PERSONA CIÈNCIA EMPRESA
Universitat Ramon Llull

COURSE: ADVANCED CHROMATOGRAPHY

SUBJECT: Advanced Analytical Chemistry
MODULE: Technological
PROGRAM: University Master's Degree in Analytical Chemistry

GENERAL CHARACTERISTICS*

Type: ☐ Basic training, ☑ Compulsory, ☐ Elective

☐ Master's thesis work, ☐ Practicum

Duration: Annual **Semester/s**: 1st
Number of credits ECTS: 5
Language/s: Catalan, Spanish, English

DESCRIPTION

BRIEF DESCRIPTION AND JUSTIFICATION

This subject provides students the required knowledge and skills to understand, choose and use chromatographic and related methods needed for advanced work and research in many fields of Chemistry. Emphasis will be placed not only in the description of the techniques more used, but a particular focus on the parameters that define the quality of the methods and results (including examples of validation of procedures, calculation of the uncertainty in results, for instance). Similarly, issues related to the economic cost of the equipment and methods, safety requirements, maintenance and calibration will be included.

COMPETENCES

- Have an advanced knowledge of gas chromatography, liquid chromatography, mass spectrometry and electrophoretic techniques for designing, developing and applying methods of analysis (E3).
- Ability to interpret results obtained with chromatographic and electrophoretic techniques and mass spectrometry in order to identify and quantify the chemical compounds (E4).
- Have and understand knowledge that provides a basis or opportunity for originality in developing and / or applying ideas, often in a research context (CB6).
- Be able to apply the knowledge and the ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to the field of study (CB7).
- Students should be able to integrate knowledge and face the complexity of formulating judgments based on incomplete or limited information to include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments (CB8).
- Students should be able to communicate their conclusions and the knowledge and reasons to make them, to specialist and non-specialist audiences clearly and unambiguously (CB9).
- Have the ability to assess the impact of the use of chemistry in sustainable development of society (T3).
- CG2 – Ability to perform a responsible practice of the profession.

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PREREQUISITES*

The requirements for accessing to the master.

CONTENTS

1. Gas Chromatography
   1.1. Gases and control systems
   1.2. Conventional and non-conventional systems of sample introduction
   1.3. Types of injectors
   1.4. Automatic systems for sample preparation and injection
   1.5. Techniques of Derivatization
   1.6. Columns and stationary phases
   1.7. Detectors. Conventional and mass spectrometers
   1.8. Method Validation of Gas Chromatography
   1.9. Application Examples

2. Supercritical Fluid Chromatography

3. Liquid Chromatography
   3.1. Mobile phase and eluents drive systems
   3.2. Sample preparation
   3.3. Pre- and post-column derivatization
   3.4. Types of injectors
   3.5. Columns and stationary phases
   3.6. HPLC & UHPLC. Transfer of Methods
   3.7. Detectors. Conventional and mass spectrometers
   3.8. Validation of HPLC methods
   3.9. Application Examples

4. Capillary electrophoresis
   4.1. Instrumentation
   4.2. Theory
   4.3. Separation methods in Capillary Electrophoresis
   4.4. Detectors
   4.5. Application Examples

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METHODOLOGY

TRAINING ACTIVITIES*

Training activities	ECTS Credits	Competences
Sessions of exposition of concepts	31 / 1.15	E3, CB6, CG2
Sessions solving exercises, problems and cases	4 / 0.15	E4, CB6, CB7
Seminars	2 / 0.10	E3, E4, T3, CG2
Practical / laboratory work	-	-
Presentations	4 / 0.10	CB8, CB9
Activities of personal study by students	90 / 3.35	E3, E4
Evaluation activities (exams, monitoring controls ...)	4 / 0.15	E3, E4, T3, CB9, CG2
TOTAL	**5**	

EXPLANATION OF THE TEACHING METHODOLOGY

In the sessions of **explanation,** the concepts included in the program are presented using classical techniques: chalkboard and projections. In some classes, academic experiences that facilitate the understanding of some concepts and promote the participation of students are interleaved. The dynamic classes, where the question-answer game can benefit not only the student who asked the question, but also to encourage their peers, are promoted.

Problem and exercises solving sessions: Collections of exercises and problems are provided to the students throughout the course. The aim of the exercises is intended to help students to understand, deepen and relate the concepts studied in the sessions of explanation concepts. Using the problems, students learn to use theoretical concepts and reinforce their understanding. The exercises and problems corresponding respectively to the parts of theory and problems of examinations are joining these collections. In class problems / exercises-type and the problems / exercises that are more difficult for students are solved.

Seminars are offered on a particular topic -or a part of the course- to strengthen it or simply answer the doubts that have been raised to the students when studying, without the limitation that the time factor imposes in other kind of class.

Presentations: Students expose, in a limited time in front of their classmates and teacher, the bibliographic research projects, which have been commissioned them. Be valued especially compressing the texts read, clarity and dynamism of exposure and the ability to answer the questions.

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EVALUATION

ASSESSMENT SYSTEM *

Evaluation Methods	Weight	Competences
Exams	50 %	E3, E4, CB6, CB7, T3, CG2
Monitoring activities	25 %	E3, E4, CB6, CB7, CG2
Projects and presentations	20 %	E3, E4,CB8, CB9, T3, CG2
Experimental work	-	-
Participation	5 %	CB9, CG2

LEARNING OUTCOMES

The student must show proficiency to apply chromatographic techniques to identify and quantify chemical compounds. (E3, E4). Final exam, monitoring activities, work and presentations, and Participation.

The student must demonstrate proficiency in the application of mass spectrometry for identifying and quantifying chemical compounds. (E3, E4). Final exam, monitoring activities, works and presentations, and participation.

The student must demonstrate the ability to apply appropriate analytical techniques depending on the level of concentration of the chemical compounds present in the samples. (E3, E4, CG2). Final exam, monitoring activities, works and presentations.

The student must know how to interpret the results obtained with different analytical techniques to determine the concentration of chemical compounds present in the samples. (E3, E4). Final exam, monitoring activities.

The student must demonstrate knowledge of the main chemical properties of the most important chemicals as well as the implications arising from misuse (CG2, T3). Final exam, monitoring activities, work and presentations, and Participation.

QUALIFICATION

The grade of this course is obtained:

Final Exam	**50%**
Monitoring Activities	**25%**
Projects and Presentations	**20%**
Participation	**5%**

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Monitoring activities will assess in writing the knowledge the students acquire throughout the course.
The projects and presentations include tasks proposed during the course.

If the final exam grade is less than 4 points, the first call of the course will be failed.

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ASSESSMENT OF COMPETENCES

Competences	Assessment Methods	Observations
Have and understand knowledge that provides a basis or opportunity for originality in developing and / or applying ideas, often in a research context (CB6).	Exams. Monitoring Activities.	Questions of theory and problems.
Be able to apply acquired knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to the field of study (CB7).	Exams. Monitoring Activities.	Questions about numerical problems and about choosing appropriate methods for samples and analytes.
Students should be able to integrate knowledge and face the complexity of formulating judgments based on incomplete or limited information to include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments (CB8).	Exams. Works and presentations.	Questions to justify approaches or interpret results.
Students should be able to communicate their conclusions and the knowledge and reasons to make them, to specialist and non-specialist audiences clearly and unambiguously (CB9).	Works and presentations and Participation.	Specific activities in seminars or class.
Have the ability to assess the impact of the use of chemistry in sustainable development of society (T3).	Exams. Works and presentations.	Specific questions on the subject.
Ability to perform a responsible practice of the profession (CG2).	Participation.	Specific activities in seminars or class.
Have an advanced knowledge of gas chromatography, liquid chromatography, mass spectrometry and electrophoretic techniques for designing, developing and applying methods of analysis (E3).	Final Exam, Monitoring Activities, Works and presentations.	Questions of theory
Ability to interpret results obtained with chromatographic and electrophoretic techniques and mass spectrometry in order to identify and quantify the chemical compounds (E4).	Final Exam, Monitoring Activities, Works and presentations.	Questions to justify approaches or interpret results

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BIBLIOGRAPHY

1. M. V. Dabrio et al. Cromatografía y electroforesis en columna. Ed. Springer. Barcelona (2002).
2. Teacher notes.
3. Colin F. Poole. Gas chromatography. Elsevier, Amsterdam (2012).
4. R. Andrew Shalliker. Hyphenated and alternative methods of detection in chromatography. Boca Raton : CRC Press, cop. 2012
5. Lloyd R. Snyder, Joseph J. Kirkland, John W. Dolan. Introduction to modern liquid chromatography. Hoboken, N.J. : Wiley, cop. 2010

DOCUMENT HISTORY

PREVIOUS CHANGES
September 2015: Comellas

LAST REVISION
September 2016: Comellas