R O M Â N I A
MINISTERUL EDUCAȚIEI ȘI CERCETĂRII
Universitatea din Craiova
FACULTATEA DE ȘTIINȚE/ DEPARTAMENTUL DE CHIMIE
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Subject Description

1. Program information

1.1. Institution	University of Craiova
1.2. Faculty	Science
1.3. Department	Chemistry
1.4. Study field	Chemistry
1.5. Study level	Master
1.6. Type of education	full-time
1.7. Study program	Advanced Chemistry

2. Subject information

2.1. Subject	Advanced electrochemistry and corrosion						
2.2. Course coordinator	Conf.dr. Bogdan TUTUNARU						
2.3. Application coordinator	Conf.dr. Bogdan TUTUNARU						
2.4. Year of study	I	2.5. Semester	1	2.6. Type of evaluation	E	2.7. Subject type	DS/DOB

3. Total estimated tipe (hours/semester)

3.1. Number of hours per week	4	from which: 3.2 course	2	3.3. seminar/lab	2
3.4. Total hours in curriculum	56	from which: 3.5 course	28	3.6. seminar/lab	28
Time allocation – hours/week					
Study using textbooks, course materials, bibliographies, and notes					30
Additional documentation in the library, on specialized electronic platforms, and in the field					15
Preparation of seminars/labs, assignments, reports, portfolios, and essays					15
Tutoring					5
Examinations					4
Other activities					
3.7. Total hours of individual study					69
3.8. Total hours per semester					125
3.9. Number of ECTS					5

4. Preconditions (if the case)

4.1. of curriculum	• The Applied Electrochemistry and Corrosion course assumes basic knowledge of physical chemistry at the undergraduate level. Therefore, this course will be beneficial for both undergraduate and graduate students, as well as for researchers specializing in physical chemistry, materials electrochemistry, corrosion science and their applications.
4.2. of competences	• Minimum knowledge of computer use / specific programs in graphic and/or documentation methods.

5. Conditions (if the case)

5.1. for course	• Lecture hall equipped with computer, video projection system, and internet connection
5.2. for labs	• Laboratory equipped with the materials, equipment, and reagents necessary to carry out experimental work

6. Course objectives - expected learning outcomes achieved by completing and passing the course

Knowledge	1. Graduates define, understand, explain, and apply advanced knowledge of chemistry from specialized literature in practice. 2. Graduates select and use appropriate experimental and theoretical methodologies to investigate complex scientific problems, assessing their impact on the environment and society. 3. Graduates write analysis and scientific reports, presenting the results of their research and experiments, in line with professional ethics and standards. 4. The graduate describes and integrates interdisciplinary knowledge into the implementation of research projects.
Skills	1. Graduates apply major concepts in analytical, inorganic, organic, and physical chemistry to chemical practice. 2. Graduates evaluate and analyze experimental techniques to conduct and design experiments, analyze and test (qualitatively and quantitatively) chemical elements and substances; design, coordinate, and conduct chemical experiments. 3. Graduates apply critical thinking, following the structure and principles of scientific writing to develop and present scientific reports. 4. Graduates apply interdisciplinary methods to solve complex theoretical and practical chemical problems in their professional and research activities.
Responsibility and authonomy	1. Graduates are able to adapt major scientific concepts in the field of chemistry to conduct research, improve or develop new concepts, knowledge, theories, and operational methods, products, and services in order to apply them in specific activities for product and process quality control. 2. Graduates use classical laboratory instruments/techniques and modern equipment independently, design experiments, and interpret and analyze the obtained results accurately. They design learning situations focused on developing experimental techniques and methods specific to chemical laboratories. 3. Graduates prepare and present scientific reports in line with ethical standards for collecting and interpreting results. 4. Graduates assume responsibility for managing interdisciplinary collaborations and coordinating activities within work and research teams..

7. Table of contents

7.1. COURSE	Mode of operation	Teaching methods	Allocated time (hours)
1. Basic notions. The modern notion of oxidation-reduction. Oxidation number. The notion of current. Current and Current density. Conducting media. Different charge carriers. Different classes of conductors.	On site	Lecture, explanation and interactive presentation, heuristic conversation, problem solving	2
2. Electrolytes: Elementary Concepts. The Arrhenius theory of electrolytes. Structure of Solutions. Classification of solvents.			2
3. Transport Processes in Electrolyte Systems. Conduction of Electricity in Electrolytes. Classification of conductors. Conductivity of electrolytes.			2
4. Equilibria of Charge Transfer in Heterogeneous Electrochemical Systems. Structure and Electrical Properties of Interfacial Regions. Classification of electrical potentials at interfaces. The Galvani potential difference. The Volta potential difference.			2
5. Double layer. Models of the double layer. Helmholtz model. Gouy-Chapman model. Gouy-Chapman-Stern model. Bockris – Devanathan – Muller model.			2
6. Theories of electrode potential. Osmotic theory of electrode potential. Theory of ion hydration. Normal and standard electrode potentials.			2

7. Description and operation of an electrochemical chain. General features. Electrochimical cell and chain. The polarity of the electrodes. Sign convention for the current through an interface. Sign convention for current.			2
8. Electrochemical principles. Introduction. i-E curves in simple systems; i-E curves in systems containing a reducing agent, an oxidizing agent, or a mixture. i-E curves in fast and slow systems. i-E curves with multiple voltammetric waves.			2
9. Electrochemical oxidation mechanisms; EEC, ECE, CEE mechanisms. Intermediates in electrochemical oxidation reactions of molecular compounds. The main classes of oxidizable compounds.			2
10. Electrochemical reduction mechanisms; EEC, ECE, CEE mechanisms. Intermediates in electrochemical reduction reactions of molec.			2
11. Electrocatalytic reactions. Anodically initiated electrocatalytic reactions. Cathodically initiated electrocatalytic reactions. Influence of the nature of the electrode on the reaction mechanism.			2
12. Introduction and Overview of Electrochemical Corrosion. Definition and Examples of Corrosion. Corrosion Mechanisms. The Elementary Electrochemical Corrosion Circuit. Reactions: Cathodic and Anodic Reactions.			2
13. Formal kinetics of electrode reactions. Butler-Volmer equation. Tafel relation.			2
14. Factors that influence corrosion processes. Nature of the metal and surface condition. Ph of the aggressive environment. Molecular oxygen concentration. Accelerators of the corrosion rate. Temperature. Flow rate of the aggressive environment.			2
References:			
1. Jin Koryta, Jin Dvorak, Ladislav Kavan. Principles of Electrochemistry. Second Edition. 1993. John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012, USA. ISBN 0 471 93713 4			
2. Advanced Electrochemistry. Interfaces, thermodynamics, and electrochemical techniques. Andrzej Lasia. Département de chimie. Université de Sherbrooke. 2023 (revised)			
3. Christine LEFROU, Pierre FABRY and Jean-Claude POIGNET. Electrochemistry - The Basics, with Examples. EDP Sciences, Grenoble Sciences' collection, 2009, ISBN 978 2 7598 0425 2.			
4. E.E. Stansbury and R.A. Buchanan. Fundamentals of Electrochemical Corrosion. ASM International, Materials Park, OH 44073-0002. ISBN: 0-87170-676-8.			
5. Course notes, B. Tutunaru			

7.2. Lab	Mode of operation	Teaching methods	Allocated time (hours)
L1. Safety rules in Electrochemistry lab.	On site	Experiment, explanation, discussion, debate, and questioning	4
L2. Methods and methodologies used in the study of the electrochemical behavior of biologically active compounds.			4
L3. Experimental determination of the breakdown voltage and discharge potentials of molecules.			4
L4. Electrochemical oxidation and reduction through direct and indirect mechanisms of food or textile dyes.			4
L5. Electrochemical synthesis of iodoform.			4

L6. Experimental determination of the corrosion rate of iron and zinc.			4
L7 Laboratory colloquium. Review of papers.			4
References:			
1. B. Tutunaru. Electrochimie experimentala vol. I, vol. II, vol. III, Ed. Sitech, Craiova, 2025			
2. Christine LEFROU, Pierre FABRY and Jean-Claude POIGNET. Electrochemistry - The Basics, with Examples. EDP Sciences, Grenoble Sciences' collection, 2009, ISBN 978 2 7598 0425 2.			
3. C.M.A. Brett. A.M. Oliveira Brett. Electrochemistry - Principles, Methods, and Applications. 1994. United States. Oxford University Press Inc., New York			

8. Corrrelation of the discipline content with the expectations of representatives of the epistemic community, professional associations, and representative employers in the field related to the program

The course material addresses the study of electron transfer in molecules of molecular compounds, an issue intensively studied at national and international level. At the same time, students acquire knowledge regarding the degradation of these organic compounds from polluted waters, as well as notions of corrosion and anti-corrosion protection.

9. Evaluation

Activity	9.1. Evaluation criteria	9.2. Evaluation method	9.3. Contribution to final score
9.4. Course	theoretical concepts and mechanisms, critical analysis of literature or design of a catalytic system	Written Exam	50%
		Portofolio	20%
9.5. Lab	synthesis, characterization, data interpretation	Project Work	30%
9.6. Minimum performance standard			
• Basic understanding of core concepts. • Knowledge of main types of electrode processes. • Elementary understanding of electrochemical mechanisms. • Completion of practical/project tasks			

Date
22.09.2025

Course coordinator,
Conf.dr. Bogdan TUTUNARU

Date of approval
25.09.2025

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Head of Department,
Conf.dr. Nicoleta Cioateră