PERSONA CIÈNCIA EMPRESA
Universitat Ramon Llull

COURSE: ANALYTICAL TECHNOLOGY LABORATORY

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

GENERAL FEATURES *

Type: ☐ Basic Training ☑ Compulsory ☐ Elective
☐ Master's thesis work, ☐ Practicum

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

DESCRIPTION

BRIEF DESCRIPTION AND JUSTIFICATION (The meaning of the course in relation to the program. Between 100 and 200 words.)

In this subject advanced instrumental analysis techniques will be explored: structural determination, electrochemical techniques, spectrophotometric techniques and chromatographic techniques.

The objective of the subject is to provide the student with knowledge for the application of these techniques to the quantitative / qualitative analysis of samples and the instrumentation required to perform the corresponding assays. It is also intended to provide students with knowledge of the latest advances in these techniques and methodology that enable them to apply such methodologies in their professional lives and to judge critically the obtained results. Finally, solid and liquid samples will be analyzed using these analytical techniques.

COMPETENCES (Of course you put in relation to the skills pre-assigned in the field.)

Basic competences
CB6 - Have and understand knowledge which provides the ground or opportunity to be innovative in the development and/or application of ideas, often in a research context
CB7 - Apply their knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study
CB8 - Integrate knowledge and deal with the complexity of formulating judgments based on information which, being incomplete or limited, includes reflections on social and ethical responsibilities related to the application of their knowledge and judgments
CB9 - Communicate conclusions, and the reasons that sustain them, to specialized and non-specialized audiences in a clear and unambiguous way.

General competences
CG2 - Ability to perform a responsible practice of the profession

* These features should not be modified without the approval of the bodies responsible for academic higher-level structures (field, module and / or system).

Specific competences

E2 - Ability to interpret the results obtained with NMR, X-ray diffraction and thermal analysis to identify and determine the structure of chemical compounds

E4 - Ability to interpret the results obtained with chromatographic, electrophoretic techniques and mass spectrometry in the identification and quantitative determination of chemical compounds

E5- Demonstrate advanced knowledge of atomic and molecular spectroscopies, voltamperometry, voltammetry and other advanced electrochemical techniques for designing, applying and interpreting analytical methods.

E6 - Ability to interpret the results obtained with advanced techniques of atomic and molecular spectroscopies, voltamperometry, voltammetry and other advanced electrochemical techniques in the quantitative determination of chemical compounds detected in samples.

E8 - Ability to interpret the results obtained applying statistical techniques, design of experiments and process optimization methods to experimental data obtained in an analytical chemistry laboratory

PREREQUISITES * (Modules, materials, disciplines or expertise needed to track the subject. Contain subjects that must have been completed can be made.)

Applicants to the Master's Degree Program in possession of a degree or bachelor's degree in Chemistry do not need bridging courses. Applicants in possession of other degrees must previously studied subjects that included contents of Instrumental Analysis, Structural Determination (including Mass Spectrometry) and Statistics. If not, bridging courses will be required.

CONTENTS (Sections that make up the syllabus, to a second level of detail.)

1. STRUCTURAL DETERMINATION.
    1.1. IR SPECTROSCOPY.
    1.2. 1H-RMN I 13C-RMN SPECTROSCOPY.
    1.3. MASS SPECTROSCOPY (MS).
2. CHROMATOGRAPHY.
    2.1. GAS CHROMATOGRAPHY.
    2.2. LIQUID CHROMATOGRAPHY.
3. SPECTROPHOTOCHEMICAL METHODS.
    3.1. UV-VIS SPECTROSCOPY.
    3.2. GRAPHITE FURNACE.
    3.3. PLASMA TECHNIQUES (ICP).
    3.4. FLUORESCENCE.
4. ELECTROCHEMICAL METHODS.
    4.1. AMPEROMETRY
    4.2. STRIPPING ANALYSIS.
    4.3. CYCLIC VOLTAMMETRY.

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METHODOLOGY

TRAINING ACTIVITIES * (Complete the table relating activities, workload in ECTS credits, and skills.)

Training Activities	ECTS	Competences
Sessions of exposition of concepts	0.37	E2, E4, E6, E8 CG2
Sessions solving exercises, problems and cases	-	
Seminars	0.19	E2, E4, E6, E8 CG2
Practical work / laboratory	4.1	E2, E4, E6, E8 CG2
Presentations	0.19	E2, E4, E6, E8 CG2
Activities of personal study by students	-	
Evaluation activities (exams, monitoring controls ...)	0.15	E2, E4, E6, E8 CG2
TOTAL	**5**	

TEACHING METHODOLOGY (Justifying the teaching methods used in relation to the competences and contents of the course. Between 100 and 200 words.)

Students will perform a set of different laboratory demonstrations in groups of 2-3. These demonstrations will be based in each of the four areas of knowledge of the course: Structural Determination, Chromatography, Spectrophotometric Methods and Electrochemistry.

Each lab laboratory demonstrations must be completed before a previously stablished deadline. A paperwork will be given to the student with a brief description of the analytical method. All documents will be available online.

All experimental results and observations must be annotated in the Laboratory Notebook. The Laboratory Notebook should be available to the laboratory Professor and will be graded.

After completing each laboratory demonstration, students must submit a report describing the goals and main results achieved during the demonstration.

EVALUATION

ASSESSMENT SYSTEM * (Complete the table relating evaluation methods, competences and weight in the course grade.)

Evaluation Methods	%	Competences
Final Exam	-	
Monitoring activities	15	E2, E4, E6, E8, CG2
Projects and presentations	30	E2, E4, E6, E8, CG2
Practical work / laboratory	50	E2, E4, E6, E8, CG2
Participation	5	E2, E4, E6, E8, CG2

LEARNING OUTCOMES (Explanation of the embodiments that allow the student skills assessment, relating them to the skills and methods of assessment.)

- Students must demonstrate their ability to design, plan and perform experiments to determine the structure of chemical compounds and their concentration. (E2, E4, E6, E8) Monitoring activities, Works and presentations, Experimental work and Participation.
- Students must demonstrate their ability to interpret the results obtained in the experiments carried out to determine the structure of chemical compounds and their concentration. (E2, E4, E6, E8, CG2) Monitoring activities, Works and presentations, Experimental work and Participation.
- Students must demonstrate their ability to communicate effectively both orally and in writing. (CB9). Monitoring activities, Works and presentations, Experimental work and Participation.
- Students must be able to develop learning skills and recognize the need for ongoing training for their proper professional development. (CB10) Monitoring activities, Works and presentations, Experimental work and Participation

QUALIFICATION (Explanation of the computer system of the course grade.)

The grade of this course is obtained:

Monitoring activities	15%
Projects and presentations	30%
Practical work / laboratory	50%
Participation	5%

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- **Monitoring activities** include works (exercises, problems and cases) that perform and deliver the students during the course.
- Students do group **Projects** of 2-3 people. Some of these works include presenting it to other peers.
- The **practical work** includes all reports of the laboratory demonstrations performed.

  The grade of the **practical work** / **laboratory** must be equal or higher than to 4 to be able to pass the course.

- The **participation** includes attendance, initiative and the attitude shown by the student in relation to the teacher and their peers.

ASSESSMENT OF THE COMPETENCES (Define calculation expressions for each competence and the relevant evaluation methods.)

All competences will be evaluated using the final grade of the course.

BIBLIOGRAPHY (Recommended and accessible to students.)

- M. V. Dabrio y colaboradores. Cromatografía y electroforesis en columna. Ed. Springer. Barcelona (2000).
- Roger M. Smith. Gas and Liquid Chromatography in Analytical Chemistry. Ed. John Wiley & Sons. (1988).
- A.J. Bard, Electrochemical Methods, John Wiley & Sons, 1980
- R, Thomas, Practical Guide to ICP-MS, CRC Press, 2008

DOCUMENT HISTORY

PREVIOUS CHANGES (You set the date and author / s, the most recent first)
17th September 2014, Sergi Colominas
15th July 2015, Sergi Colominas

LAST REVISION (Indicate date and author / s.)
21st July 2016, Sergi Colominas