COURSE DATA

DATA SUBJECT

Code: 34230
Name: Analytical Chemistry III
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	Annual, First quarter
1929 - Double Degree Program in Physics and Chemistry	Facultat de Física	4	First quarter
1934 - Double Degree Program in Chemistry-Chemical Engineering	Facultat de Química	4	

SUBJECT-MATTER

Degree	Subject-matter	Character
1110 - Degree in Chemistry	Analytical Chemistry	COMPULSORY
1929 - Double Degree Program in Physics and Chemistry	Cuarto Curso (Obligatorio)	COMPULSORY
1934 - Double Degree Program in Chemistry-Chemical Engineering	Cuarto curso	COMPULSORY

COORDINATION

CAMPINS FALCO PILAR

SUMMARY

On this course students complete their overview of the various types of instrumental analytical techniques by analysing separation and coupled techniques. The course provides students with a solid foundation for selecting analytical methods using the techniques they have studied both in previous academic years and in this one and for addressing univariate, bivariate and multivariate data processing with the most common statistical techniques and the independence and critical spirit that is afforded by satisfactory knowledge of the fundamentals of this sub-discipline.

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 have previously passed the subject(s)
34183 - General Chemistry I
34184 - General Chemistry II

1929 - Double Degree Program in Physics and Chemistry

Obligation to have previously passed the subject(s)
34183 - General Chemistry I
34184 - General Chemistry II

1934 - Double Degree Program in Chemistry-Chemical Engineering

Obligation to have previously passed the subject(s)
34183 - General Chemistry I
34184 - General Chemistry II

OTHER REQUIREMENTS

To successfully complete this course, students should have acquired knowledge from previous courses. In particular, they should have a basic understanding of the analytic process and analytical chemistry as well as knowledge of the chemistry of solutions, spectroscopic techniques, univariate data management (calibration), and significant features of the analytical methods.

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 apply metrology in chemical processes, including quality management.

At the end of the course, the student will be able to assess risks in the use of chemical substances and laboratory procedures.

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 distinguish the principles, procedures and techniques used for the determination, separation, identification and characterisation of chemical compounds.

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 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. Non-chromatographic separation techniques

Concept of analytical separation and classification of separation techniques. Liquid-liquid extraction. Liquid-solid extraction. Solid-liquid extraction. Gas-solid extraction. Miniaturized techniques. Active and passive samplers.

2. Chromatographic techniques

Concept of chromatography and classification of chromatographic techniques. Chromatography theories. Fundamental parameters in zonal elution chromatography. General characteristics of the detectors used in chromatography. Qualitative and quantitative methods.

3. Gas Chromatography

Gas chromatograph schematic. Field of application, common derivatizations in GC. Injection of the sample with/without division and directly in the column. PTV injectors. usual stationary phases. Column types. Common detectors in CG. Qualitative and quantitative applications.

4. High-Performance Liquid Chromatography

HPLC chromatograph. Scope. Injection systems. Pumping systems. Columns: types and selection criteria. Detectors in liquid chromatography. Partition liquid chromatography. Ion chromatography.

5. Capillary electrophoreisis

Instruments. Scope. Injection systems. Capillaries and buffer solutions. Detectors. Capillary zone electrophoresis (CZE). Micellar electrokinetic capillary chromatography (MEKC). Capillary electrochromatography (CEC).

6. Mass spectrometry. Coupled techniques.

Basic components of a mass spectrometer. Sample introduction systems. Ionization sources. Analyzers. Detectors. Work modes and data characteristics. GC-MS, HPLC-MS, ICP-MS hybridization: instrumentation, common interfaces, acquisition modes and field of application.

Objects and variables. Types of variables. The object-variable matrix and its transpose. Data preprocessing.

7. Multivariate chemometrics.

Variance-covariance matrix. Matrix of correlations. Classification of multivariable chemometric techniques.

8. Unsupervised and supervised analysis techniques.

Cluster analysis. Principal component analysis (PCA). Discriminant analysis. Classification techniques using non-parametric methods. Smooth modeling technique independent of class analogies (SIMCA).

9. Experimental design and multivariate optimization.

Objectives and terminology in experimental design and multivariate optimization. sweeping designs. Evaluation of the importance of the factors and their interaction. Designs for calculating response surface. Interpretive optimization. Sequential optimization.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	9,00
Theory	51,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	24,00
Preparation of lessons	16,00
Preparation for assessment activities	21,00
Resolution of case studies	9,00
Total hours	**90,00**

TEACHING METHODOLOGY

This course consists of:

• Whole-group lectures

Lectures will be combined with cooperative learning models. The instructor will provide an overview of the

topic under study, explain the key concepts, and answer any questions that arise. To help students meet the learning objectives, activities to promote cooperative learning and student participation will be introduced. To encourage individual study and in-depth preparation of the topics, basic and complementary bibliographies will be provided.

The practical problem-solving sessions will apply the theoretical knowledge acquired. The lecturer will provide problem-type examples and present the information the students will need for learning to identify the essential features of the approach and the techniques needed to solve the problems.

• Tutorials with each subgroup

The lecturer will guide the student on all elements of the learning process regarding both general approaches and specific issues. In class students will solve problems, tackle other issues and conduct other work proposed by the lecturer. A selection of these activities will be corrected or presented. The lecturer will also provide other problems and issues for students to work on at home before correcting them in class.

Seminars and Conference

Seminars and Conference will focus on complementary aspects of their training in Analytical Chemistry. For this task, students attending the event and answer a questionnaire prepared by the instructor.

EVALUATION

FIRST CALL

The assessment of student learning will consider all the aspects outlined in the methodology section of this teaching guide. The evaluation consists of two components:

1) Tests (70%): These tests include written, oral, and/or practical exams.

2) Continuous Evaluation (30%): Each student's performance is assessed based on the proposed activities (questions, exercises, evaluation tests, etc) participation, and engagement in the teaching-learning process. Note that continuous evaluation activities are non-recoverable.

The final mark will be the sum of the exam mark and the marks obtained in all assigned activities, according to the previously indicated percentages. To pass the course, the student must obtain a minimum mark of 4.5 on the final exam, and the weighted average must be equal to or higher than 5. There is no minimum mark required in continuous evaluation to average with the exam, but the mark obtained in this part will necessarily be included in the calculation of the final course mark.

Copying or plagiarism of any assignment that is part of the evaluation will result in the impossibility of passing the course, and the student will be subject to the appropriate disciplinary procedures.

It should be noted 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 documents of the University".Evaluation system of the subject.

SECOND CALL

In the second call, the mark will be obtained by applying the same criteria as in the first call.

REFERENCES

- SKOOG, D.A.; HOLLER, F.J. Y NIEMAN, T.A. Principios de Análisis Instrumental, 5ª Edición. Madrid: McGraw-Hill, 2001. ISBN 8448127757
- HARVEY, D. Química Analítica moderna. Madrid: McGraw-Hill, 2002.ISBN 9788448136352
- HARRIS, D.C. Análisis Químico Cuantitativo, 3ª Edición. Barcelona: Reverté, 2007. ISBN 9788429172249
- SKOOG, D.A.; WEST, D.M.; HOLLER, F.J. Y CROUCH, S.R. Fundamentos de Química Analítica, 8ª edición. Madrid: Thomson-Paraninfo, 2005. ISBN: 9788497323338
- MILLER, J.N. Y MILLER, J.C. Estadística y Quimiometría para Química Analítica. Madrid: Prentice Hall, Pearson Educación, 2002. ISBN 8420535141
- KELLNER, R.; MERMET, J.M.; OTTO, M.; VALCÁRCEL, M. Y WIDMER, H.M. Analytical Chemistry: a modern approach to analytical science, 2ª edición. Winheim: Wiley-VCH, 2004. ISBN 3527305904
- RAMIS, G. Y GARCÍA ALVAREZ-COQUE, M.C. Quimiometria. Madrid: Síntesis, 2001. ISBN 8477389047