UAB
Universitat Autònoma de Barcelona

Analytical Chemistry

Code: 103282
ECTS Credits: 5

2024/2025

Degree	Type	Year
2501922 Nanoscience and Nanotechnology	OB	3

Contact

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Teaching groups languages

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

Prerequisites

To have completed the subject of Chemical Reactivity, 1st year Degree in Nanoscience and Nanotechnology

Objectives and Contextualisation

In this subject the basic knowledge of Analytical Chemistry and Chemical Analysis must be acquired. The main objective is to establish the concepts and methodologies of work, so that the student can apply them in real practical cases. Some examples of application in the field of analytical nanosystems will be mentioned.

The subject is structured in five blocks of homogeneous content but of different duration.

Block 1: The objective of Analytical Chemistry, the analytical process and, above all, the different calibration methods are introduced, as well as basic statistics for its correct use and interpretation of results.

Block 2: Introduction to chromatography. Basic principles; gas chromatography; high resolution liquid chromatography.

Block 3: Brief introduction to the classical methods of wet analysis.

Block 4: Introduction to analytical spectroscopy. Special emphasis will be placed on molecular analysis techniques and the most common atomic analysis techniques will be introduced. The principles and applications of infrared spectroscopy will be described as an example of qualitative analysis.

Block 5: Introduction to electrochemical analysis, especially potentiometric methods and the basic principles of amperometry.

Competences

- Apply the concepts, principles, theories and fundamental facts of nanoscience and nanotechnology to solve problems of a quantitative or qualitative nature in the field of nanoscience and nanotechnology.
- Be ethically committed.
- Communicate orally and in writing in one's own language.

- Demonstrate knowledge of the concepts, principles, theories and fundamental facts related with nanoscience and nanotechnology.
- Handle the standard instruments and materials of physical, chemical and biological testing laboratories for the study and analysis of phenomena on a nanoscale.
- Interpret the data obtained by means of experimental measures, including the use of computer tools, identify and understand their meanings in relation to appropriate chemical, physical or biological theories.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
- Propose creative ideas and solutions.
- Reason in a critical manner
- Recognise and analyse physical, chemical and biological problems in the field of nanoscience and nanotechnology and propose answers or suitable studies for their resolution, including when necessary the use of bibliographic sources.
- Recognise the terms used in the fields of physics, chemistry, biology, nanoscience and nanotechnology in the English language and use English effectively in writing and orally in all areas of work.
- Resolve problems and make decisions.
- Show sensitivity for environmental issues.
- Work correctly with the formulas, chemical equations and magnitudes used in chemistry.
- Work on the synthesis, characterisation and study of the properties of materials on a nanoscale from previously established procedures.

Learning Outcomes

1. Analyse situations and problems in the field of physics and chemistry, and propose experimental responses or studies using bibliographic sources.
2. Be ethically committed.
3. Classify electroanalytical and optical analysis methods, and how they are used.
4. Communicate orally and in writing in one's own language.
5. Correctly handle glass and another types of material usually found in a synthesis and characterisation laboratory.
6. Correctly use computer tools to calculate, graphically represent and interpret the data obtained, as well as its quality.
7. Correctly use the necessary computer tools to resolve, expose and interpret an analytical problem.
8. Critically evaluate experimental results and deduce their meaning.
9. Describe standard analytical methods based on acid-base equilibriums, complex formation, redox and precipitation.
10. Describe the principles involved in electrochemical and optical analysis methods.
11. Design simple experiments for the study of simple chemical and physical systems.
12. Employ information and communication technology in the documentation of cases and problems.
13. Identify the most important analytical separation techniques.
14. Identify the statistical methods for the treatment of the results of analyses to obtain information on their quality.
15. Interpret analysis results and assess their quality, relating them to the previous information on the sample.
16. Interpret basic chemistry texts and bibliographies in English.
17. Interpret the data obtained from experimental measurements to characterise a chemical compound or a material.
18. Interpret the results obtained from analytical problems.
19. Justify the results obtained in the laboratory from chemical compound synthesis, separation, purification and characterisation processes on the basis of knowledge of their structure and properties.
20. Learn autonomously.
21. Manage the organisation and planning of tasks.
22. Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
23. Perform basic synthesis, separation and purification procedures in a chemistry laboratory

24. Perform basic synthesis, separation and purification procedures in a synthesis and characterisation laboratory.
25. Plan the right strategy in the different stages of the analytical procedure to solve the problems being addressed.
26. Present brief reports on the subject in English.
27. Propose creative ideas and solutions.
28. Reason in a critical manner
29. Recognise the stages of the analytical procedure in chemical analysis.
30. Recognise the terms relative to physics and materials.
31. Recognise, analyse and resolve electrochemical problems (batteries).
32. Relate experimental data with the physical and chemical properties and/or analysis of the systems that are the object of study.
33. Resolve exercises and problems related with chemical separations using different bibliographic sources and simulation programs.
34. Resolve problems and make decisions.
35. Select appropriate laboratory material for an analytical determination.
36. Show sensitivity for environmental issues.
37. Use data processors to produce reports.
38. Work correctly with the formulas, chemical equations and magnitudes used in chemistry.

Content

B1. Introduction and data processing

Unit 1. Objective of the Analytical Chemistry. Analytical process. Methods of analysis: classical methods and instrumental methods. Calibration protocols: external calibration, standard addition and internal standard.

Unit 2. Validation of an analytical method. Analytical quality parameters. Precision. Accuracy. Sensitivity. Selectivity. Detection limit and quantification limit.

Unit 3. Statistical evaluation of analytical data. Experimental error, uncertainty and significant figures. Significance tests: t and F. Univariable calibration methods: lineasr regression.

B2. Introduction to chromatography

Unit 4. Introduction. Classification of chromatographic techniques. Basic parameters.

Unit 5. Gas chromatography. Instrumentation. Types of columns. Stationary phases. Mass detector coupling. Application examples.

Unit 6. High resolution liquid chromatography. Instrumentation. Application examples

B3. Classical chemical analysis

Unit 7. Quantitativeness of a reaction. Conditional constants. Complexation volumes. Examples of applications.

Unit 8. Sampling. Sampling statistics. Ingamells equation. Sample preparation. Solid phase extraction (SPE).

B4. Introduction to analytical spectroscopy

Unit 9. Electromagnetic spectrum. Matter radiation interaction. Classification of spectroscopic techniques. Beer-Lambert's law.

Unit 10. Molecular spectroscopy. Classification. UV-Vis spectrophotometry. Luminescence. Optical sensors. Immunoassays. Infrared spectroscopy: application to qualitative analysis.

Unit 11. Atomic spectroscopy. Classification. Atomic absorption spectroscopy. Emission spectroscopy: flame and ICP.

B5. Introduction to electrochemical analysis:

Unit 12. Potentiometry. Indicator electrodes. Reference electrodes. Selective electrodes. Sensors and biosensors.

Unit 13. Amperometry. Polarography. Basic concept of the amperometric curves. Example of amperometry: blood glucose control.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theory classes	25	1	1, 8, 3, 4, 9, 10, 26, 21, 14, 13, 16, 22, 30, 29, 31, 34, 6, 7, 37
laboratory practices	12	0.48	4, 11, 23, 24, 26, 21, 17, 16, 19, 5, 2, 36, 22, 25, 27, 28, 30, 32, 34, 35, 38, 6, 7, 37
resolution of numerical exercises	8	0.32	1, 8, 4, 11, 12, 26, 21, 17, 16, 36, 22, 25, 28, 30, 32, 33, 34, 38, 6, 7, 37
Type: Supervised			
Complementary works (audiovisual or reports)	6	0.24	4, 12, 26, 36, 27, 28, 7, 37
Tutorials	4	0.16	
Type: Autonomous			
Bibliographic search	5	0.2	12
Resolution of numerical exercices	11	0.44	1, 11, 18, 31, 32, 33, 34, 38
study	48	1.92	1, 20, 8, 3, 9, 11, 12, 10, 21, 14, 13, 16, 22, 25, 28, 30, 29, 32

The student will carry out three types of activities: directed, autonomous and supervised.

1. Supervised activities: Attendance is compulsory and is carried out in the presence of a teacher.

1. Theoretical classes: The teacher explains the contents of the subject and answers any questions that the student may have.

2. Problems solving: The knowledge acquired in the master classes and in the autonomous activities of the student, mainly through the study, are applied to the resolution of problems and exercises related to the contents of the subject.

3. Laboratory practices: They involve the performance of practical work related to the contents of the subject.

2. Autonomous activities: With these activities the student alone, or in group, has to achieve the own competences of the asignatura. These activities include study, problem solving, text reading and bibliography research.

3. Supervised activities: The student can request tutorials of support for the assimilation of the matter exposed in the classes of theory and problems and for the resolution of the complementary works.

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

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Laboratory practices reports	15%	0	0	8, 23, 24, 15, 17, 19, 5, 36, 27, 35, 6, 37
Partial exams	70%	6	0.24	20, 3, 4, 9, 11, 10, 14, 13, 15, 18, 25, 28, 30, 29, 31, 32, 33, 34
Presentation of complementary works	15%	0	0	1, 12, 26, 21, 16, 2, 22, 28, 33, 38, 7, 37

CONTINUOUS ASSESSMENT

1. WRITTEN EXAMS (70%)

A) Partials: there are two partials on the concepts of theory and problems (they eliminate matter). The weight of each part will depend on the distribution of hours and matter between parts, the proportion of each part in the final grade may be modified, which will be indicated in the presentation of the subject. The minimum grade to be able to average between the partials is 4.0.

B) Retaken exams: the student who does not reach 4.0 in one (or both) partials, will have the possibility to retake the exam.

To be able to attend the recovery of the partial or final exams, you must have taken a minimum of 2/3 of the continuous assessment activities and have a minimum grade of 3.5 taking into account every evaluation activity.

You need a minimum grade of 4 *from the exams to be able to average with the other activities.* If this mark is not reached, the subject will be considered suspended and the mark of the resit exam will be recorded in the minutes.

2. CLASSROOM EVALUATION AND DELIVERY ACTIVITIES (15%)

Individual: simulation study of a separation of a sample sample by HPLC

In pairs: presentation of a concept of the syllabus, which will be chosen at the beginning of the course.

3. PRACTICES (15%).

Internship reports. Preparation of an internship report.

Attendance at laboratory practices is mandatory. In the event of non-compliance with safety regulations, a student may be expelled from the laboratory and suspended from that day's practice. In the event of serious or repeated non-compliance with safety regulations, he / she may be expelled from the laboratory and suspended from the subject.

To pass the course, a minimum overallgrade of 5.0 must be obtained.

SINGLE ASSESSMENT

Students who have taken the single assessment mode will have to take a final exam consisting of an examination of the entire theoretical and problem syllabus of the course. This test will take place on the day on which the students of the continuous assessment take the exam of the second mid-term. The student's grade will be:

Grade for the course = (Final exam mark - 75% + Laboratory mark - 25%)/100

If the final mark does not reach 5, the student has another opportunity to pass the course by means of retaking an exam that will be held on the date set by the degree coordination office. In this test, 75% of the mark corresponding to the theory part can be recovered. The practical part is not recoverable.

Bibliography

D.C. Harris, C.A. Lucy. Quantitative Chemical Analysis, 9th edition. Mac Millan Education 2016

D.S.Hage, J.R.Carr Analytical Chemistry and Quantitative Analysis, Pearson 2010

G.D. Christian, P. Dasgupta, K.A. Schug, Analytical Chemistry, 7th edition, Wiley International, 2014

Software

To activate the Excel Complement: Data Analysis

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	1	Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	2	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	3	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed