VNIVERSITAT DE VALÈNCIA

Course Guide
42929 Advanced techniques in spectrometry and electroanalysis

COURSE DATA

Data Subject	
Code	42929
Name	Advanced techniques in spectrometry and electroanalysis
Cycle	Master's degree
ECTS Credits	4.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
2109 - Master's Degree in Experimental Techniques in Chemistry	Faculty of Chemistry	1	First term

Subject-matter

Degree	Subject-matter	Character
2109 - Master's Degree in Experimental Techniques in Chemistry	1 - Advanced laboratory of experimental techniques in chemistry	Obligatory

Coordination

Name	Department
BENEITO CAMBRA, MIRIAM	310 - Analytical Chemistry
CARRASCO CORREA, ENRIQUE JAVIER	310 - Analytical Chemistry
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.

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

2109 - Master's Degree 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 realacionados 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 arealizar 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 (RD 1393/2007) // NO CONTENT (RD 822/2021)

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

1. Describe the fundamentals and basic instrumentation of scanning and transmission electron microcopies.
2. Describe their analytical applications.
3. Describe some of the most recent developments of the scanning electron microscopy.
4. Use the scanning electron microscopy and promote research
5. Describe the interaction processes between radiation and samples.
6. Material surface morphologic studies with spectrometric techniques and its relationship with analytical parameters.
7. Carry out microanalysis by X-ray with energy dispersive spectrometry.

8. Recognize the basic parameters of the voltammetric records.
9. Identify different types of electrochemical processes.
10. Define electrochemical techniques of more frequent use (cyclic, differential pulse and square wave voltamperometries) and recognize the corresponding graphic records.
11. Apply electrochemical techniques to the resolution of classical analytical problems.
12. Describe the main procedures of electrodical modification.
13. Describe the essential characteristics of potentiometric, amperometric, and voltammetric sensors and to determine selectivity coefficients of ion selective electrodes from potentiometric data.
14. Recognize the differential characteristics between conventional electrochemical techniques and nanoelectrochemical.
15. Solve problems of determination of concentrations from potentiometric, amperometric or voltammetric data.
16. Regarding the Sustainable Development Goals (SDGs), it is expected that students will be able to know in this subject how to apply the knowledge learned to guarantee an inclusive, equitable, and quality education and promote learning opportunities for everyone (SDG 4), to acquire a special sensitivity for sustainable management of water (SDG 6), raw materials and energy sources (SDG 7), as well as for an environmentally friendly and sustainable development (SDGs 11 , 12, 13, 14 and 15), in addition to being able to design, select and/or develop efficient products, chemical processes, and analytical methodologies (SDG 7) that minimize their impact on the environment (SDGs 14 and 15), using alternative raw materials and reducing wastes (SDG 11).

DESCRIPTION OF CONTENTS

1. Morphological analysis of smart materials by scanning electron microscopy

- Morphological characterization of functional materials, such as organic porous polymers and metal organic frameworks, among others, by scanning electron microscopy micrographs.
- Morphological structure interpretation and its relationship with the analytical performance of the smart materials.

2. X-ray Spectrometry

- Energy X-ray spectroscopy analysis to structure characterization.

3. Electroanalytic nanoscopic techniques

- Voltammetry using macro and micro electrodes.

4. Electrochemical sensors

- Preparation of a potentiometric sensor and selectivitystudy

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
TOTAL	**100,00**	

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 methdology 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

1- 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.
- Bonnel, D.A. (Ed.) Scanning Probe Microscopy and Spectroscopy: Theory, Techniques and Applications. 2ª 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.; FioriI, 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