UAB
Universitat Autònoma de Barcelona

Separation Techniques

Code: 102529
ECTS Credits: 6

2024/2025

Degree	Type	Year
2502444 Chemistry	OB	3

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Teachers

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Teaching groups languages

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

Prerequisites

It is necessary to have studied the subjects of Chemistry of the lower level classes, as well as those of the same course of the first semester.

Objectives and Contextualisation

The main objective of the subject of Separation Techniques is to get the student to understand the concepts, principles, theories and fundamental facts of the main separation techniques in Chemistry, both chromatographic and non-chromatographic. It also includes knowledge of the basics of relative chromatographic and non-chromatographic instrumentation, as well as various current and future fields of application. Simultaneously, the aim is for the student to be able to solve exercises and problems related to chemical separations, using different bibliographic sources.

Competences

- "Interpret data obtained by means of experimental measures, including the use of IT tools; identify their meaning and relate the data with appropriate chemistry, physics or biology theories."
- Adapt to new situations.
- Be ethically committed.
- Communicate orally and in writing in one's own language.

- Learn autonomously.
- Manage the organisation and planning of tasks.
- Manage, analyse and synthesise information.
- Obtain information, including by digital means.
- Operate with a certain degree of autonomy and integrate quickly in the work setting.
- Propose creative ideas and solutions.
- Reason in a critical manner
- Recognise and analyse chemical problems and propose suitable answers or studies to resolve them.
- Resolve problems and make decisions.
- Show an understanding of the basic concepts, principles, theories and facts of the different areas of chemistry.
- Show initiative and an enterprising spirit.
- Show motivation for quality.
- Show sensitivity for environmental issues.
- Use IT to treat and present information.
- Use the English language properly in the field of chemistry.
- Work in a team and show concern for interpersonal relations at work.

Learning Outcomes

1. Adapt to new situations.
2. Be ethically committed.
3. Communicate orally and in writing in one's own language.
4. Describe the basics of chromatographic instrumentation.
5. Describe the basics of the main chromatographic and non-chromatographic chemical separation techniques.
6. Evaluate the capacities of the information contained in online networks.
7. Identify the fields of application of the main chromatographic techniques.
8. Learn autonomously.
9. Manage the organisation and planning of tasks.
10. Manage, analyse and synthesise information.
11. Obtain information, including by digital means.
12. Operate with a certain degree of autonomy and integrate quickly in the work setting.
13. Propose creative ideas and solutions.
14. Reason in a critical manner
15. Recognise the English terminology in bibliographic databases and online information.
16. Resolve exercises and problems related with chemical separations using different bibliographic sources and simulation programs.
17. Resolve problems and make decisions.
18. Show initiative and an enterprising spirit.
19. Show motivation for quality.
20. Show sensitivity for environmental issues.
21. Use English scientific terms in the field of separation techniques.
22. Use IT to treat and present information.
23. Work in a team and show concern for interpersonal relations at work.

Content

Unit 1. Introduction. Analytical techniques of separation. Separation processes in Chemistry. Separation in Analytical Chemistry. Fundamentals of separation processes. Classifications.

Unit 2. Separation techniques applied to sample treatment. Non chromatographic techniques: Solvent extraction: Concept. Law of distribution. Simple and successive extraction. Solid phase extraction (SPE): Basic concepts, MIPs. Applications.

Unit 3. Introduction to chromatography. Concept Bases chromatographic separations. Classifications. First layer.

Unit 4. Chromatographic parameters. Basic definitions. Retention parameters. Thermodynamic aspects: distribution coefficient. Retention factor (capacity) and selectivity factor. Theory of dishes. Efficiency Kinetic aspects: bandwidth and Van Deemter equation. Resolution Qualitative and quantitative analysis in chromatography.

Unit 5. Chromatography of gases. Principles of gas chromatography. Instrumentation Bearer gas Injectors Columns. Stationary phases Detectors Factors that affect separation and resolution. Gas chromatography - solid (adsorption). Gas-liquid chromatography. Applications for qualitative analysis. Index of Kovats. Derivation. Applications to quantitative analysis.

Unit 6. Liquid chromatography (I). Liquid column chromatography. High resolution liquid chromatography (HPLC). Instrumentation Columns. Detectors Liquid chromatography - liquid (partition). Bound stationary phases: normal phase and reverse phase. Mobile phase: strength and selectivity of the solvent. Applications.

Unit 7. Liquid chromatography (II). Others Liquid-solid chromatographies. Adsorption. Ion chromatography: Ion exchange base and resin converters. Molecular exclusion chromatography.

Unit 8. Separation with supercritical fluids. Characteristics of supercritical fluids. Extraction and chromatography with supercritical fluids. Applications.

Unit 9. The mass spectrometer asa chromatography detector. The mass spectrometer and its characteristics.Gas-mass and liquid-mass interface. Type of ionization. Types of spectrometers. Differences between MS and MSn.

Unit 10. Capillary electrophoresis. Concept of electrophoresis. Capillary electrophoresis. Electrosmotic flow and electrophoretic mobility. Instrumentation Capillary electrophoresis zone. Applications.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Seminars	1	0.04	1, 6, 3, 18, 19, 9, 10, 7, 2, 20, 11, 13, 14, 15, 23, 21, 22
Solving problems classes	12	0.48	1, 3, 18, 19, 9, 10, 7, 2, 20, 11, 12, 13, 14, 15, 16, 17, 23, 21, 22
Teaching class	36	1.44	1, 6, 3, 18, 19, 4, 5, 9, 10, 7, 2, 20, 11, 12, 13, 14, 15, 23, 21, 22
Type: Autonomous			
Self study	92	3.68	1, 8, 6, 3, 18, 19, 9, 10, 2, 20, 11, 12, 13, 14, 15, 16, 17, 23, 21, 22

Teaching methodology and training activities

The training activities are divided into three sections: theory classes, problem classes and seminars, each one with its specific methodology.

Theory classes

The teacher will explain the content of the syllabus with the support of audiovisual material that will be available to students in the Virtual Campus of the subject. These lectures will be an important part of the theory section.

Under the guidance of the teacher and through communication through the Virtual Campus, the knowledge of selected parts of the syllabus will have to be searched and studied by means of autonomous learning by the students. In order to facilitate this task, information about locations will be provided in textbooks, web pages, etc.

Solving problem classes

The number of students in solving problem class groups will depend on the teaching plan programmed by the Department of Chemistry.

The dossiers of problem statements of the subject by categorized subjects will be delivered through the Virtual Campus, which will be solved during the face-to-face problem sessions (scheduled in the time schedule prepared by the Coordination of the Degree in Chemistry). In these sessions, solving problem teachers will present the experimental and calculation principles needed to work on the problems stated, explaining the guidelines for solving them and at the same time reinforcing the knowledge of different parts of the subject of the theory classes.

Seminars

A seminar can be programmed to deal with specific subjects related to the subject's program or to review concepts at the end of the course.

Material available on the Virtual Campus of the subject

Teaching guide

Presentations used by teachers in the theory classes

Dossiers of solving problem classes

Calendar of teachingactivities (classroom, seminar classes, assessments,...)

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
Cooperative work or Evidences	30%	2	0.08	1, 6, 3, 9, 10, 20, 11, 12, 13, 15, 17, 23, 21, 22
Exam 1st part	35%	2	0.08	1, 8, 3, 4, 5, 9, 10, 7, 2, 14, 16, 17, 21
Exam 2nd part	35%	2	0.08	1, 8, 3, 4, 5, 9, 10, 7, 2, 14, 16, 17, 21
Final Exam	70%	3	0.12	1, 8, 6, 3, 18, 19, 4, 5, 9, 10, 7, 2, 20, 11, 12, 13, 14, 15, 16, 17, 23, 21, 22

The evaluation process follows the principle of continuous evaluation. For the evaluation of the subject, will be performed:

A) Two partial trials on the dates indicated by the faculty, each corresponding to a part of the subject. The weight of each part will come according to the corresponding calendar and each course will be indicated. Usually, the content of the 1st part is never less than 1/3 of the total. Partial trials are individual. Both the theoretical part and practical problems solving will be evaluated, and the grade for each part of the exam (theory and problems) must be equal to or higher than 3.5. To be able to average for the final grade, the partial grade must be equal to or higher than 4.0. The average mark of these two tests must be at least 5.0 and will have a weighting of 70% in the final grade.

B) Cooperative activities or Evidences. These works can be done in groups or individually, and the maximum number of participants will be set before each work. The overall grade for this work will have a weighting of 30% in the final grade.

The final grade for the subject is the sum of the weighted grades from the previous two items. To pass the course, students must obtain a final grade equal to or higher than 5.0.

If all the Cooperative Activities or Evidences are not presented, the student will be qualified as "not assessable", regardless of the mark of the partial exams.

Students who do not pass the assessment of the partial trials in section (A) will have an extraordinary assessment on the dates determined by the faculty. In order to beable to take the resit exam, students must have participated in assessment activities throughout the course that are equivalent to 2/3 of the final grade.

Only the note referred to in section (A) can be retrieved. For final mark, the note in section (B) will be the same.

To recover the grade in section (A), the student must compulsorily present each of the partials with a grade lower than 4.0. In the event that the average mark of the partials is less than 5.0, and the partials both have a mark higher than 4.0, the student may decide to take the extraordinary assessment of both partials or only the extraordinary assessment of that partial that has the lowest mark.

The mark of the resit exam will replace the previous mark in the calculation of the final mark. To be able to average for the final grade, the grade of the partial must be equal to or higher than 4.0.

UNIQUE ASSESSMENT

Students who have accepted the single assessment modality will have to take a final test, where both the theoretical part and solving practical problems will be evaluated, and the grade for each part of the exam (theory and problems) must be equal to or greater than 3.5. The exam grade must be at least 5.0 and will have a weighting of 70% in the final grade.
On the same day of the exam, the student must hand in the evidences that has been taken during the course. The overall grade of this work will have a weighting of 30% in the final grade.
If the final grade does not reach 5, the student has another opportunity to pass the subject through the resit exam that will be held on the date set by the degree coordinator.

Bibliography

1) Daniel C. Harris, *Anàlisi química quantitativa*, Traducció 6a ed., Editorial: Reverté, 2006.

2) Daniel C. Harris, Charles A. Lucy, *Quantitative Chemical Analysis*, 10th ed., Editorial: MacMillan Learning, 2020.

3) Douglas Skoog, F. Holler, Stanley Crounch, *Principles of Instrumental Analysis*, 7th ed., Editorial: Brooks/Cole, 2017.

4) James W. Robinson et al., *Undergraduate Instrumental Analysis*, 7th ed., Editorial: CRC Press, 2014.

5) James W. Robinson et al., *Instrumental Analytical Chemistry: An Introduction*, Chapters 1, 10, 11 and 12, 1st ed., Editorial: CRC Press, 2021.

6) Gary D. Christian et al., *Analytical Chemistry*, 7th ed., Editorial: Wiley International, 2014.

7) J.M. Andrade-Garda, et al., *Problems of Instrumental Analytical Chemistry*, Chapter 6, Editorial: World Scientific, 2017.

ON-LINE Bibliography:

https://chem.libretexts.org/Bookshelves/Analytical_Chemistry

Software

Microsoft Excel will be used.

HPLC on-line simulator:

http://www.multidlc.org/hplcsim/hplcsim.html

This is the original webpage of the HPLC simulator:

https://www.hplcsimulator.org/simulator.php

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	2	Catalan	second semester	afternoon
(SEM) Seminars	1	Catalan	second semester	morning-mixed
(SEM) Seminars	2	Catalan	second semester	afternoon
(TE) Theory	1	Catalan	second semester	morning-mixed
(TE) Theory	2	Catalan	second semester	afternoon