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 covering the most frequently used electrochemical techniques, specific electrode processes in cells of current interest, and the design and characterization of technological materials. Throughout the course, examples of electrochemical reactions and electrode processes of professional interest are introduced, including the electrosynthesis of pharmaceuticals, electrosynthesis of conducting polymers, electrogeneration of hydrogen, oxygen and chlorine, electrochromic processes, anodizing, galvanizing, surface metallization, electrocatalysis, electrodialysis, paint cataphoresis, anodic dissolution of metals, wastewater decontamination, corrosion of technological metals, charge storage in batteries and capacitors, and selected bioelectrochemical processes.

Initially, general concepts related to laboratory electrochemical techniques are presented, introducing current intensity as a kinetic quantity and electrical potential as a thermodynamic quantity. The second topic focuses on species transport in electrochemical cells associated with electrochemical and mechanical gradients, including electrical resistance measurements related to the transport of charged species in solids and solutions. The third topic introduces electrochemical kinetics, with particular emphasis on the interpretation of electron transfer processes from a molecular perspective, while the fourth topic addresses the study of electrodes to complement the previous knowledge acquired on electrochemical cell processes. The fifth topic is devoted to electrochemical impedance spectroscopy as an example of an electrochemical technique used for the design and characterization of materials and electrode processes, analyzing the relationship between the perturbation produced by applying alternating current to electrochemical cells and their electrical response. Finally, the sixth topic focuses on the

application of the concepts developed throughout the previous topics.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

It is recommended that students have prior knowledge of structure, stoichiometric calculations, mass and energy balances, basic Physics and Mathematics, Macroscopic and Statistical Thermodynamics, Kinetics and Interfacial Phenomena, as well as basic 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. Electrochemical techniques.
2. Faradaic and non-faradaic processes.
3. Equivalent electrical circuits.
4. Charging current and detection limit.
5. Dimensional analysis and units.

2. TRANSPORT IN ELECTROCHEMICAL CELLS.

1. Nernst-Planck equation.
2. Ionic conductivity in solutions.
3. Transport through membranes.
4. Electrical percolation.
5. Effect of ohmic drop.

3. ELECTRON TRANSFER.

1. Voltammetry of electroactive thin films.
2. Butler-Volmer equation.
3. Tafel equation.
4. The symmetry parameter.
5. Simulation of voltammograms and chronoamperograms.

4. ELECTRODES.

1. Galvani and Volta potentials.
2. Theory of electrochemical potential.
3. Physical significance of the first-type electrode potential.
4. Second-type electrodes, redox, and gas electrodes.
5. Types of working electrodes.

5. ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY.

1. Introduction to alternating current.
2. Electrochemical impedance spectroscopy.
3. Nyquist, Bode and Cole-Cole plots.
4. Equivalent circuits as analogues of electrode processes.
5. Applications to the design and characterization of materials.

6. OVERVIEW OF APPLIED ELECTROCHEMISTRY.

1. Surface treatments.
2. Electrical energy storage.
3. Fuel cells.
4. Electrochemistry and the environment.
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	37,50
Preparation of lessons	0,00
Preparation for assessment activities	10,00
Resolution of case studies	0,00
Total hours	**67,50**

TEACHING METHODOLOGY

The development of the course is structured around three main components: lecture-practical classes, group tutorials, and independent learning activities.

During the lecture-practical classes, students will be provided with a general overview of each topic, with particular emphasis on the key concepts required for their understanding. Students will also be directed to the most appropriate resources for the subsequent in-depth study of each topic. In some classroom sessions, the lecturer will explain a series of model problems illustrating the application of the theoretical concepts, whereas in other sessions the students themselves will take the leading role.

During the face-to-face group tutorials, the lecturer will guide students through all aspects of the learning process, addressing both general approaches and specific questions. In addition, students will receive a set of supplementary activities designed to reinforce their knowledge and provide further practice on each of the topics covered in class.

Each student must submit the activities and assignments specified by the lecturer throughout the course.

EVALUATION

The following assessment systems will be used:

Tests consisting of written, oral and/or practical examinations. These assessments are recoverable.

Assessment of group tutorial sessions, seminars, preparation of assignments and/or oral presentations. By their very nature, these activities are non-recoverable.

Continuous assessment of each student based on face-to-face activities, submission of exercises, participation, and degree of involvement in the teaching–learning process. By their very nature, these activities are non-recoverable.

The assessment of student learning will take into account all the aspects described in the methodology section of this course syllabus.

Modality A

First examination period

The final grade will consist of:

- Examination (50%), consisting of a series of theoretical questions and numerical problems covering the basic concepts taught during the course. The examination is recoverable in the second examination period.
- Continuous assessment (40%), including questionnaires and the submission of problems and/or exercises discussed during the tutorial sessions. These activities are non-recoverable.
- Preparation and oral presentation of a monographic project (10%) related to the course contents. This activity is non-recoverable.

The minimum overall grade required to pass the course is 5.0 out of 10.

A minimum grade of 4.0 out of 10 in the written examination is required for the examination mark to be averaged with the continuous assessment grade.

Second examination period

The same assessment criteria as in the first examination period will apply.

Modality B

This modality will only be accepted in highly exceptional cases in which the lecturer has approved the student's request.

First examination period

The final grade will consist of:

- Examination (90%).
- Continuous assessment activities (10%). In this modality, continuous assessment will be carried out through the online submission of problems, exercises and/or monographic projects.

A minimum grade of 4.5 out of 10 in the written examination is required for the examination mark to be averaged with the continuous assessment grade.

The minimum overall grade required to pass the course is 5.0 out of 10.

The default assessment modality is Modality A. Access to Modality B requires a justified inability to attend the face-to-face activities and the approval of the lecturer responsible for the course.

Second examination period

The same assessment criteria as in the first examination period will apply.

Final warning

Any manifest copying or plagiarism in any assessment activity will result in the student being unable to pass the course and will lead to the corresponding disciplinary procedures.

Students should note that, in accordance with Article 13(d) of the University Student Statute (Royal Decree 1791/2010, of 30 December), *"it is the duty of students to refrain from using or cooperating in fraudulent*

procedures in assessment tests, in assignments submitted, or in official University documents."

REFERENCES

Basic:

- BARD, A. J.; FAULKNER, L. R.; WHITE, H. S. *Electrochemical Methods: Fundamentals and Applications*, 3rd ed. Wiley, 2025. ISBN 9781119334064.
- VICENTE, F. *Guía de Electroquímica*. Gómez Coll, 2001. ISBN 8493226653.
- FERNÁNDEZ DOMENE, R. M.; ROSELLÓ MÁRQUEZ, G.; BAUTISTA GRAU, P.; SÁNCHEZ TOVAR, R.; GARCÍA ANTÓN, J. *Fundamentos de Teoría Electroquímica*. Universitat Politècnica de València, 2020. ISBN 9788490488706.

Additional:

- VICENTE, F. (coord.). *Materiales y Procesos Electródicos*. INSDE, 2002. ISBN 8460753603.
- VICENTE, F.; NAVARRO, J.; GARCÍA, J. J.; BENITO, D.; PERROT, H.; GIMÉNEZ, D. *Aplicabilidad de la Microbalanza de Cuarzo*. Gómez Coll, 2001. ISBN 8469941771.
- FERNÁNDEZ ROMERO, A. J.; GARCÍA ANTÓN, J.; RODRIGO, M.; SIRÉS, I. *Aplicaciones medioambientales y energéticas de la tecnología electroquímica*. Reverté, 2021. ISBN 9788429170757.