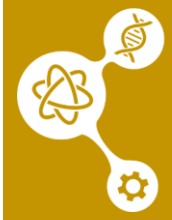
Academic Year 2026/2027

Course guide:

ANALYTICAL CHEMISTRY



FACULTY OF CHEMICAL SCIENCES

1. IDENTIFICATIÓN

Degree Program	Bachelor's Degree in Chemical Engineering			Code	801543
Course	Analytical Chemistry			ECTS	9
Subject Area	Chemistry and Biochemistry				
Module	Chemical Technology				
Course Type	Compulsory	Year	Second	Semester	First
Responsible Department	Analytical Chemistry				

Teaching staff

Activity	Lecturer	Email	Office
Course Coordinator	LOURDES AGÜÍ CHICHARRO	malagui@ucm.es	QB-321B
Laboratory Coordinator	LOURDES AGÜÍ CHICHARRO	malagui@ucm.es	QB-321B

Group A

Activity	Lecturer	Email	Office
Lectures Seminars Tutorials	LOURDES AGÜÍ CHICHARRO	malagui@ucm.es	QB-321B
Lectures Seminars Tutorials	NOELIA ROSALES CONRADO	nrosales@ucm.es	QA-322B

Group B

Actividad	Lecturer	Email	Office
Lectures Seminars Tutorials	JUAN JOSÉ RODRÍGUEZ BENCOMO	Juanjr10@ucm.es	QA-321A
Lectures Seminars Tutorials	REYNALDO VILLALONGA SANTANA	rvillalonga@quim.ucm.es	QB-342C

Laboratory

Group	Semester	Lecturer	Email	Office
A	1º	María Dolores Marazuela Lamata	marazuela@quim.ucm.es	QB-432
A	1º	Victor Ruiz-Valdepeñas Montiel	vrvmontiel@ucm.es	QB-437
A	1º	Reynaldo Villalonga Santana	rvillalonga@quijm.ucm.es	QB-342C
A	1º	Juan José Rodríguez Bencomo	Juanjr10@ucm.es	QA-321A
A	1º	Justavo Moreno Martín	gusmoren@ucm.es	QA-402
B	1º	Melisa del Barrio Redondo	melisdel@ucm.es	QA-402

B	1º	Ema Gracia Lor	emgracia@ucm.es	QA-405
B	1º	Teresa Pérez Corona	mtperezc@ucm.es	QA-319B
B	1º	Esther Sánchez Tirado	esther..sanchez@ucm.es	QA-405
B	1º	Beatriz Gómez Gómez	beatrgom@ucm.es	QA-402

2. OBJECTIVES

General Objective

The aim of this course is to introduce students to Analytical Chemistry so that they acquire a clear and up-to-date understanding of the analytical process, its theoretical foundations, and analytical methodology, as well as the applications of volumetric, gravimetric, and major instrumental techniques in quantitative analysis.

The course also seeks to provide students with fundamental experimental skills for the selection, implementation, and evaluation of different analytical methods.

Upon completion of the course, students should be able to apply their knowledge of chemical equilibria to volumetric and gravimetric analysis, as well as apply instrumental techniques to chemical analysis.

Specific Objectives

- To understand the general methodology of the analytical process and appreciate the importance of each stage involved
- To understand the application of chemical equilibria in volumetric and gravimetric analysis.
- To become familiar with spectroscopic, electrochemical, and chromatographic analytical techniques.
- To acquire knowledge of the practical applications of quantitative analytical methods.

3. PRIOR KNOWLEDGE AND RECOMMENDATIONS

Prior knowledge

Following this course satisfactorily requires the students to have previously acquired the knowledge and competencies corresponding to the first-year courses *"Applied Statistics"*, *"Basic Chemistry"*, and *"Mathematics I"*, (including inorganic and organic chemical nomenclature and formulation, the Periodic Table and common oxidation states, balancing chemical reactions, expression of concentrations and preparation of solutions, as well as the fundamentals of equilibria in solution).

Although enrolment in this course is not formally conditioned on these prior knowledge, effective mastery of this knowledge is essential to follow this course with a reasonable prospect of success.

Recommendations

It is also advisable for students to have a basic level of English that enables them to consult academic literature, conduct information searches, and communicate both in written and oral form in this language.

4. CONTENTS

Brief description

Theoretical Content

The analytical process and measurement in Analytical Chemistry. Analytical properties. Titrimetric methods: acid–base, precipitation, complexometric, and redox titrations. Gravimetric analysis: types and applications. Instrumental techniques: general principles and basic instrumentation. Optical and electroanalytical techniques. Separation techniques in analytical chemistry: chromatographic and non-chromatographic methods

Practical Content

Application of classical and instrumental methods to the determination of chemical species and compounds. Application of chromatographic separation techniques to representative samples.

Course Syllabus

THEORETICAL CONTENT

Topic 1: Analytical Chemistry: Concept, Objectives, and Methodology

Stages of the analytical process. Analytical methods.

Topic 2: Fundamentals of Volumetric Analysis

Requirements and classification of reactions used in titrimetry. Standard solutions. Titration curves: end-point detection and titration error.

Topic 3: Acid–Base Titrations

Titration curves. Acid–base indicators. Applications: determination of elemental nitrogen using the Kjeldahl method; determination of inorganic substances such as carbonates, phosphates, and other analyses.

Topic 4: Complexometric Titrations

Monodentate and polydentate ligands. Complexometric titrations. Titration curves. Indicators. Applications: determination of water hardness.

Topic 5: Precipitation Titrations and Gravimetric Analysis

Precipitation titration curves and applications. Gravimetric analysis: types and applications.

Topic 6: Redox Titrations

Titration curves. Redox indicators. Oxidizing and reducing agents used as titrants. Applications: determination of chemical oxygen demand and Karl Fischer method for water determination.

Topic 7: Instrumental Techniques of Analysis

Fundamentals and classification. Main components of an analytical instrument. Relationship between analytical signal and concentration. Analytical performance characteristics of methods.

Topic 8: Molecular Absorption Spectroscopy (UV–Visible and Infrared): Analytical Applications

Fundamentals. Beer–Lambert law. Instrumentation. Applications: quantitative analysis.

Topic 9: Molecular Luminescence Spectroscopy: Analytical Applications

Fundamentals and types of luminescence. Factors affecting fluorescence emission. Instrumentation. Applications.

Topic 10: Atomic Spectroscopy: Absorption and Emission Techniques

Fundamentals and classification. Atomization systems. Atomic absorption techniques. Atomic emission techniques. Applications.

Topic 11: Introduction to Electrochemical Analytical Techniques

Fundamentals and classification. Potentiometric techniques. Voltammetric techniques. Applications.

Topic 12: Introduction to Chromatographic Techniques

Fundamentals and chromatographic parameters. Gas chromatography. Liquid chromatography. Applications.

Topic 13: Introduction to Sample Preparation

Sample preparation for analysis. Mineralization procedures. Extraction methods.

PRACTICAL CONTENT

1. Acid–base titration. Determination of nitrogen in flour by the Kjeldahl method.
2. Volumetric determination of water hardness.
3. Determination of vitamin C in a pharmaceutical preparation.
4. Determination of fluoride ions in toothpaste by direct potentiometry.
5. Determination of phosphates by molecular absorption spectrophotometry.
6. Determination of trans fatty acids in margarines by infrared spectrometry.
7. Determination of quinine in tonic water by molecular fluorescence.
8. Determination of zinc in water by atomic absorption spectrometry.
9. Determination of paracetamol, caffeine, and acetylsalicylic acid in analgesics by liquid chromatography.
10. Determination of hydrocarbons by gas chromatography.

5. COMPETENCES

General competencies

CG1-TQ1	Use concepts for the autonomous learning of new methods and theories.
CG2-TQ2	Design experimental procedures applied to chemical analysis.

Specific competencies

CE24-QB1	Describe the stages of the analytical process, weighing the importance of each with a view to obtaining quality measurements.
CE24-QB2	Apply the concepts acquired in the study of ionic equilibria in solution to volumetric and gravimetric analysis.
CE24-QB3	Describe the basic foundations of the main optical, electrochemical, and chromatographic instrumental analytical techniques.
CE24-QB4	Select the appropriate technique for solving a specific analytical problem.
CE25-QB1	Acquire the experimental skills required to perform volumetric and gravimetric analyses and to apply instrumental and separation techniques to the solution of specific analytical problems in different industrial processes

Cross-cutting

CT1-TQ1	Develop capacity for analysis and synthesis.
CT2-TQ1	Solve problems in the area of Chemical Technology.
CT4-TQ1	Communicate in Spanish using standard audiovisual media.
CT5-TQ2	Consult, use and analyse specialised databases and resources accessible through the Internet.
CT6-TQ1	Use computer tools and programs to calculate, simulate, and approximate.
CT8-TQ1	Demonstrate capacity for critical and self-critical reasoning.
CT11-TQ1	Learn autonomously.
CT12-TQ1	Develop sensitivity to the social and environmental repercussions of engineering solutions.

6. LEARNING OUTCOMES

On successful completion of the course, the student will be able to:

THEORY

- Explain the principles and objectives of Analytical Chemistry.
- Describe the stages of the analytical process and the types of analytical methods
- Apply the concepts of accuracy, precision, selectivity, and sensitivity.
- Explain the fundamentals of titrimetric methods, titration curves, and end-point indicators..
- Classify types of standard solutions.
- Calculate titration error.
- Describe the main applications of acid–base titrations.
- Describe the main applications of complexometric titrations.
- Describe the main applications of precipitation titrations.
- Classify gravimetric methods.
- Describe the main applications of gravimetric analysis.
- Describe the main applications of redox titrations.

- Distinguish between classical and instrumental analytical methods.
- Classify instrumental analytical techniques.
- Describe the fundamental components of an analytical instrument.
- Use different calibration methods.
- Determine the analyte content in a sample and its associated uncertainty.
- Describe the analytical performance characteristics of an instrumental method.
- Classify spectroscopic analytical techniques.
- Explain the principles of molecular UV, visible, and infrared spectroscopy.
- Describe the components of the corresponding spectrophotometers.
- Explain the principles of molecular emission spectroscopy.
- Describe the components of molecular emission spectrophotometers.
- Explain the principles of atomic absorption and emission spectroscopy.
- Describe the components of atomic absorption and emission instruments.
- Describe the main applications of atomic absorption and emission techniques in different fields.
- Explain the principles and classification of electrochemical analytical techniques.
- Describe the types of potentiometric techniques.
- Distinguish between the types of electrodes used in potentiometry.
- Classify anodic stripping voltammetric techniques.
- Understand the applications of potentiometric and voltammetric techniques.
- Describe the main applications of potentiometric and voltammetric techniques.
- Classify chromatographic techniques.
- Describe and calculate chromatographic parameters.
- Describe the fundamental instrumental components of gas chromatography and liquid chromatography systems.
- Describe the main applications of chromatographic techniques

PRACTICAL CLASSES

- Apply the most appropriate analytical methods for different types of samples.
- Prepare standard solutions.
- Calculate analyte concentrations from volumetric data.
- Operate instruments used in different analytical techniques.
- Interpret data obtained from instrumental measurements.
- Prepare laboratory reports and written documentation.

7. WORKLOAD DISTRIBUTION BY ACTIVITY

Activity	In-class (hours)	Self-study (hours)	Credits
Lectures	30	55	3,4
Seminars	21	29	2,0
Tutorials / guided work	4	6	0,4
Laboratory sessions	30	22,5	2,1
Preparation of assignments and exams	8	19,5	1,1
Total	**93**	**132**	**9**

8. METHODOLOGY

The course contents are delivered to students through in-person classes, organized into three groups:

The so-called **in-class theoretical lectures** will be delivered to the whole group, and their purpose is to introduce students to the course content. At the beginning of each topic, the main content and learning objectives will be clearly presented. At the end of each topic, a brief summary of the most relevant aspects will be provided, along with questions designed to help interrelate previously studied content. Examples will be used to support the concepts developed or to introduce new content. Students will be provided with the most appropriate teaching materials to facilitate their follow-up of the lectures, preferably through the Virtual Campus. The teaching tools used will include the blackboard and PowerPoint presentations, as well as links to relevant websites when appropriate.

In the **seminars associated with the theoretical content**, problem-solving activities related to the topics covered in lectures will be primarily carried out. On a regular basis, students will be provided with a set of problems/exercises with the aim of encouraging their independent work prior to the seminar sessions. Problem-solving will be conducted in different ways: the lecturer will solve representative problems, and students will also be encouraged to solve problems at the board, followed by discussion with their peers and, when possible, relating the problems to real-life applications. When appropriate, computer software (e.g., Excel, Origin) may also be used for graphical and/or mathematical resolution of some of the proposed problems. Finally, exercises and/or tests will be collected periodically for assessment purposes, some of which may be set in English.

Laboratory sessions will be delivered in 3-hour classes, during which students will apply the knowledge of analytical methods acquired through face-to-face activities and their own independent study. In addition, data processing and evaluation of the results obtained in the laboratory will be addressed, as well as their relevance and practical implications.

Prior to the first laboratory session of the course, students must provide written confirmation that they have read, understood, and accepted the laboratory safety regulations.

Laboratory-related seminars will be held in sessions separate from the laboratory classes themselves. These sessions will provide students with the necessary guidelines to carry out laboratory work safely, as well as explanations of the experimental procedures to be performed. When appropriate, data processing and evaluation of the results obtained in the laboratory will also be addressed. At the end of each seminar, a short test covering the content discussed will be conducted. The overall grade obtained in the seminars will be weighted as an additional laboratory practice in the final laboratory mark.

In **supervised activities**, students will be required to present and/or deliver a piece of work during the course on topics related to the subject. These activities will be assessed as part of independent or non-contact learning activities. The general aim of these assignments is for students to become familiar with the usefulness of the analytical methods studied in the course, their real-world application in evaluating the quality of analytical methods, and their use in industrial processes as well as in the environmental field.

The assignments proposed for each student will consider two possible formats:

1) Numerical problem-solving related to a real case, and
2) Preparation of a specific topic, including the corresponding bibliographic research.

Tutorial sessions will be scheduled in small groups. During these sessions, students' questions will be addressed, and problems and exercises provided by the lecturer, related to the course content, will be discussed, as well as specific practical cases. Students will be assigned problems or questions to be solved during the tutorial session, which will be considered for continuous assessment.

The **Virtual Campus** will be used to ensure smooth communication between lecturers and students through its email system, and as a platform for providing students with the materials used in lectures, seminars, and laboratory sessions.

It may also be used as a tool to provide students with additional or supplementary information on topics of interest that are not considered appropriate to cover during face-to-face classes.

Part of the recommended bibliography and supporting materials made available on the Virtual Campus for the development of the teaching activities in this course will be in English.

9. BIBLIOGRAPHY

Basic

- Skoog, D. A., West, D. M. Holler, F. J., Crouch, S. R., "*Fundamentos de Química Analítica*", Ed. Thomson, 8ª ed., 2005.
- Silva M. y Barbosa J. "*Equilibrios iónicos y sus aplicaciones analíticas*", Ed. Síntesis, 1ª ed., 2004.
- Yáñez-Sedeño P., Pingarrón J.M., Manuel de Villena F. J., "*Problemas resueltos de Química Analítica*", Ed. Síntesis, 1ª ed., 2003
- Yáñez-Sedeño, P.; Pingarrón Carrazón, J.; González Cortés, A. "*300 problemas resueltos de química analítica*", Ed. Síntesis, 1ª ed., 2022
- Skoog, D. A., Holler, F.J. and Crouch, S.R.., "*Principios de Análisis instrumental*", Ed. Cengage Learning, 6ª Ed., 2008.
- Skoog, Douglas A.; Holler, F. James y Crouch, Stanley R.: "*Principles of Instrumental Analysis*", 6ª ed., Ed. Cengage Kearning, 2008
- Polo Díez, L.M., "*Fundamentos de Cromatografía*", Ed. Dextra, 2015.

Complementary

- Skoog, D., Holler, J. y Nieman, T. "*Principios de análisis instrumental*", Ed. McGraw-Hill, 5ª ed., 2003.
- Valcárcel Cases, M. Y Gómez Hens, A. "*Técnicas Analíticas de Separación*", Ed. Reverté, 1994.
- Cela, R., Lorenza, A. y Casais, M.C., "*Técnicas de separación en Química Analítica*", Ed. Síntesis.
- Harris, D. C., "*Análisis Químico Cuantitativo*", Ed. Reverté, 3ª ed., 2007.
- Harris, D. C. "*Quantitative Chemical Analysis*", 7th ed.; W.H. Freeman: New York, 2007.
- Skoog, D. A., West, D. M., "*Análisis Instrumental*", Ed. McGraw-Hill
- Hernández, L y González, C. "*Introducción al análisis instrumental*", Ed. Ariel Ciencia, 2002.
- Rubinson, K.A. y Rubinson, J.F. "*Análisis Instrumental*", Pearson Education S.S., 2000.

10. EVALUATION

Attendance at supervised tutorials, theory lectures, seminar sessions, and laboratory classes is required. In order to be eligible for the final assessment, students must attend at least 70% of all face-to-face activities.

The final course grade will be calculated as the weighted average of the different assessable activities. However, to pass the course, students must obtain the minimum grade established for each activity. If this requirement is not met, the final grade will be the weighted average, capped at 4.5 out of 10. This criterion shall apply to both the ordinary and extraordinary assessment periods

Marks corresponding to the assessment activities included in the course evaluation system (midterm examinations, laboratory work, tutorials, problem assignments, etc.) will be communicated to students sufficiently in advance of the final examination so that they may adequately plan their study schedule for this and other courses.

In particular, marks for midterm examinations will be released within a maximum period of 20 days, except in the case of the second midterm examination, for which the period may be shorter in order to accommodate the scheduling of the final examination.

In all cases, a minimum period of seven days between the publication of marks and the date of the final examination will be respected

❖ WRITTEN EXAMS: 65%

Ordinary Examination Session: A midterm examination covering the Classical Methods section of the course will be held (40% of the total mark). A minimum grade of 5 out of 10 is required in order to exempt this part from the final examination of the ordinary examination session.

At the end of the semester, a final examination covering the entire course content will be held. Students who have passed the first part may choose either to take an examination covering only the second part (60%) — for which a minimum grade of 4.0 out of 10 must be obtained — or to sit the examination covering the entire course content.

The written examinations will include problems and theoretical questions related to the course syllabus. The marks assigned to each question and problem will be clearly specified.

The final mark for the written examination, both in the ordinary and resit examination sessions, will account for 65% of the final course grade. A minimum mark of 4.5 out of 10 must be obtained in order to pass the course.

Assessed Competences: CG1-TQ1, CG2-TQ2, CE24-QB1, CE24-QB2, CE24-QB3, CT1-TQ1, CT2-TQ1, CT8-TQ1.

❖ LABORATORY SESSIONS: 20% (10% Exam; 10% Laboratory Work)

Attendance at all laboratory sessions and associated seminars is required. An unexcused absence from a laboratory session may be sufficient grounds for this component not to contribute to the overall course grade. Changes of laboratory group will only be authorised upon presentation of appropriate supporting documentation.

The laboratory component will account for 20% of the final course grade. Assessment will be based on a written examination (Part E), as well as the laboratory report and laboratory performance (Part P). In order to pass the laboratory component, students

must obtain a mark higher than 4 out of 10 in the written exam (grade E) and a mark higher than 5 out of 10 in the practical component (laboratory report and laboratory work) (grade P).

The final laboratory grade will be calculated as the average of grades E and P, and the resulting final mark must be equal to or greater than 5 out of 10 in order to pass. Students who fail the laboratory component may only retake it in the July resit examination session if they have completed all laboratory sessions. In such cases, they may resit the failed component(s): written examination and/or practical examination.

Students who completed the laboratory sessions in previous academic years may request exemption from repeating them, provided that no more than one year has elapsed since completion and that the laboratory component was previously passed.

If plagiarism is detected in the laboratory report, or if the results and answers included in the report do not correspond to the work actually carried out in the laboratory, the final laboratory grade will be recorded as FAIL.

The written examination will assess aspects related to the theoretical foundations, working methods, and numerical calculations associated with the laboratory experiments carried out.

Assessed Competences: CE24-QB2, CE24-QB4, CE25-QB1, CT1-TQ1, CT2-TQ1, CT12-TQ1.

❖ INDIVIDUAL WORK: 15%

The assessment of the individual learning work carried out by the student will account for 15% of the final grade and will be based on the following factors:

- The student's proficiency in solving the proposed problems and exercises, which will be collected periodically during in-person sessions or submitted via the "Assignments" section of the Virtual Campus (CV).
- Work and participation in theory-related seminars.
- Work and participation in mandatory tutorials, in which the student's understanding must be reflected in the problems solved, proposed by the lecturer.
- Completion of a small-group project selected from those proposed by the lecturer. If deemed appropriate, the project will be presented in a face-to-face session. In such cases, following each presentation, groups will be subject to questions from peers and/or the lecturer regarding the topic. The lecturer will assess the project in terms of design, content, originality, discussion, etc., as well as the presentation and defence when applicable.
- Completion of periodic assessments, either in person or through any of the tools available in the Virtual Campus (CV).

Assessed Competences: CE24-QB2, CE24-QB4, CE25-QB1, CT1-TQ1, CT2-TQ1, CT4-TQ1, CT5-TQ2, CT6-TQ1, CT8-TQ1, CT11-TQ1, CT12-TQ1.

❖ JULY EXAMINATION SESSION:

The written examination will cover the entire syllabus and, as in the ordinary examination session, will account for 65% of the final course grade.

The assessment of individual work directed activities, and active participation during the course will also be considered in the resit examination session (15%).

ACTIVITY PLANNING - SCHEDULE

TOPIC	ACTIVITY	HOURS	GROUPS	START	END
1.- Analytical Chemistry: concept, objectives, and methodology	Theory	1	1	1ª Week	
2.- Fundamentals of Volumetric Analysis	Theory	1	1	1ª Week	
3.- Acid–Base Titrations	Theory	2	1	1ª Week	2ª Week
	Seminar	2	1	2ª Week	
4.- Complex Formation Titrations	Theory	2	1	3ª Week	
	Seminar	1	1	3ª Week	4ª Week
	Scheduled Tutorial Session*	1	2	3ª Week	
5.- Precipitation Titrations	Theory	2	1	4ª Week	
	Seminar	2	1	4ª Week	
6.- Redox Titrations	Theory	2	1	5ª Week	6ª Week
	Seminar	2	1	6ª Week	
7.- Instrumental Analytical Techniques	Theory	2	1	6ª Week	7ª Week
	Seminar	2	1	8ª Week	
	Scheduled Tutorial Session*	1	2	8ª Week	
8.- Ultraviolet–Visible and Infrared Molecular Absorption Spectroscopy: Analytical Applications of the Techniques	Theory	4	1	9ª Week	
	Seminar	2	1		
9.- Molecular Luminescence Spectroscopy: Analytical Applications of the Technique	Theory	2	1	9ª Week	
	Seminar	1	1	10ª Week	
10.- Atomic Spectroscopy: Absorption and Emission Techniques. Analytical Applications of the Techniques	Theory	4	1	10ª Week	11ª Week
	Seminar	2	1	11ª Week	
	Scheduled Tutorial Session*	1	2	12ª Week	

11.- Introducción a las técnicas electroquímicas de análisis	Theory	4	1	12ª Week	13ª Week
	Seminar	2	1	13ª Week	
12.-Introducción a las técnicas cromatográficas de análisis	Theory	4	1	13ª Week	14ª Week
	Seminar	2	1	15ª Week	
13.- Introducción a la preparación de la muestra	Theory	3	1	15ª Week	
	Seminar	0	1		
	Scheduled Tutorial Session*	1	2		

* The scheduling of tutorials depends on the overall timetable of all the subjects in the program.

SUMMARY OF THE ACTIVITIES

ACTIVITY	ASSOCIATED COMPTENCES	TEACHING ACTIVITY	STUDENT ACTIVITY	ASSESSMENT	P	NP	TOTAL	C
Lectures	CG1-TQ1, CE24-QB1, CE24-QB2, CE24-QB3, CT11-TQ1, CT12-TQ1	Presentation of theoretical concepts.	Note-taking.	Assessment of written answers to questions related to the theoretical concepts covered.	30	55	85	
Seminars	CG2-TQ2, CE24-QB4, CT1-TQ1, CT2-TQ1, CT6-TQ1, CT8-TQ1	Application of the theory to the solving of exercises and problems.	Note-taking. Completion of exercises. Asking questions and raising queries.	Assessment of written answers (problem formulation and final results) provided for the solution of practical exercises and numerical problems.	21	29	50	
Supervised Activities	CT4-TQ1, CT5-TQ2, CT6-TQ1, CT11-TQ1	Preparation and submission of assignments.	Written preparation of individual assignments.	Assessment of the work.	4	6	10	**5%**
Tutorial Sessions / Self-study	CT1-TQ1, CT2-TQ1, CT4-TQ1	It supports students in guiding their study through explanations and bibliographic recommendations. Proposal of numerical problems.	Consultation with the lecturer regarding conceptual and methodological difficulties encountered while studying the subject. Submission of numerical problems solved at home. Solving a numerical problem proposed during the tutorial session.	Assessment of the submitted problem sets and the proposed numerical problem.				**10%**

ACTIVITY	ASSOCIATED COMPTENCES	TEACHING ACTIVITY	STUDENT ACTIVITY	ASSESSMENT	P	NP	TOTAL	C
Laboratory Sessions	CE24-QB4, CE25-QB1, CT5-TQ2, CT6-TQ1, CT11-TQ1, CT12-TQ1	Instruction in the safe handling of chemical reagents, laboratory equipment, and analytical instrumentation.	Note-taking related to the laboratory practice, recording experimental data, and evaluating the results. Preparation of a laboratory report.	Assessment of written responses to questions related to the theoretical and practical concepts covered, assessment of the submitted laboratory report, and assessment of experimental work carried out in the laboratory.	30	22,5	52,5	**20%**
Exams	CE24-QB2, CE24-QB3, CE24-QB4, CT1-TQ1, CT2-TQ1, CT8-TQ1, CT12-TQ1	Preparation, supervision, and marking of the examination. Student assessment.	Preparation and implementation.	Assessment of a written examination at the end of the semester.	8	19,5	27,5	**65%**

P: Contact activities.

NP: Non-contact (independent study).

C: Grade.