COURSE DATA

DATA SUBJECT

Code: 36464
Name: Electrochemistry
Cycle: Undergraduate Studies
ECTS Credits: 4.5
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Facultat de Química	4	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1110 - Degree in Chemistry	Physical Chemistry Applied	ELECTIVES

COORDINATION

GARCIA JAREÑO JOSE JUAN

SUMMARY

The program is divided into six topics in which the most used electrochemical techniques are studied, some electrode processes in cells of current interest and the design and characterization of technological materials. Throughout the course we introduce examples of electrochemical reactions and electrode processes of professional interest: electrosynthesis of drugs, conductive polymer electrosynthesis, hydrogen, oxygen and chlorine electrogeneration, electrochromic processes, anodizing, galvanizing, surface metallization, electrocatalysis, electrodialysis, cataphoresis of paints, anodic dissolution of metals, decontamination of wastewater, corrosion of technological metals, accumulation of charges in batteries and condensers, and also some bioelectrochemical processes. Initially, general concepts about laboratory electrochemical techniques are described. Current intensity is introduced as a kinetic magnitude and the electrical potential as a thermodynamic magnitude. In the second topic, the transport of species in cells associated with electrochemical
and mechanical gradients is analyzed, introducing the measure of electrical resistances associated with the transport of loaded species in solids and solutions. In the third topic an introduction to the electrochemical kinetics is made, focusing on the interpretation of the electron transfer stages from a molecular perspective, while in the fourth topic
insists on the study of electrodes to complete the previous knowledge about processes in cells. The fifth topic introduces electrochemical impedance spectroscopy as an example of electrochemical technique useful for the design and characterization of materials and electrode processes, analyzing the relationship between the perturbation caused by applying alternating current to cells and their electrical response,while that in the sixth theme the application of the contents of the previous topics.

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).

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

Related with all the disciplines with the following contents: Structure, Stoichiometric calculations. Balances of mass and energy. Basic knowledge of Physics and Mathematics, Macroscopic Thermodynamics and Statistical Thermodynamics, Kinetic and Interficial Phenomena. Basic knoweldge of Physical Chemistry, Analytical Chemistry, Organic Chemistry and Inorganic Chemistry.

COMPETENCES / LEARNING OUTCOMES

1110 - Degree in Chemistry

At the end of the course, the student will be able to apply metrology in chemical processes, including quality management.

At the end of the course, the student will be able to assess risks in the use of chemical substances and laboratory procedures.

At the end of the course, the student will be able to describe the characteristics and behaviour of the different states of matter and the theories used to explain them.

At the end of the course, the student will be able to distinguish between qualitative and quantitative aspects of chemical problems.

At the end of the course, the student will be able to identify chemical processes in everyday life.

At the end of the course, the student will be able to identify the main types of chemical reactions and their key characteristics.

At the end of the course, the student will be able to identify the structure and reactivity of the main classes of biomolecules and the chemistry of key biological processes.

At the end of the course, the student will be able to implement sustainable and environmentally friendly methodologies.

At the end of the course, the student will be able to relate theory and experimentation.

At the end of the course, the student will be able to solve problems effectively.

At the end of the course, the student will be able to state the principles of quantum mechanics and apply them to the description of the structure and properties of atoms and molecules.

At the end of the course, the student will correctly use chemical terminology, nomenclature, conventions and units.

At the end of the course, the student will demonstrate inductive and deductive reasoning skills.

At the end of the course, the student will demonstrate the ability to analyse, synthesise and apply critical reasoning.

At the end of the course, the student will interpret the data from observations and measurements in the laboratory in terms of their significance and the theories that support them.

At the end of the course, the student will relate chemistry to other disciplines.

At the end of the subject, the student will evaluate, interpret and synthesize the chemical data and information correctly.

Collaborate effectively in teams, assuming responsibilities and leadership roles and contributing to collective improvement and development.

Communicate effectively, both orally and in writing, adapting to the characteristics of the situation and the audience.

Comprender la empresa como una realidad sistémica e inherentemente compleja, reconociendo e identificando las dimensiones consustanciales a los sistemas de gestión empresarial y los condicionantes, externos e internos, que inciden sobre su gestión.
Ser capaces de categorizar y jerarquizar las decisiones organizativas, e interpretar los procesos de adopción de decisiones en el ámbito de los modelos teóricos. Discriminar y manejar los principales métodos y técnicas disponibles para la elaboración del diagnóstico estratégico. Poder elaborar un diagnóstico estratégico básico.

Comprender las particularidades contables que presenta la regulación jurídico-mercantil de las empresas, relacionando la legislación mercantil aplicable a los distintos tipos operaciones societarias con la contabilidad de los hechos económicos que se regulan. Aprender a relacionar las leyes mercantiles que se ocupan de los concursos de acreedores con la contabilidad, adquiriendo práctica en el manejo de determinados textos legales vigentes.

Contribute to the design, development and implementation of solutions that address social needs, taking the Sustainable Development Goals as a reference.

Demonstrate critical and self-critical reasoning within the field of study, considering aspects such as professional ethics, moral values and the social implications of the different activities undertaken.

Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.

Handle the instrumentation used in the different areas of chemistry.

Ser capaces de analizar la influencia que sobre el diseño del sistema de información de costes, ejercen, tanto la actividad concreta desarrollada por la entidad como la tecnología utilizada, la estructura organizativa y el estilo de dirección. Calcular costes preestablecidos y relacionarlos con la planificación y el control de la actividad interna. Seleccionar aquellos indicadores de gestión que faciliten el desempeño personal, estableciendo la frecuencia y el formato en función del usuario de destino.

Ser capaces de configurar y manejar un sistema integrado para la gestión contable de la empresa. Utilizar la hoja de cálculo como herramienta de análisis de la información económica de la empresa. Saber aplicar programas de apoyo a tareas específicas de gestión.

Understand and recognise, from within the discipline, inequalities based on sex and gender in society; integrate different needs and preferences related to sex and gender into problem-solving and solution design.

DESCRIPTION OF CONTENTS

1. OVERVIEW OF ELECTROCHEMISTRY

1.1. Electrochemical techniques.
1.2. Faradic and non-faradic processes.
1.3. Equivalent electrical circuits.
1.4. Charge current and detection limit.
1.5. Dimensional analysis and units.

2. TRANSPORT IN ELECTROCHEMICAL CELLS

2.1. Nerst-Planck equation.
2.2. Ionic conductivity in solutions.
2.3. Transport through membranes.
2.4. Electric percolation.
2.5. Ohmic drop effect.

3. ELECTRON TRANSFER

3.1. Voltammetry of electroactive thin films.
3.2. Butler-Volmer equation.
3.3. Tafel equation.
3.4. The symmetry parameter.
3.5. Simulation of voltammograms and chronoamperograms.

4. ELECTRODES

4.1. Potentials of Galvani and Volta.
4.2. Theory of the electrochemical potential.
4.3. Physical significance of the electrode potential of the first type.
4.4. Electrodes of the second type, redox, and gases.
4.5. Types of working electrodes.

5. ELECTROCHEMICAL IMPEDANCE ELECTROCHEMISTRY

5.1. Introduction to alternating current.
5.2. Electrochemical impedance spectroscopy.
5.3. Representations of Nyquist, Bode and Cole-Cole.
5.4. Equivalent circuits as analogs of electrode processes.
5.5 Applications to the design and characterization of materials.

6. OVERVIEW OF THE APPLIED ELECTROCHEMISTRY

6.1. Surface treatments.
6.2. Storage of electrical energy.
6.3. Fuel cells.
6.4. Electrochemistry and Environment
6.5. Corrosion.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	7,00
Theory	38,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	37,00
Preparation of lessons	0,00
Preparation for assessment activities	10,00
Resolution of case studies	0,00
Total hours	**67,00**

TEACHING METHODOLOGY

The development of the course is structured around three axes: the theoretical-practical classes, the seminars and the realization of activities in the non-contact hours. As for the first ones, they will offer a global vision of the treated topic and will affect those key concepts for understanding. Likewise, it will be indicated the most recommendable resources for the subsequent preparation of each topic in depth. In some face-to-face sessions the student will be explained a series of problems of applications of the theoretical concepts and other sessions, however, the protagonism will pass completely into the hands of the student. Regarding the group tutorials, the teacher will guide the student on all the elements that make up the learning process, both in terms of general issues and specific issues. Also, the student will receive a list of additional activities that will serve to strengthen their knowledge and exercise in each of the aspects discussed in class sessions. The student must submit resolved the activities and works that the professor indicate throughout the course.

EVALUATION

The students' learning will be evaluated in the first call considering three different contributions. In the first place, there will be a continuous evaluation of the progress and activities developed throughout the course, which will be based on the measure of the issues and problems delivered to the students and in the work done in the tutoriial sessions. the numerical rating value in this section will constitute 40% of the final grade.
An additional 10% will be obtained by carrying out and presenting one or more monographic works.
Finally, the third contribution will correspond to the individual answer on the knowledge acquired in evaluation tests and a final exam that will rebound with 50% to the final grade.
In each of the parts must be rated with a grade of 4/10 to average the final overall grade.

Final warning
Copying or plagiarism of any assignment that is part of the evaluation will make it impossible to pass the course, and the student will be subject to the appropriate disciplinary procedures.
Please note that, according to Article 13 d) of the University Student Statute (RD 1791/2010, December 30), 'it is the duty of a student to refrain from using or cooperating in fraudulent procedures in evaluation tests, in the work performed or in official University documents'.

REFERENCES

Basic
- Electrochemical Methods: Fundamentals and Applications, A.J. Bard, y A.R.N Faulkner, Ed. Wiley, ISBN 97811183112803 (1980).
- Electrochemistry, P.H. Rieger, Ed. S. Springer, ISBN 9789401106917 (1994).
- Guía de Electroquímica. F. Vicente. Ed. Gómez Coll, ISBN 8493226653 (2001).

Additional
- Fundamentos de la Electroquímica Teórica, B.B. Damaskin, y O.A. Petri, Ed. Mir, ISBN mkt00000252321 (1981).

- Materiales y Procesos Electródicos. Varios autores. Coordinado por F. Vicente. Ed. INSDE, ISSBN 460753603 (2002).
- Aplicabilidad de la Microbalanza de Cuarzo, F. Vicente, J. Navarro, J.J. García, D. Benito, H. Perrot, D. Giménez. Ed. Gómez Coll. ISBN 8469941771 (2001).