VNIVERSITAT DE VALÈNCIA

# Course Guide
# 34196 Physical Chemistry Laboratory I

## COURSE DATA

### DATA SUBJECT

**Code:** 34196
**Name:** Physical Chemistry Laboratory I
**Cycle:** Undergraduate Studies
**ECTS Credits:** 6
**Academic year:** 2026-27

### STUDY (S)

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1110 - Degree in Chemistry | Facultat de Química | 2 | First quarter |

### SUBJECT-MATTER

| Degree | Subject-matter | Character |
|---|---|---|
| 1110 - Degree in Chemistry | Physical Chemistry | COMPULSORY |

### COORDINATION

PORCAR I BOIX IOLANDA

## SUMMARY

The "Physical Chemistry Laboratory I" is a compulsory subject taught in the third semester (2nd year) of the Degree in Chemistry.

The course will consist of conducting a series of experimental practices with which it is intended that students acquire skills in the use of some of the most common techniques used in a laboratory of Physical Chemistry. The experiments will be quantitatively carried out and persecute the determination of magnitudes that bring into play concepts related to chemical kinetics and thermodynamics of chemical equilibrium and phase equilibrium. Practices are held so that students have to: a) pre resolve issues related to its approach and realization using the acquired theoretical knowledge, and b) make a graphic and numerical treatment, and critical analysis of the results obtained in the laboratory.

Regarding the Sustainable Development Goals (SDGs), 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 (SDGs 11 , 12, 13, 14 and 15)

# PREVIOUS KNOWLEDGE

## RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

## OTHER REQUIREMENTS

To address successfully the subject, it is essential that the student possesses a number of previous theoretical and practical knowledge. The course is designed so that the knowledge needed to address the proposed experiences have obtained previously in the introductory session.

# COMPETENCES / LEARNING OUTCOMES

## 1108 -

Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.

Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.

Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional.

Demonstrate knowledge of the main aspects of chemical terminology, nomenclature, conventions and units.

Demonstrate knowledge of the main types of chemical reaction and their main characteristics.

Demonstrate knowledge of the principles of thermodynamics and kinetics and their applications in chemistry.

Demonstrate the ability to adapt to new situations.

Develop capacity for analysis, synthesis and critical thinking.

Evaluate, interpret and synthesise chemical data and information.

Handle chemicals safely.

Handle the instrumentation used in the different areas of chemistry.

Have basic skills in the use of information and communication technology and properly manage the information obtained.

Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them.

Learn autonomously.

Relate theory and experimentation.

Show inductive and deductive reasoning ability.

Solve problems effectively.

Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.

Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.

## 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. CONDUCTIMETRIC DETERMINATION OF THE IONIZATION CONSTANT OF A WEAK ELECTROLYTE (acetic acid)

By using the conductivity of different acetic acid solutions, the degree of dissociation of the acid is determined as a function of the concentration. Also, the dissociation constant of the acetic acid is obtained by using different approaches

### 2. SPECTROPHOTOMETRIC DETERMINATION OF THE pK OF AN INDICATOR

The absorption spectrum of a series of solutions of the methyl orange indicator is registered at different pH, and from the absorbance measured and the pH of the solution, the equilibrium constant is determined.

## 3. KINETIC STUDY OF THE PHENOLPHTHALEIN DISCOLORATION IN BASIC MEDIUM

The rate law for the reaction of phenolphthalein discoloration in basic medium is determined. The absorbance of phenolphthalein in NaOH solutions of different concentration is measured as a function of time. The study is performed by applying an irreversible treatment at the beginning of the reaction and a reversible treatment at longer times.

## 4. STUDY OF THE EFFECT OF TEMPERATURE ON THE REACTION RATE

The kinetics of oxidation of the iodide ion by hydrogen peroxide in sulfuric acid medium is studied at two temperatures. The reaction occurs in the presence of a known amount of thiosulfate, which progressively reduces the iodine produced so that the iodide concentration remains approximately constant. This procedure allows us to follow the evolution of the hydrogen peroxide concentration with time and to determine the reaction order with respect to hydrogen peroxide. The experimental procedure design also provides the fractional reaction times at two different temperatures and, based on them, to determine the activation energy of the reaction.

## 5. KINETIC STUDY OF THE REACTION BETWEEN IODINE AND ACETONE

The rate law for the reaction between iodine and acetone catalyzed by acid is determined. The kinetic is followed by determining the samples concentration by thiosulfate titration. Reaction orders with respect to acetone and to acid are determined by changing concentrations of acid and acetone in different assays.

## 6. PHASE DIAGRAM BOILING POINT-COMPOSITION OF BINARY LIQUID MIXTURES

The phase diagram of the liquid-vapor mixture of methanol-chloroform is constructed and the azeotropic mixture composition is determined. The composition of the gas-phase is determined by measuring its refractive index and using the previously built calibration curve.

# 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 | 30,00 |
| Independent study and work | 40,00 |
| Preparation of lessons | 0,00 |
| Preparation for assessment activities | 20,00 |
| Resolution of case studies | 0,00 |
| **Total hours** | **90,00** |

## TEACHING METHODOLOGY

The course will run through the following teaching methods:

- Resolution of pre-laboratory questions and issues

- Practical classes

- Data processing and calculations

- Resolution of post-laboratory issues and questions

Before the beginning of the lab sessions there will be one introductory session in order to explain:

- The general rules of the physical chemistry laboratory

- How the course will develop

- Those concepts and skills that the student has not previously been taught but necessary to address the subject

The development of the course is structured around the following topics:

**i) Preparation of the experience to be performed**

The student will have the script for each of the experiences to be performed as well as a number of questions related to the theoretical concepts and experimental procedure used in each of the experiences. These questions will be answered before starting the lab session, submitted on-line or on paper, and then reviewed by the lecturer. The student must prepare each experiment with the help of all the material provided by the lecturer: script, issues, questions, tests and information.

**ii) Work in the laboratory**

The experiments are carried out in pairs and, in some cases, the results are shared among various partners in order to enhance teamwork.

# iii) Laboratory notebook

An important part of laboratory work is the laboratory notebook. In that book, students must keep record of the observations made and data obtained during the experiences, together with the data processing and calculations required. In no case loose sheets may be used. It is **compulsory** to use the notebook, which must be available anytime for the lecturer to review it. The student will hand in each practice upon finishing it and, in addition, it has to be handed in at the end of the course within the deadline set in the general course instructions.

# iv) Calculations and results

Treatment of the data and calculations obtained will be started in a specific lab session so that the lecturer can guide and direct what to do to achieve the final results. If data processing cannot be finished in class, the student will complete the task at home. One aspect to be considered in the presentation of results is the proper use of the units and of the corresponding significant figures. It is also important that students learn how to create tables and figures in which the data are collected. This treatment will be recorded in the laboratory notebook.

# v) Seminars / Experimental practical test

Doubts will be resolved, and the results and procedures of the practices carried out will be analyzed. Likewise, the student will have to implement the abilities and skills acquired in the laboratory through an individual practical test

## EVALUATION

# Attendance at all sessions is compulsory to pass the course.

The assessment of learning will be made in two distinct blocks:

1) Continuous assessment throughout the learning phase. This assessment is not re-assessable.

2) Evaluation of specific activities. This assessment is re-assessable in a second evaluation sitting.

1) Continuous assessment involves:

**i) Preparation of the experiment.** (10% of the overall mark)

The lecturer will evaluate a number of issues/questions and previous activities that will be available on the virtual platform. These may be submitted online or handed in to the lecturer.

**ii) Experimental work at the lab.** (10% of the overall mark)

It considers the students' abilities in laboratory work and in the processing of results, as well as their interest and attitude.

**iii) Laboratory notebook.** (30% of the overall mark)

The lecturer will evaluate the collection and clarity of the data and results presented in the notebook, as well as its usefulness for working in the lab. It has to be written according to some specific instructions that should be given at the beginning of the course.

2) Specific assessment involves:

**iv) Experimental practical test**. (15% of the overall mark)

The skills and abilities acquired by the student during the subject will be individually evaluated.

**i) Written exam.** (35% of the overall mark)

Students will undertake a written examination on the date indicated.

## Each item (i-v) must have a mark equal to or greater than 5 points to count towards the final mark.

**FIRST EXAMINATION SITTING**

The overall mark obtained by the student is the weighted average indicated above, regarding both the continuous and specific assessments (items i to v).

## SECOND EXAMINATION SITTING

In the second call the scores and final grade are obtained by applying the same criteria as in the first call. In a second examination sitting, only the mark achieved for specific activities (i.e., the experimental practical test and the written exam) will be carried forward. However, if the student does not approve any of the items, the teacher may, it is feasible and considers it appropriate, propose additional activities to recover it.

# 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

**Basic.**


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**Additional.**


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- Jaylor J.R. An Introduction to Error Analysis: The Study of Uncertanties in Physical Measurements. Second Ed. Univeristy Science Books. Sausalita, California, 1997. ISBN 0-93572-75-X

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