

**Instrumental Chemical Analytics**

Code: 106056  
ECTS Credits: 3

Degree	Type	Year	Semester
2500897 Chemical Engineering	OB	2	2

## Contact

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## Teaching groups languages

You can check it through this [link](#). To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

## Prerequisites

Basic knowledge of general chemistry. It is recommended to have acquired the basic knowledge and skills taught in the subjects Inorganic Chemistry and Equilibrium, and Fundamentals of Chemistry

## Objectives and Contextualisation

### Context

The subject Instrumental Analytical Chemistry is taught in the Chemical Engineering Degree as a compulsory subject within the second academic year. It is an introductory subject and also finalist, since it has no continuity in the Study Plan.

### Objectives

The Instrumental Analytical Chemistry course aims to introduce the basic knowledge of instrumental analysis techniques, particularly UV-Visible spectroscopy, potentiometric methods, emphasizing the pH electrode, and a brief introduction to chromatography in general as a separation technique of complex samples.

The main objectives of the subject are:

- Describe the rationale and basic instrumentation associated with the techniques studied
- Apply this knowledge to solve chemical analysis problems.

## Competences

- Apply relevant knowledge of the basic sciences, such as mathematics, chemistry, physics and biology, and the principles of economics, biochemistry, statistics and material science, to comprehend, describe and resolve typical chemical engineering problems.
- Develop personal work habits.
- Develop thinking habits.

## Learning Outcomes

1. Apply knowledge of abundance, natural state and reactivity of chemical elements to the method or methods of obtainment and/or purification.
2. Develop a capacity for analysis, synthesis and prospection.
3. Develop critical thinking and reasoning
4. Work autonomously.

## Content

### PART I: GENERAL INTRODUCTION

Lesson 1.- Classification of analytical methods. Instrumental Methods of Analysis. Calibration of an instrument and calibration of the analytical method. External patterns. Linear least squares regression. Interpolation of the sample. Quality parameters of an analytical instrument: sensitivity, limit of detection and limit of quantification. Standard addition.

### PART II: INTRODUCTION TO MOLECULAR ABSORPTION SPECTROSCOPY

Lesson 2.- Optical analysis techniques. Properties of electromagnetic radiation. Electromagnetic spectrum. Electromagnetic radiation-matter interaction. Classification of optical analysis techniques. Absorption and emission of radiation. Lambert-Beer law and limitations. Calibration procedure.

Lesson 3.- Introduction to molecular absorption spectroscopic techniques: UV-Vis and IR. Fundamentals of the techniques. Instrumentation: parts of a spectrophotometer. Applications.

### PART III: INTRODUCTION TO POTENTIOMETRY

Lesson 4.- Electroanalytical techniques. Classification Type of electrochemical cells. Potentiometry. The salt bridge. Indicator electrode and reference electrode. ISEs. membrane potential pH electrode. Applications of potentiometry.

### PART IV: INTRODUCTION TO CHROMATOGRAPHY

Lesson 5.- Separation techniques. Introduction to chromatography. Fundamentals of chromatographic techniques. Classification of chromatographic techniques. HPLC liquid chromatography. GC gas chromatography. Chromatogram. Retention time and dead time. Separation efficiency: capacity factor and selectivity factor. Resolution.

Lesson 6 (Part I).- Chromatographic signal: peak height and area. Calibration with addition of internal pattern.

Lesson 6 (Part II).- Gas chromatography. Instrumentation. Carrier gas Temperature control. Columns. Detectors Applications. Liquid chromatography (HPLC). Instrumentation. Columns. Detectors Applications.

## Methodology

### Methodology

Although the teacher will use the master class to transmit knowledge of the core aspects of each topic, the student must be an active part of the learning process (interactive master class). In this sense, initiatives on inquiry, motivation, and the process of knowing things will be promoted, with the student having to create and adapt them to their own learning process. The master classes will be reinforced with audiovisual support. The teacher will carry out tasks of orientation, guidance and reinforcement of those aspects that present greater difficulty. Abundant bibliographical material will be made available to students, including theoretical content and exercises. To encourage critical reasoning, discussion, and reflection on the part of the student, work groups will be enabled in the problem classes in order to complete the learning process through group discussion.

Satisfaction surveys: Approximately 15 minutes of a class will be reserved, within the calendar established by the centre or by the degree, so that students can answer the surveys to evaluate the teaching performance of the teaching staff and the evaluation of the subject or module.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problems and exercises	5	0.2	1, 2, 3, 4
Theory classes	20	0.8	1, 2, 3
Type: Supervised			
Scheduled tutorials	3	0.12	2, 3
Type: Autonomous			
Autonomous study	44	1.76	1, 2, 3, 4

## Assessment

### Continuous assessment

The evaluation will be individual and will be carried out continuously in the different training activities that have been programmed.

Individual written tests: There will be two partial exams that will include the contents addressed in the different lessons, whose weight will be 90% of the final grade (each partial exam has a weight of 45% of the final grade).

Submission of exercises and papers: Throughout the course the student must submit exercises that will be proposed by the teacher. You will have exercises that will have to be done in class, and others will have to be done as autonomous work by the student.

In no case, the days that the exercises will be done will be scheduled and there will be no prior notice. All exercises will be compulsory.

Attitude in training activities: Active participation, face-to-face attendance, as well as the attitude in the different training activities such as lectures, problems, seminars, and practical laboratory sessions, will have a subjective assessment by the teacher.

The exercises delivered and the attitude will have a weight in the final grade of 10%

It will be considered NOT EVALUABLE if no partial exam is taken and the make-up exam is not taken.

VERY IMPORTANT!! To pass the course, it is necessary to obtain a score equal to or greater than 5.0 out of 10 in the FINAL MARK (by partials) and have a mark equal to or greater than 5.0 in the PARTIAL MARK.

PARTIAL MARK= PARTIAL SCORE 1\*0.50 + PARTIAL SCORE 2\*0.50

FINAL MARK (by partials) = PARTIAL MARK (if PARTIAL MARK  $\geq$  5.0) \* 0.90 + (EXERCISES + ATTITUDE) \* 0.10

Right to recovery exam:

- In the case of not passing the subject by partial plus the work done, the student will have the right to a RECOVERY EXAM of ALL THE SUBJECT. To pass the subject, it is mandatory to obtain a RECOVERY EXAM MARK equal to or greater than 5.0, but in this case, the final grade will be strictly 5.0 plus 10% of the grade (out of 10) obtained in the exercises.

FINAL MARK (Ex. recovery) = RECOVERY EXAM MARK (all subject) (5.0 if RECOVERY EXAM MARK  $\geq$  5.0) + (EXERCISES + ATTITUDE) \* 0.10

Single assessment

Students who have accepted the single assessment modality must take a final test (single exam) that will consist of an exam of the entire theoretical syllabus and problems of the subject.

This test will take place on the day that the continuous assessment students take the second partial exam.

It will be considered NOT EVALUABLE if the single exam is not taken and the recovery exam is not taken.

VERY IMPORTANT!! To pass the subject, it is necessary to obtain a score equal to or greater than 5.0 out of 10 in the FINAL MARK (single exam).

Right to the recovery exam (single evaluation):

- If the FINAL MARK (single exam) is less than 5.0, the student will be entitled to a RECOVERY EXAM of ALL THE SUBJECT. To pass the subject, it is mandatory to obtain a RECOVERY EXAM NOTE equal to or greater than 5.0, but in this case, the final grade will be strictly 5.0 on the academic record.

The recovery exam will be the same as the one carried out by the students who have taken advantage of the continuous evaluation, as well as the date of the test.

FINAL MARK (Ex. Recovery) = RECOVERY EXAM MARK (all subject)

*The final marks of the students who pass the subject can be distributed between 5 and 10, always maintaining the order of the students according to the FINAL NOTE obtained, to achieve the distribution between approved, notable, excellent and MHS, that teachers consider appropriate.*

*Students will have to act honestly throughout the course. Participation in dishonest attitudes (cheating, allowing copying or any action aimed at distorting an evaluation) in any follow-up test or exam will be grounds for a qualification of "Failed" with a final grade of 0 in the subject, regardless of the rest of the grades obtained by the students involved. During the written tests, mobile phones or any other telecommunication device they must be disconnected and stored in the bags or backpacks that will have to be on the platform. If a student is found to be carrying an unauthorized device during the exam and/or follow-up test, the student will be expelled from the classroom and will have a "Failed" grade in the subject.*

## Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Carrying out work and solving problems.	10%	1	0.04	2, 3, 4
Realization of two partial written tests	90%	2	0.08	1, 2, 3, 4

## Bibliography

Análisis instrumental

D.A. Skoog i Leary

Editorial Mc Graw-Hill, 4ª edició, México (1994)

Anàlisi química cuantitativa

D.C. Harris

Editorial Reverté, Catalunya (2006)

Principios de Análisis Instrumental

Skoog, Holler, Nieman

Editorial Mc Graw-Hill, 5ª edición 2001

## Software

Microsof 365

Teams

Campus Virtual