

**COURSE DATA****Data Subject**

<b>Code</b>	42929
<b>Name</b>	Advanced techniques in spectrometry and electroanalysis
<b>Cycle</b>	Master's degree
<b>ECTS Credits</b>	4.0
<b>Academic year</b>	2021 - 2022

**Study (s)**

<b>Degree</b>	<b>Center</b>	<b>Acad. year</b>	<b>Period</b>
2109 - M.D. in Experimental Techniques in Chemistry	Faculty of Chemistry	1	First term

**Subject-matter**

<b>Degree</b>	<b>Subject-matter</b>	<b>Character</b>
2109 - M.D. in Experimental Techniques in Chemistry	1 - Advanced laboratory of experimental techniques in chemistry	Obligatory

**Coordination**

<b>Name</b>	<b>Department</b>
DOMENECH CARBO, ANTONIO	310 - Analytical Chemistry

**SUMMARY**

Laboratory Subject dedicated to learning work methodologies used in the employment of advanced techniques such as mass spectrometry or electronic microprobe X-ray spectrometry, as well as in the use of nanoscopic electroanalytic techniques or the use of electrochemical sensors.

**PREVIOUS KNOWLEDGE****Relationship to other subjects of the same degree**

There are no specified enrollment restrictions with other subjects of the curriculum.

**Other requirements**

Prior knowledge of chemistry and experimental work in the laboratory of chemistry taught in the degrees indicated in the recommended income profile for the student of the master's degree are required.

**OUTCOMES****2109 - M.D. in Experimental Techniques in Chemistry**

- To acquire basic skills to develop laboratory work in biomedical research.
- Be able to access the information required (databases, scientific articles, etc.) and to interpret and use it sensibly.
- Ser capaces de seleccionar y optimizar las variables instrumentales para obtener los mejores parámetros analíticos en las técnicas experimentales estudiadas.
- Ser capaces de emplear las herramientas básicas para el tratamiento de datos experimentales en el laboratorio.
- Realizar estudios relacionados con el análisis y/o la caracterización de sustancias químicas tales como: control de calidad, diseño de protocolos de trabajo para laboratorios, diseño e implementación de procesos de acreditación y validación, diseño y desarrollo de proyectos I+D+I, emisión de informes, certificaciones y/o dictámenes, etc.
- Ser capaces de planificar y gestionar los recursos disponibles de un laboratorio químico, teniendo en cuenta los principios básicos de la calidad, prevención de riesgos, seguridad y sostenibilidad.
- Seleccionar la instrumentación química comercializada apropiada para el estudio a realizar y de aplicar sus conocimientos para utilizarla de manera correcta.
- To prepare a clear and concise memory of the results of your work and the conclusions obtained.

**LEARNING OUTCOMES**

At the end of the teaching-learning process, the student should be capable of:

- 1 Describe the fundamentals and basic electronic microprobe instrumentation.
- 2 Describe your analytical applications.
- 3 Describe some of the most recent developments of the electron microprobe.
4. Use the electronic microprobe and promote research
- 5 Describe the procedures for obtaining x-ray and understand the characteristics of the required instrumentation.
- 6 Describe the processes of interaction of X radiation with material systems.
- 7 Explain the problem of matrix interference.
- 8 Carry out microanalysis by x-ray with energy dispersive spectrometry.
9. Recognize the basic parameters of the voltammetric records.
- 10 Identify different types of electrochemical processes.
- 11 Define electrochemical techniques of more frequent use (cyclic, differential pulse and square wave voltamperometries) and recognize the corresponding graphic records.
12. Apply electrochemical techniques to the resolution of classical analytical problems.
- 13 Describe the main procedures of electrochemical modification.



14 Describe the essential characteristics of potentiometric, amperometric, and voltammetric sensors and to determine selectivity coefficients of ion selective electrodes from potentiometric data.

15. Recognize the differential characteristics between conventional electrochemical techniques and nanoelectrochemical.

16 Solve problems of determination of concentrations from potentiometric, amperometric or voltammetric data.

## DESCRIPTION OF CONTENTS

### 1. Analysis by electron microprobe

- Morphological characterization of polymeric stationary phases by means of image by scanning electron microscopy
- Characterization of metalorganic structures by scanning electronic microscopy and microanalysis x-ray with energy dispersive spectrometry

### 2. X-ray Spectrometry

Analysis of materials by X-ray fluorescence

### 3. Electroanalytic nanoscopic techniques

Voltammetry using macro and micro electrodes

### 4. Electrochemical sensors

Preparation of a sensor with potentiometric study of selectivity

**WORKLOAD**

ACTIVITY	Hours	% To be attended
Laboratory practices	40,00	100
Development of individual work	12,00	0
Study and independent work	16,00	0
Readings supplementary material	4,00	0
Preparation of evaluation activities	12,00	0
Preparation of practical classes and problem	8,00	0
Resolution of case studies	8,00	0
<b>TOTAL</b>	<b>100,00</b>	

**TEACHING METHODOLOGY****Presential Activities**

Laboratory classes will begin with seminars in which Professor will perform a brief introduction of the objective, fundamentals and experimental practices methodology to perform.

The teacher will held in the laboratory the necessary explanations on operation of the instruments to be used in each practice prior to their use by students and will supervise its use during practices, to enhance knowledge on the techniques used.

Students will carry out the practice following the corresponding protocols or manual of practices.

Classroom activities performed in the laboratory, presentations and exhibitions of works will be part of the ongoing evaluation of the student (formative activities AF2 of verifica and teaching methodology MD1 of verifica)

Written examinations of the subject will be carried out on the date specified in the programming of the assessment tests (formative activities AF4 of verifica and teaching methodology MD1 of verifica).

The competences to acquire from the presential activities will be:

Generals: CG1 and CG3

Specific: CE2, CE3, CE4, CE5 y CE6

**Non-presential activities**

Students will conduct the non-presential activities requested by the teacher (memoirs, reports of practices, etc.) and they will deliver them on the specified date.



The competences to acquire from the presential activities will be:

Specific: CE7

## EVALUATION

Along the sessions, focus in the resolution of practical assays, the assistance and participation of the students will be evaluated individually (by oral answers or by writing questions planned by the professor, by planning questions which its answer will be relevant for all the group). Also, these questions will include the design of working protocols, the selection of variables and the tools for the data treatment (verifica competences CE2, CE3, CE5 and CE6). The competences to evaluate: specifics: CE2, CE3, CE4, CE5 and CE6

### WEIGHT 40

2.- An assessment of non-classroom-based activities (memories and/or reports of practices delivered)

The reports performed by the students will include the main conclusions extracted from the laboratory work (working protocols, variable selection and data treatment; verifica competences CE2, CE5, CE6 and CE7) and it will be done by couples to improve the group working (consensus decision making: verifica competences CG1 and CE7)

### WEIGHT 30

3. -Written examinations (Based on the results of learning the content and on the specific objectives of each subject)

The exam will consist in the resolution of questions and practical examples related to the studied techniques (verifica competences: CE2, CE4, CE5 and CE6).

### WEIGHT 30

## REFERENCES

### Basic

- Aballe, M.; López Ruiz, J.; Badía, J.M.; Adeva, P.(Eds.) Microscopía Electrónica de Barrido y Microanálisis por Rayos X, CSIC y Ed. Rueda, Madrid, 1996.
- Bennet, H.; Oliver, G. XRF Analysis of Ceramics, Minerals and Allied Materials. Wiley, Chichester, 1992.
- Bonnel, D.A. (Ed.) Scanning Probe Microscopy and Spectroscopy: Theory, Techniques and



Applications. 2<sup>a</sup> ed., Wiley, Nueva York, 2001.

Doménech, A.; Doménech, M.T.; Costa, V. Electrochemical methods for archaeometry, conservation and restoration, Springer, Berlin, 2009.

Doménech, A. Electrochemistry of Porous Materials, Taylor & Francis, Boca Raton, 2010.

Goldstein, J.I.; Newbury, D.E.; Echlin, P.; Joy, D.C.; Fioril, Ch.; Lifshin, E. Scanning Electros Microscopy and X-Ray Microanalysis. Plenum Press, Nueva York, 1984.

Pingarrón, J.M.; Sánchez Batanero, P. Química electroanalítica: fundamentos y aplicaciones. Síntesis, Madrid, 2003.

Tertian, R.; Claise, F. Principles of Quantitative X-Ray Fluorescence Analysis. Heyden, Londres, 1982

## ADDENDUM COVID-19

**This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council**

### Contents

*The contents initially indicated in the teaching guide are maintained.*

### Workload and temporary teaching planning

Regarding the workload:

*The different activities described in the Teaching Guide are maintained with the intended dedication.*

Regarding the temporary teaching planning:

No variation with respect to what was initially planned in the teaching guide has been considered.

### Teaching Methodology

With regard to laboratory courses, the maximum face-to-face teaching will be lying in compliance with the rules of distance and occupation of spaces fixed by the academic authorities. In this sense, the teaching type "L" will be 100% face-to-face, and the teaching type "U" will be non-face-to-face and will be taught through the tools offered by the virtual classroom. [Indicate if there is any variation with respect to the teaching guide (individual work ...)]

The methodology used for non-face-to-face classes shall be:



1. Synchronously using virtual classroom tools (Teams, Blackboard ...)
2. Asynchronously using locut power-point presentations or other virtual classroom tools
3. Resolution of exercises and questionnaires

*If there is a closure of the facilities for health reasons that totally or partially affects the classes of the course, they will be replaced by non-face-to-face sessions following the established schedules and using the tools of the virtual classroom.*

### **Evaluation**

*The evaluation system described in the Teaching Guide of the subject in which the various evaluable activities have been specified as well as their contribution to the final grade of the subject is maintained.*

*If there is a closure of the facilities for health reasons affecting the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade of the subject will remain unchanged, as set out in this guide.*

### **References**

*The literature recommended in the Teaching Guide is maintained since it is accessible*