



## 1. General information

**Course:** INSTRUMENTAL SEPARATION METHODS**Type:** CORE COURSE**Degree:** 398 - UNDERGRADUATE DEGREE PROGRAMME IN CHEMISTRY**Center:** 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY**Year:** 3**Main language:** Spanish**Use of additional languages:****Web site:****Code:** 57321**ECTS credits:** 6**Academic year:** 2020-21**Group(s):** 20 23**Duration:** C2**Second language:****English Friendly:** Y**Bilingual:** N

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## 2. Pre-Requisites

Not established

It is recommended to have studied the subjects: Fundamentals of analytical chemistry, instrumental analysis I and instrumental analysis II

## 3. Justification in the curriculum, relation to other subjects and to the profession

The subject of instrumental methods of separation is included within the subject of instrumental analysis, including in the Chemistry Fundamentals module. Its justification in the curriculum is obvious due to analytical separation techniques are one of the most powerful tools available to carry out the qualitative and quantitative determination of the analytes of interest in different samples (pharmaceutical, biological, environmental, etc.). In this subject we study the theoretical principles of the different instrumental separation techniques, with special emphasis on chromatographic techniques. It will also address the study of the different instrumentation components. An important aspect to consider will be the different detectors that can be used, the hybridization with the mass spectrometry and the expected response according to the selectivity or universality of the detector.

Finally, this subject is related to the other two that configure the matter of instrumental analysis (instrumental analysis I and instrumental analysis II). This subject contributes to carry out the functions of the chemical graduate in the Laboratory of Quality control and in the research and development laboratories.

## 4. Degree competences achieved in this course

## Course competences

Code	Description
CB02	Apply their knowledge to their job or vocation in a professional manner and show that they have the competences to construct and justify arguments and solve problems within their subject area.
CB03	Be able to gather and process relevant information (usually within their subject area) to give opinions, including reflections on relevant social, scientific or ethical issues.
CB04	Transmit information, ideas, problems and solutions for both specialist and non-specialist audiences.
CB05	Have developed the necessary learning abilities to carry on studying autonomously
E05	Know the chemical elements and their compounds, their forms of obtaining, structure, properties and reactivity, as well as the main techniques for their analysis
E06	Know the structural properties of chemical compounds, including stereochemistry, as well as the main structural research techniques
E14	Know and know how to apply the metrology of chemical processes, including quality management
E15	Know how to handle the standard chemical instrumentation and be able to elaborate and manage standardized procedures of work in the laboratory and chemical industry
E16	Plan, design and develop projects and experiments
E17	Develop the ability to relate to each other the different specialties of Chemistry, as well as this one with other disciplines (interdisciplinary character)
G02	Be able to gather and interpret data, information and relevant results, obtain conclusions and issue reasoned reports on scientific, technological or other problems that require the use of chemical tools
G03	Know how to apply the theoretical-practical knowledge acquired in the different professional contexts of Chemistry
G04	Know how to communicate, orally and in writing, the knowledge, procedures and results of chemistry, both specialized and non-specialized
G05	Acquire and adapt new knowledge and techniques of any scientific-technical discipline with incidence in the chemical field
T04	Ethical commitment and professional ethics
T05	Organization and planning capacity
T06	Ability to approach decision making
T09	Motivation for quality, job security and awareness of environmental issues, with knowledge of internationally recognized systems for the correct management of these aspects

T10	Ability to use specific software for chemistry at user level
T11	Ability to obtain bibliographic information, including Internet resources

## 5. Objectives or Learning Outcomes

### Course learning outcomes

#### Description

Acquire skills for practical laboratory work, being able to develop experimentally analytical processes that include the planning of sampling, its treatment and analysis using different instrumental methods, emphasizing its use to solve real analytical problems

Acquire skills for planning, writing and validating work protocols in the laboratory

Acquire critical judgment in the selection of the most appropriate analytical methodology according to the usual standards

Train the student to tackle an analytical problem, search and select the most relevant bibliography, synthesize it by extracting its most important parts, and expose and explain it in public

Train the student to be sensitive to the ethical exercise of the profession, becoming aware of the social responsibility of their reports and their impact on decision making

Understand the advantages, disadvantages, limitations and applications of the main instrumental methods of analysis

Know the essential components of the current analytical instrumentation and its function within the configuration of the instrument

Know the basics of the main instrumental analytical techniques and their most relevant applications currently in laboratories

### Additional outcomes

## 6. Units / Contents

**Unit 1: Introduction to separation techniques**

**Unit 2: Gas chromatography**

**Unit 3: Thin layer Chromatography**

**Unit 4: Liquid chromatography**

**Unit 5: Liquid liquid partition chromatography**

**Unit 6: Adsorption chromatography**

**Unit 7: Size exclusion chromatography**

**Unit 8: Ion exchange chromatography**

**Unit 9: Supercritical fluid Chromatography**

**Unit 10: Capillary electrophoresis**

## 7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	E05 E06 E14 E17 G02 G03 G04 G05 T11	1.08	27	N	-	
Class Attendance (practical) [ON-SITE]	Practical or hands-on activities	E05 E06 E14 E15 E16 E17 G02 G03 G04 G05 T10	0.64	16	Y	Y	
Workshops or seminars [ON-SITE]	Problem solving and exercises	E06 E14 E16 E17 G02 G03 G04 G05 T10 T11	0.4	10	Y	N	
Group tutoring sessions [ON-SITE]	Group tutoring sessions	E05 E14 E17 G03 G04	0.08	2	N	-	
Study and Exam Preparation [OFF-SITE]	Self-study	E05 E06 E14 E16 E17 G02 G03 G04 G05 T10 T11	0.96	24	N	-	
Progress test [ON-SITE]	Combination of methods	E16 G02 G03 G04	0.08	2	Y	N	
Practicum and practical activities report writing or preparation [OFF-SITE]	Self-study	G02 G04	1	25	Y	Y	
Final test [ON-SITE]	Assessment tests	E16 G02 G03 G04	0.12	3	Y	Y	
Writing of reports or projects [OFF-SITE]	Self-study		1.64	41	Y	Y	
<b>Total:</b>			<b>6</b>	<b>150</b>			
<b>Total credits of in-class work: 2.4</b>			<b>Total class time hours: 60</b>				
<b>Total credits of out of class work: 3.6</b>			<b>Total hours of out of class work: 90</b>				

As: Assessable training activity

Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

## 8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Progress Tests	35.00%	0.00%	A short trial will be conducted during the semester to assess learning follow-up
Laboratory sessions	15.00%	15.00%	Laboratory Work and report
Assessment of problem solving and/or case studies	15.00%	0.00%	The student's circulatory problems resolution and participation in the class will be positively valued
Final test	35.00%	85.00%	A final exam of the subject will be carried out. Those students who have passed the test of progress will be evaluated from the rest of the subject.

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject, an ordinary and an extraordinary one (evaluating 100% of the competences).

#### Evaluation criteria for the final exam:

##### Continuous assessment:

Laboratory assistance is obligatory and not recoverable, in addition it is essential to overcome the practices to approve the subject. To pass the subject it is necessary to obtain a 5. The final qualification will be obtained by applying the valuation percentages indicated above.

If the above requirements are not met, the qualification will be fail.

##### Non-continuous evaluation:

A final theoric exam (85%) and a final laboratory exam (15%) will be done. It will be necessary to obtain a rating greater than 5 in the written exam and to the laboratory practices.

#### Specifications for the resit/retake exam:

A final exam will be carried out and the qualification obtained from the laboratory practices will be considered. It is necessary to obtain a rating greater than 5 the written exam and in to the laboratory practices.

#### Specifications for the second resit / retake exam:

The same of the retake exam.

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	16
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	10
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	24
Progress test [PRESENCIAL][Combination of methods]	2
Practicum and practical activities report writing or preparation [AUTÓNOMA][Self-study]	25
Final test [PRESENCIAL][Assessment tests]	3
Writing of reports or projects [AUTÓNOMA][Self-study]	41
Unit 1 (de 10): Introduction to separation techniques	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Unit 2 (de 10): Gas chromatography	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Unit 3 (de 10): Thin layer Chromatography	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Unit 4 (de 10): Liquid chromatography	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 5 (de 10): Liquid liquid partition chromatography	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 6 (de 10): Adsorption chromatography	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 7 (de 10): Size exclusion chromatography	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 8 (de 10): Ion exchange chromatography	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Unit 9 (de 10): Supercritical fluid Chromatography	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 10 (de 10): Capillary electrophoresis	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Global activity	
Activities	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	27
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	16
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	10
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	24
Progress test [PRESENCIAL][Combination of methods]	2
Practicum and practical activities report writing or preparation [AUTÓNOMA][Self-study]	25
Final test [PRESENCIAL][Assessment tests]	3

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Patrick Camilleri	Capillary electrophoresis : theory and practice / edited by Patrick Camilleri	CRC Press	Boca Raton	0-8493-9127-X	1997	
Hobart H. Willard.	INSTRUMENTAL methods of analysis	Belmont, California :	Wadsworth	0-534-98144-5	1988	
Cela R; Lorenzo R.A; Casais M.C.	tecnicas de separación en Química Analítica	Síntesis			2002	
Dabrio, M.V.	Cromatografía y electroforesis en columna	Springer-Verlag Ibérica			2000	
Fernández Gutierrez A; Segura Carretero A.	Electroforesis capilar: Aproximación según la técnica de detección	Universidad de Granada			2005	
Hernández L.; González, C.	Introducción al análisis instrumental	Ed. Ariel			2002	
Rubinson K. A.; Rubinson J.F.	Análisis Instrumental	Prentice Hall			2000	
Skoog, D. A; Holler, F. J.; Nieman, T. A.	Principios de Análisis Instrumental	McGraw-Hill			2000	
Skoog, D.; West, D.; Holler, F.; Crouch, S.	Fundamentos de Química Analítica	Thomson			2005	
Valcárcel Cases M; Gómez Hens A.	Técnicas Analíticas de Separación	Reverté			1990	
A. Braithwaite	Chromatographic methods	Chapman and Hall	New York	0-412-25890-0	1990	