Course unit English denomination	Electrocatalysis & Electrosynthesis
SSD	CHEM-02/A
Teacher in charge (if defined)	ISSE Abdirisak Ahmed (8h), DURANTE Christian (8h), FANTIN Marco (8h)
Teaching Hours	24
Number of ECTS credits allocated	3
Course period	01-02/2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☐ Yes (.....% minimum of presence) ☒ No
Course unit contents	**Introduction to electrochemical systems** Conductors, interfacial potentials, double layer structure, electrode potentials, polarization, ideal polarized and non-polarizable electrodes. **Electrosynthesis** General cell designs, diaphragm materials, electrode materials, pretreatment and activation of electrode materials, reference electrodes, solvents and electrolytes, potentiostatic and galvanostic modes of electrolysis, figures of merit of electrolysis. **Electrochemical kinetics** kinetics of electron transfer at electrodes, Butler-Volmer equation; limiting cases of low and high overpotentials; effect of mass-transfer; Fick's laws of diffusion and their applications in electrochemistry; diffusion overpotential. **Electrochemical techniques** electrochemical methods in three- and four-electrode cell configurations; cyclic voltammetry: reversible, quasi-reversible and irreversible systems; effect of chemical reactions coupled with electron transfer(s); rotating disk and ring disk electrode; electrochemical impedance spectroscopy; electrochemical probe microscopy. **Homogeneous electrocatalysis** electrocatalysis by metal complexes, electrocatalysis by organic mediators; some homogeneous electrocatalytic reactions of relevance in electrosynthesis, and in energy conversion and storage; homogeneous photo-electrocatalysis. **Heterogeneous electrocatalysis** microscopical view of an electrocatalytic surface; a quantitative descriptor for catalysis: the Volcano plot; examples of important electrocatalytic processes: hydrogen evolution reaction; water splitting; O_2 reduction reaction, CO_2 reduction, activation of carbon-halogen bonds, etc.

Learning goals	Knowledge: Fundamentals on thermodynamics and kinetics of electrode processes. Principal electrochemical techniques such as cyclic voltammetry and rotating disk and ring-disk electrode Skills: Designing electrochemical experiments Comprehension and interpretation of electrochemical data Competencies: Analysis of electrochemical reaction mechanisms Determination of kinetic parameters by electrochemical techniques
Teaching methods	Frontal teaching
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No Students external to the PhD Course admitted upon evaluation of the CV by the teachers
Prerequisites (not mandatory)	max 3750 caratteri
Examination methods	At the end of the course, each student will be given one or more scientific papers dealing with the application of electrochemistry in important topics such as electrocatalysis, electrosynthesis, energy conversion, pollution remediation, etc. On the examination day, each student will be given 15-20 min to deliver an oral presentation on his/her assignment in the classroom, followed by a general discussion on the topic with the whole class.
Suggested readings	Slides/articles provided by the teacher
Additional information (not mandatory)	max 3750 caratteri