphosphine using reverse phase HPLC chromatography.

6. Kinetic theory of gases. Measurement of the viscosity of a gas, estimate of the molecular diameter and determination of the molecular mass

The diameter and the molecular mass of two gases are estimated from the viscosity and the mass by applying the kinetic theory of gases.

7. Quantum Chemical calculations: I-Geometric and electronic structures. II-Electronic spectra.

The main methods for semi-empirical calculations are introduced. The methods are applied to a set of molecules of the family of alkanes, alkenes, and aromatic systems. The geometric and electronic structures of the molecules are determined and the absorption spectra are computed.

8. Study of electronic systems with the Hückel method

The aim of the study is to familiarise students with the method of molecular orbitals constructed as a linear combination of atomic orbitals (MO-LCAO). To achieve such goal the Hückel method is used because of its simplicity.

9. Molecular modeling: structure and reactivity

The study aims to familiarise students with the following concepts: potential energy surface, local minimum, global minimum, saddle point, barrier of potential, optimisation of the geometry, internal coordinates, field of forces, and molecular mechanics.

10. Parker actinometer

The experiment involves the assembly and calibration of the Parker actinometer.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	12,00
Laboratory	48,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00

Individual or group project	26,00
Independent study and work	30,00
Preparation of lessons	14,00
Preparation for assessment activities	20,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

The following methodologies will be applied to the course:

- Lectures
- Practical classes
- Data processing, calculations, and resolution of questions
- Information search

The students will have available in advance an explanatory text for each experiment or computational study, which may be downloaded from the web page of the teaching laboratories of the Department of Physical Chemistry. There you will find general information about how to work in the laboratory, educational materials, and links of interest that may be consulted at any time.

The course includes 60 face-to-face hours distributed in 15 sessions of 4 hours each. There will be 6 laboratory practices and 3 seminars, which will be dedicated to activities related to the acquisition of transversal competences.

The experiments or computational studies are organized in groups of two with 4 sessions devoted to each of the groups as follows:

Session 1: Explanation of the two experiments.

Session 2: Realization of the first experiment.

Session 3: Realization of the second experiment.

Session 4: Calculations and questions about both experiments in the computer classroom.

The six scheduled experimental practices will be carried out in twelve sessions. Three more sessions will be devoted to seminars.

The course is organized into the following items:

1. Preparatory session

Each experiment has a few specific objectives which are described in the corresponding explanatory text, as well as the recommended literature to use for its preparation. Before the practical session, students must read carefully the text, prepare an outline of the experimental procedure, answer the questions raised, and do the calculations necessary to make the experiment.

2. Practical work.

The practical work will be carried out in pairs and in some cases the results will be shared by all the students, which can help to enhance teamwork.

The students should write all the experimental data and measurements in their workbooks while they are working in the laboratory.

3. Calculations and discussion of results.

The students will start to do the calculations in the laboratory. Furthermore, they should analyze the experimental results obtained in the laboratory as well as previous calculations, and express the results with appropriate units and significant figures. Therefore, this stage aims to develop the capacity for analysis of the student.

4. Laboratory notebook.

The students should keep up to date the laboratory notebook. The teacher will periodically review the notebook, and the student will submit it at the end of the course within the deadline set by the teacher.

5. Report of the experiments or computational studies.

One goal of this course is that students become familiar with the writing of a scientific work. To achieve such goal, each student will present a manuscript about one of the experiments or computational studies carried out in the course which will be assigned by the teacher. This work will be performed individually and submitted by the deadline set by the teacher.

6. Seminars.

The students will be instructed in the search for bibliographic information and the use of databases to complete the carried out experimental studies. The results, experimental techniques, and computational methods used in the course will be discussed as well.

EVALUATION

Attendance to all sessions is compulsory. To pass the course the student must attend at least 90% of the seminars and laboratory sessions. The evaluation of learning will be individual and will be held according to the following criteria:

1. Continuous assessment: 50% of the overall grade.

It will be based on face-to-face activities, degree of involvement in the teaching-learning process during the laboratory sessions and on the presentation of the results obtained. Attitude, acquired skills and laboratory notebook (35%) will be assessed, on the one hand, and, on the other, reports, memories and/or oral communication (15%)

2. Written, oral and/or experimental exams: 50% of the overall grade.

The student will take a written theoretical exam (30%) and a practical exam in the laboratory (20%) on the indicated dates.

FIRST CALL

The evaluation will be done by the average of the two sets of evaluation indicated above. To pass the course a minimum overall mark of 5.0 is required and, moreover, a minimum grade of 4.5 over 10 must be achieved in each of the four evaluable subsections.

SECOND CALL

In the second call, the students will be able to do again the theoretical and practical tests and presentation of results, namely the examinations and report.

The evaluation will take place following the same weighting criteria as in the first call.

Final warning

Copying or plagiarism of any assignment that is part of the evaluation will make it impossible to pass the course, and the student will be subject to the appropriate disciplinary procedures.

Please note that, according to Article 13 d) of the University Student Statute (RD 1791/2010, December 30), *"it is the duty of a student to refrain from using or cooperating in fraudulent procedures in evaluation tests, in the work performed or in official University documents"*.

REFERENCES

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