Universitat Autònoma de Barcelona

2020/2021

Separation Techniques

Code: 102529
ECTS Credits: 6

Degree	Type	Year	Semester
2502444 Chemistry	OB	3	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Jordi Coello Bonilla

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 the fundamental facts of the main chemistry separation techniques, both chromatographic and non-chromatographic. The knowledge of the fundamentals of chromatographic and non-chromatographic instrumentation is also included, as well as several current and future application fields. Simultaneously, it is intended that the student be able to solve exercises and problems related to chemical separations, using different bibliographic sources as well as simulation programs.

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 ones 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 ones 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

PROGRAM

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

Unit 2. Introduction to chromatography. Concept Bases chromatographic separations. Classifications. First layer.

Unit 3. 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 4. 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 5. Liquid chromatography (I). Liquid column chromatography. High resolution liquid chromatography (HPLC). Instrumentation Columns. Detectors Liquid chromatography - liquid (partition). Stations connected: normal phase and reverse phase. Mobile phase: strength and selectivity of the solvent. Applications.

Unit 6. Liquid chromatography (II). Others Liquid-solid chromatographies. Adsorption. Ion chromatography: Ion exchange base and resin converters. Molecular exclusion chromatography.

Unit 7. Separation with supercritical fluids. Characteristics of supercritical fluids. Extraction and chromatography with supercritical fluids. Applications.

Unit 8. The mass spectrometer as a 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 9. Separation techniques applied to sample treatment. Solvent extraction: Concept. Law of distribution. Simple and successive extraction. Solid phase extraction (SPE): Basic concepts, MIPs. Applications.

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

Methodology

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 the most 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 problem groups will depend on the teaching plan programmed by the Department of Chemistry.

At the beginning of the semester a dossier of statements of problems of the subject will be delivered through the Virtual Campus that will be resolved throughout the sessions. In these sessions distributed throughout the semester, the problem professor will present the experimental and calculation principles necessary to work on the problems, explaining the guidelines for their resolution and at the same time reinforcing the knowledge of different parts of the subject of the classes of theory

Seminars

Seminars 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 to theory classes

Dossier of solving problem classes

Calendar of teaching activities (classroom, seminar classes, assessments,...)

Activities

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

Assessment

Evaluation

The evaluation process follows the principle of continuous evaluation. For the evaluation of the subject, they will be carried out:

A) Two partial tests (65%) on the dates indicated by the faculty, each corresponding to a part of the subject. The weight of each part will depend on the corresponding calendar and will indicate each course. Usually, the content of the 1st part is never less than 1/3 of the total. Partial tests are individual. Each partial test will have two parts. The first part will consist of several questions related to the theory part of the subject (it may be type test and may also include some short questions). In the second part, the student will have to solve some problems. The theory part will be between 40-60% of the partial mark, and the part of problems between 40-60%. To be able to make an average for the final mark, the qualification of the partial must be equal to or greater than 4.0. The final mark of these two tests will have a weighting of 65% in the final grade.

B) Cooperative activities or Evidences (25%). These works will be carried out either in groups or individually, and the maximum number of participants will be fixed before each work. The overall mark of this work will have a weighting of 20% in the final grade.

C) Forum (10%): participation in the Forum of the virtual Campus of the subject, with a minimum of 3 answers accounted for in the Forum to be able to access this percentage of the note (it will be valued with a 0, 0.5 or 1).

The final grade is the sum of the weighted notes of the two previous items. To pass the subject, students must obtain an average of 5.0 or more. The student who does not pass the normal assessment will have an extraordinary evaluation, in the dates determined by the faculty. Only the note referred to in section A can be recovered; In the face of recovery, the note in section B will be the same.

In order to be able to attend the recovery, the student must have been previously evaluated of continuous assessment activities that are equivalent to 2/3 of the final mark.

To recover the note from section A, the student will have to present each one of the partial ones with a mark of less than 4.0. In the event that the final grade is less than 5.0, and the partial ones have a score greater than 4.0, the student may decide to present themselves to the extraordinary evaluation of both partial or only to the evaluation of the students' that partial that has the lowest note.

The note of the examination of recovery will replace the previous note in the calculation of the global note.

Once the list of students approved by partials has been published, students who wish to request a special exam in order to raise a note of section A will be asked for the next two days. The exam will be of the whole subject and will be done the same day and hour as the recovery exam. If the note of this special exam is less than the note obtained previously from section A, the average of the two will be done for the calculation of 65% of the final grade.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Cooperative work or Evidences	25%	2	0.08	1, 6, 3, 9, 10, 20, 11, 12, 13, 15, 17, 23, 21, 22
Exam 1st part	20-32.5%	2	0.08	1, 8, 3, 4, 5, 9, 10, 7, 2, 14, 16, 17, 21
Exam 2nd part	20-32.5%	2	0.08	1, 8, 3, 4, 5, 9, 10, 7, 2, 14, 16, 17, 21
Final Exam	32.5-65%	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
Forum virtual campus	10%	0	0	1, 8, 6, 3, 18, 19, 4, 5, 9, 10, 7, 2, 20, 11, 12, 13, 14, 15, 17, 23, 21, 22

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Daniel C. Harris, Michelson Laboratory; versión española traducida por Dr. Vicente Berenguer Navarro (catedrático de química analítica de la Universidad de Alicante) y Dr. Ángel Berenguer Murcia (doctor en ciencias químicas por la Universidad de Alicante)

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