COURSE DATA

DATA SUBJECT

Code: 34778
Name: Instrumental techniques of chemical analysis
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	Escola Tècnica Superior d'Enginyeria	4	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	Optional subjects	ELECTIVES

COORDINATION

TORRES LAPASIO JOSE RAMON

SUMMARY

The subject ***Instrumental Techniques of Chemical Analysis*** is an optional character subject that is taught in the fourth year of the Bachelor's degree in Chemical Engineering during the spring semester. The curriculum consists of a total of 6 ECTS.

This course aims to provide students with the information needed to successfully address analytical problems related to the professional practice of chemical engineering. In this sense, the program focuses on the study of instrumental analysis techniques commonly used in industry, both for process control, quality of raw materials and manufactured goods and for environmental control.

After an overview of the so-called "analytical process" which provides general working methodology in Analytical Chemistry, a set of instrumental analysis techniques are studied indicating for each principles, basic instrumentation and variables of interest to focus, finally , in its application to solving analytical problems of interest in industry .

The course involves performing labs in which students carry out a series of determinations that allow them to put into practice the knowledge acquired. In addition, work in the laboratory is also pursuing students to gain an awareness of the risks of the instrumentation used in each technique and therefore the importance of respecting the safety rules stated in each case. The contents of the subject are: Calibration and

validation of methods, Molecular spectrometry, and Electrochemical and chromatographic methods.

Lectures will be carried out in Spanish and the laboratory classes, according to specified language in the subject file available on the degree website.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

Prior requirements or recommendations
In order to successfully address this course, students should have some previous knowledge of general chemistry already studied in Chemistry I and Chemistry II courses listed in the compulsory curriculum. Specifically, the concepts relating to the preparation and handling of solutions or calculation and expression of results, and the treatment of chemical equilibrium in various forms: acid-base, complexation, solubility and redox.

COMPETENCES / LEARNING OUTCOMES

1401 - Degree in Chemical Engineering

Act autonomously in learning, make informed decisions in different contexts, issue judgements based on experimentation and analysis and transfer knowledge to new situations.

Contribute to the design, development and implementation of solutions that respond to social demands, guided by the Sustainable Development Goals.

Demonstrate critical and self-critical thinking, considering professional ethics, moral values and social implications of the different activities carried out throughout the degree.

Propose creative and innovative solutions to complex situations or problems, typical of the area of ¿¿¿¿connection, to donate responses to the various professional and social needs

Recognise and apply the basic principles of the various subjects within this applied and professional field to deepen the learning outcomes already covered in the core subjects.

DESCRIPTION OF CONTENTS

1. Introduction to Analytical Chemistry

Objectives of Analytical Chemistry. Analytical Terminology. The analytical process: Steps thereof. Classification of instrumental methods of analysis.

2. Evaluation of results, calibration and validation of methods

Precision. Accuracy. Statistics for comparison of results. Calibration. Analytical characteristics of an analytical method. Validation.

3. Molecular Spectrometry (I)

Introduction. UV-Vis spectrophotometry absorption: Basis and instrumentation, analytical utility and applications.

4. Molecular Spectrometry (II)

Introduction. Fluorimetry: Basis and instrumentation, analytical utility, applications.

5. Polarimetry

Introduction. Polarimetry: Basis and instrumentation, analytical utility, applications.

6. Atomic spectroscopy

Introduction. Atomic spectroscopy with flame atomization. Atomic spectroscopy with electrothermal atomization. Other sources of atomization.

7. Electrochemical methods: Potenciometry

Introduction: Electrochemical cells' and redox potential. Potentiometry: Reference electrodes. Working electrodes. Ion selective electrodes. Analytical applications Nernst equation.

8. Amperometry and voltammetry

Current-potential curves. Amperometry. Voltammetry techniques. Stripping voltammetry. Analytical applications.

9. Chromatographic methods

Basis of chromatography: Various types. Column chromatography. Basic instrumentation. Chromatographic parameters. Bandwidth: Van-Deemter equation.

10. Gas chromatography

Introduction. Basic instrumentation. Experimental methodology. Analytical usefulness. Gas chromatography-mass spectrometry.

11. Liquid chromatography

Introduction: High-resolution liquid chromatography. Basic components of a HPLC. Partition chromatography: normal phase and reverse phase. Experimental methodology. Analytical usefulness and application areas.

12. Laboratory

Working methodology in Instrumental Analysis. Application of different instrumental techniques to determining substances of industrial or environmental interest.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	25,00
Laboratory	15,00
Classroom practices	20,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	15,00
Independent study and work	35,00
Preparation of lessons	15,00
Preparation for assessment activities	25,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

The course is structured around theory classes and problems, laboratory sessions and a series of seminars where students will solve exercises or discuss issues individually or in small groups.

In the theory sessions an overview of each topic will be featured. Teacher will insist in the key concepts and

fostered student engagement by posing questions. In addition, the teacher will explain how problems-type address both its approach and its numerical solution in order to consolidate the concepts developed in theory.

Seminars complement the lectures and in them, the role will go to students, working in groups, they will face problems and issues related to the concepts developed in the lectures.

In the lab, students will work in pairs and before the experimental sessions, have the information necessary for the preparation of the experiences. Once completed the experience, students must prepare and submit an analytical report which shall contain experimental data, results and conclusions. Attendance at laboratory practice sessions is compulsory.

EVALUATION

The evaluation will be carried out considering the different activities performed both in person and remotely. Specifically:

First assessment

Assignments and exercises completed during class sessions, including seminars and problem-solving activities, will account for 25% of the final grade. This component is non-recoverable and will apply to both the first and second examination sessions.

The grade for laboratory work will constitute 25% of the final grade (minimum score required to pass the course: 5.0).

A final exam will account for 50% of the final grade (minimum score: 4.0 in both the theory and problem-solving sections).

To pass the course, the final grade must be higher than 5.0.

Second assessment

Students who did not achieve the minimum required score in the final exam or in the laboratory sessions during the first examination session must take the corresponding assessments in the second session.

For the laboratory component, a written exam covering topics related to the practical activities will be conducted. Students who did not attend at least 80% of the laboratory sessions, or who failed the practical component, must also take a practical exam and submit the corresponding report.

If the course is not passed in this second session, the grade obtained in the laboratory component may be retained for enrolment in the following two academic years.

The early examination session will only be available if the laboratory practices were successfully completed in the previous academic year.

In the final exam, students must score at least 4.0 in both the theory and problem-solving sections to be eligible for averaging. The grades obtained in laboratory work and class assignments will be maintained for the second session.de Avaluació i Qualificació de la Universitat de València per a títols de Grau i Màster (http://links.uv.es/7S40pjF).

The copy or plagiarism of any activity that is part of the evaluation will mean the impossibility of passing the subject, being subsequently subjected to the appropriate disciplinary procedures indicated in the PROTOCOL OF ACTION AGAINST FRAUDULENT PRACTICES AT THE UNIVERSITAT DE VALÈNCIA (ACGUV 123/2020).

REFERENCES

- Análisis químico cuantitativo 3ªedición (6ª edición original), D.C.Harris, Editorial Reverté (2007)
- Química Analítica 6ª edición, G.C.Christian, McGraw-Hill, México (2009)
- Principios de Análisis Instrumental (6ª edición), D.A.Skoog, F.Holler, S.R.Crouch, Cengage Learning Editores, México (2008)
- Principios de Análisis Instrumental (6ª edición), D.A.Skoog, F.Holler, S.R.Crouch, Cengage Learning Editores, México (2008)
- Técnicas de separación en Química Analítica, R.Cela, R.A.Lorenzo y M.C.Casais, Síntesis, Madrid (2002)
- Técnicas analíticas de separación, M.Valcárcel Cases y M.Gómez Hens, Reverté, Barcelona (1988)
- Laboratorio de Análisis Instrumental, A.Maurí, M.Llobat y R.Herraez. Servei de Publicacions de la UV y editorial Reverté (2010)