UAB
Universitat Autònoma de Barcelona

Industrial and Environmental Monitoring

2026/2027

Code: 102498
Credits: 6

Degree programme	Type	Course
Chemistry	OP	4

Contact lecturer

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Teaching staff

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Group languages

You can consult this information at the end of the document.

Prerequisites

There are no prerequisites

Objectives

The course aims to complement and extend the basic knowledge of students in the field of Analytical Chemistry, as a science that generates quality chemical information (qualitative and quantitative) for the resolution of industrial and environmental monitoring problems. This information must incorporate next to the numerical data relative to the composition, the temporal and spatial vector that characterizes the information relative to dynamic systems in evolution.

With this objective, special importance will be given to everything related to the simplification of the analytical procedures using approximations based on the automation and interconnection of the different stages that they are composed; the reduction and integration of these stages through improvements in the selectivity of the measurements or their subsequent chemometric data treatment and, finally, the miniaturization of the instrumentation to facilitate its use outside of the environment of conventional laboratories.

The knowledge acquired in this course is fundamental to understand the importance of instrumental analysis methods for the acquisition of analytical information relevant to a management and rational exploitation of natural resources that allows their preservation and maintenance by limiting the impact of anthropogenic activities on ecosystems.

Likewise, it will show how the instrumental methods of analysis are also a basic tool for the optimization of industrial production processes and the reduction of their environmental impact, improving the quality of the products obtained, minimizing both the consumption of raw materials and the residual generation.

This course will also show the importance of multidisciplinary knowledge for the resolution of complex environmental and industrial problems. The design of analytical tools capable of providing in-situ information in real time will require understanding and addressing the learning of other areas of knowledge, showing the eminently multidisciplinarynature of Analytical Chemistry field.

The objectives of this course are:

1. Describe and deepen the fundamentals concepts and the instrumentation associated with the main instrumental techniques of analysis.

2. Describe and deepen the different analytical methodologies applicable to obtain information in real time in the field.

3. Apply the acquired knowledge to solve problems of environmental (control of natural processes and pollution by anthropogenic activities) and industrial (optimization of production and minimization of environmental impact) monitoring

Learning outcomes

1. Communicate orally and in writing in one's own language.
2. Manage the organisation and planning of tasks.
3. Resolve problems and make decisions.
4. Obtain information, including by digital means.
5. Manage, analyse and synthesise information.
6. Use IT to treat and present information.
7. Have numerical calculation skills.
8. Work in a team and show concern for interpersonal relations at work.
9. Reason in a critical manner
10. Be ethically committed.
11. Learn autonomously.
12. Adapt to new situations.
13. Propose creative ideas and solutions.
14. Lead and coordinate work groups.
15. Show sensitivity for environmental issues.
16. Define the functions of chemical analysis in sustainable development, on an industrial and environmental level.
17. Identify the current demands for information in the industrial and environmental field, and new trends in chemical analysis in order to provide solutions to optimise processes.
18. Differentiate the diverse stages of the analytical process as a key element for the obtainment of information.
19. Recognise the basics of the main instrumental analysis techniques in the industrial and environmental fields, in order to properly select the most appropriate in each case.
20. Define the concepts of integration and automation of analytical procedures as a tool for their simplification and critically evaluate the characteristics of the different types of automatic analysis systems.
21. Describe the concept of the sensor as a tool for the integration of analytical procedures, and the basic principles of transduction and selective recognition.
22. Recognise the importance of miniaturising analytical instruments in the development of analytical methodologies that provide information on the space time vector.
23. Discriminate between qualitative (screening) and quantitative analytical methods.
24. Recognise the basic chemistry used to interpret processes occurring in the natural environment.
25. Identify the main pollutant chemical agents, know their sources, and their distribution and interaction with the natural environment.
26. Recognise the different stages required to resolve an analytical process and obtain information.
27. Select the suitable methodology for the integration/automation of the analytical procedure in each case.
28. Critically evaluate the analytical methodologies used in the control of industrial and environmental processes, as well as their applicability in accordance with the type of information sought, the sample for analysis and the available means.

29. Recognise the differential characteristics of process analysers and relate them to problems derived from the analyser-process interface.
30. Plan a strategy to solve an analytical problem related with industry and environmental control, incorporating the time space vector in the information.
31. Distinguish the problems associated with the different types of analyte and sample matrices in the industrial and environmental fields (water system, atmosphere, soil).
32. Resolve examples of controlled follow-up with numerical and graphic tools.
33. Evaluate and interpret chemical data and information obtained by means of industrial and environmental monitoring.
34. Apply the analytical information obtained from the optimisation of industrial processes to improve their competitiveness and reduce environmental impact.
35. Evaluate the results of the environmental monitoring process to control the evolution of the ecosystem and thus enable effective management of natural resources.
36. Use common English terminology for industrial chemistry, electrochemistry and corrosion, environmental chemistry, green chemistry, quality management, monitoring systems, and financial and business management.
37. Summarise an article written in English in a reasonable time.

Contents

INTRODUCTION

1. Analytical Chemistry and the Control of Environmental and Industrial Processes. The Total Analytical Process. Monitoring: Extraction of information from evolving processes. Spatial and temporal Vector. New trends and challenges in Industrial and Environmental Analytical Chemistry.

INSTRUMENTATION

2. The Analytical Procedure. Instrumentation associated with the different stages. Sampling. Unit operations of sample pretreatment. Fundamental concepts of instrumental measurement techniques. Signal Acquisition and Processing.

3. Simplification of the analytical procedure applied to the process monitoring: Automation vs Integration of stages of the analytical procedure. Selection of the methodology.

4. Automation of the Global Analytical Procedure. Classification of automatic methods. Robotized analyzers. Basic principles and applications. Automatic discrete analyzers. Basic principles and applications.

5. Automation of the Analytical Procedure using Continuous Flow Analyzers. Principles and applications.

6. Integration of the Analytical Procedure. Sensor concept. Types of Sensors. Optical sensors. Electrochemical sensors. Biosensors. Gas sensors.

7. Miniaturization of analytical instrumentation. Preponderant phenomena on a micro scale. Manufacturing

technologies. Integrated analytical microsystems. On-site continuous monitoring of industrial and environmental parameters.

8. Screening Methods. Qualitative vs. quantitative aspects of problems in industrial and environmental analysis. Total Index and Binary Response Methods. Parameters Indicators of environmental quality.

9. Remote Monitoring. Conceptual development. Geographic Information Systems (GIS). Global Positioning Systems (GPS). Observation Platforms. Associated analytical instrumentation. Applications.

APPLICATIONS

10. Monitoring of water resources. Types of pollution. Types of monitoring. Sampling. Discrete and continuous monitoring: Physical, chemical and biological parameters. Analytical Instrumentation. Water quality control networks.

11. Atmospheric monitoring. Types and characteristics of atmospheric pollutants. Sampling. Monitoring techniques and associated instrumentation. Networks for manual and automatic control of atmospheric quality.

12. Soil contamination. Sampling and representativeness. Speciation Sequential extraction. Instrumental techniques for in-situ measurement. Cone Penetrometer.

13. Industrial Process Control. Case studies in the agri-food, pharmaceutical, petrochemical and mining industry.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Lectures and seminars	34	1.36	9, 10, 11, 12, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 34, 35
Laboratory practices	12	0.48	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36
Study	56	2.24	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37
Exercices solving and seminar preparation	28	1.12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, 35, 36, 37
Tutorials	10	0.4	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 28, 29, 30, 31, 32, 33, 35, 36, 37
Experimental in field practices	4	0.16	4, 5, 8, 9, 10, 11, 15, 23, 24, 30, 31, 32, 33, 34, 35

Theory classes, seminars and Laboratory Practices / Field Trips

The exhibition model will be combined (master class), with audiovisual support, and training activities that can be carried out in groups or individually.

In the theoretical classes, the teacher will offer an overview of the topics covered and will focus on those key concepts that help the student to understand and acquire the basic knowledge of the subject, answering any doubts or questions that may arise.

To promote the achievement of the learning objetives set, training activities aimed at promoting cooperative learning and student participation will be introduced. For individual study and preparation of topics in depth, a basic and complementary bibliography will be indicated.

The activities are designed to acquire specific skills, as well as to develop transversal skills.

At the end of the semester, different seminars will also be held on selected applications in the field of industrial and environmental monitoring. These seminars are intended to delve deeper into aspects covered in theory classes. The works will be elaborated by a class group or by smaller groups and will be presented orally for discussion and evaluation among peers.

Experimental Laboratory Practices will be carried out aimed at the student tackling the resolution of real analytical problems after designing, constructing and evaluating the analytical instrumentation necessary to obtain the information. It is intended that the student identify the basic problems and solve them using the knowledge acquired in the subject.

Experimental Field Practices will also be carried out to visualize the importance of environmental and industrial monitoring systems in the control and minimization of the impact of anthropogenic activities on the natural environment.

Use of AI

For this course, the use of Artificial Intelligence (AI) technologies is permitted exclusively for supporting tasks, such as bibliographic or information searches, text editing, or translations. Students must clearly identify which parts were generated using this technology, specify the tools employed, and include a critical reflection on how these tools influenced the process and the final outcome of the activity. Failure to be transparent about the use of AI in this assessable activity will be considered a lack of academic integrity and may result in a partial or total grade penalty, or more severe sanctions in serious cases.

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.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Training activities and seminars	40	2	0.08	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37
Final Term	45	2	0.08	1, 3, 5, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35
Laboratory practices	15	2	0.08	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37

Continuous Assesment

The competences of this course will be evaluated by means of:

A) Final term test (individual assessment), including the whole subject. 45 % of the final mark.

B) An evaluation of the work developed in the laboratory practices (in group). 15 % of the final mark.

C) Cooperative and collaborative activities (seminars, problems, evidences, etc.) and individual activities carried out inside and outside the classroom. They will have a weight of 40% of the final mark.

Assessments for all course material may be in written or oral format, depending on the progress of the learning process and time availability.

It will be considered a \"not presented\" in the course if the student does not appear to the laboratory practices or to the final mark.

To participate in the recovery exam, the students must have been previously evaluated in a set of activities whose weight must be equivalente to a minimum of two thirds of the total grade of the subject.

To pass the course, a minimum of 5 points (out of 10) are requested on the average of the different activities that are evaluated.

It will be considered that the student is not assessable when the activities carried out are not equivalente to 50% of those that are evaluated to obtain the total qualification of the subject.

Unique Assesment

Students who have accepted the single evaluation modality must take a final test that will consist of an examination of the entire syllabus of the subject. This test will be held on the day that the students of the continuous evaluation take the control exam of the entire subject.

The final exam may be in written or oral format, depending on time availability.

The student's qualification will be:

Course grade = (Final exam grade · 85% + Lab grade · 15%)/100

If the final grade does not reach 5, the student has another opportunity to pass the subject by means of the second chance exam that will be held on the date set by the degree coordinator. In this test, you can recover 85% ofthe grade corresponding to the theory part.

The practical part is not recoverable

It will be considered that the student is non-evaluable following the same criteria as in the continuous evaluation.

The occurrence of any irregularity in an assessment (academic fraud, plagiarism, or improper use of AI, unless such use is explicitly authorized in the course guide), which could lead to a significant change in the grade, means that the assessment will be graded as 0. If the course guide states that passing the subject requires obtaining a minimum grade in this assessment, or if multiple irregularities occur in the assessments of the same subject, the final grade for that subject will be 0. Aside from that, a disciplinary process may be initiated against the student who commits any of these irregularities.

Bibliography

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13. Marine Chemical Monitoring: Policías, Techniques and Metrological Principles. Philippe Quevauviller , Grayson, S. John Wiley & Sons. 2016. ISBN: 978-1-848-21740-9

Software

Microsoft Office

Acrobat Reader

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	1	Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	1	Spanish	second semester	morning-mixed
(PCAM) Field practices	1	Spanish	second semester	morning-mixed
(PLABs) Suport a les pràctiques de laboratori	1	Spanish	second semester	morning-mixed