SYLLABUS

1. Information about the program

1.1 Higher education institution	Politehnica University Timisoara
1.2 Faculty[1]/ Department [2]	Chemical Engineering, Biotechnologies and Environmental Protection / CAICAM
1.3 Field of study (name/code[3])	Chemical Engineering / 10.30.50
1.4 Study cycle	License
1.5 Study program (name/code/qualification)	Chemical Engineering / 10.30.50.60 /engineer

2. Information about the discipline

2.1 Name of discipline/ formative category[4]			Electrochemistry and corrosion I / DD				
2.2 Coordinator (holder) of course activities			Assist.prof. dr.eng. Andrea KELLENBERGER				
2.3 Coordinator (holder) of applied activities[5]			Assist.prof. dr.eng. Andrea KELLENBERGER				
2.4 Year of study[6]	II	**2.5** Semester	4	**2.6** Type of evaluation	D	**2.7** Regime of discipline[7]	DI

3. Total estimated time – hours / semester: direct teaching activities (fully assisted or partly assisted) and individual training activities (unassisted) [8]

3.1 Number of fully assisted hours / week	4 of which:	**3.2** course	2	**3.3** seminar / laboratory / project	0/2/0
3.1* Total number of fully assisted hours / semester	56 of which:	**3.2*** course	28	**3.3*** seminar / laboratory / project	0/28/0
3.4 Number of hours partially assisted / week	of which:	**3.5** training		**3.6** hours for diploma project elaboration	
3.4* Total number of hours partially assisted / semester	of which:	**3.5*** training		**3.6*** hours for diploma project elaboration	
3.7 Number of hours of unassisted activities / week	3.14 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			0.5
		hours of individual study after manual, course support, bibliography and notes			1.5
		training seminars / laboratories, homework and papers, portfolios and essays			1.14
3.7* Number of hours of unassisted activities / semester	44 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			7
		hours of individual study after manual, course support, bibliography and notes			21
		training seminars / laboratories, homework and papers, portfolios and essays			16
3.8 Total hours / week [9]	7.14				
3.8* Total hours /semester	100				
3.9 Number of credits	4				

4. **Prerequisites** (where applicable)

4.1 Curriculum	• Algebra, mathematical analysis, physics, inorganic chemistry, physical chemistry
4.2 Competencies	• Description, analysis and use of fundamental concepts and theories in the field of

[1] The name of the faculty which manages the educational curriculum to which the discipline belongs
[2] The name of the department entrusted with the discipline, and to which the course coordinator/holder belongs.
[3] The code provided in HG - on the approval of the Nomenclature of fields and specializations / study programs, annually updated.
[4] Discipline falls under the educational curriculum in one of the following formative disciplines: Basic Discipline (DF), Domain Discipline (DD), Specialist Discipline (DS) or Complementary Discipline (DC).
[5] Application activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr).
[6] Year of studies in which the discipline is provided in the curriculum.
[7] Discipline may have one of the following regimes: imposed discipline (DI) or compulsory discipline (DOb)-for the other fundamental fields of studies offered by UPT, optional discipline (DO) or optional discipline (Df).
[8] The number of hours in the headings 3.1 *, 3.2 *, ..., 3.8 * is obtained by multiplying by 14 (weeks) the number of hours in headings 3.1, 3.2, ..., 3.8. The information in sections 3.1, 3.4 and 3.7 is the verification keys used by ARACIS as: (3.1) + (3.4) ≥ 28 hours / wk. and (3.8) ≤ 40 hours / wk.
[9] The total number of hours / week is obtained by summing up the number of hours in points 3.1, 3.4 and 3.7.

	engineering sciences

5. Conditions (where applicable)

5.1 of the course	• Classroom equipped with blackboard and video projector
5.2 to conduct practical activities	• Laboratory with appropriate equipment

6. Specific competencies acquired through this discipline

Specific competencies	• Recognize and describe basic notions and concepts related to electrochemistry and corrosion • Explain phenomena that occur when electric current passes through electrolyte solutions • Identify electrode processes and use the laws of electrolysis • Apply methods to measure the conductivity of electrolyte solutions • Recognize different types of electrodes and use the standard potentials series • Use potentiometric methods for pH measurement
Professional competencies ascribed to the specific competencies	• - Analyse production processes for improvement; • - Manage chemical testing procedures; • - Test materials; • - Write technical reports • -Performs chemical experiments • -Approve engineering design • -Assess environmental impact
Transversal competencies ascribed to the specific competencies	• - Conduct quality control; • - Apply scientific, technological and engineering knowledge; • - Uses equipment, instruments or technological equipment accurately.

7. Objectives of the discipline (based on the grid of specific competencies acquired - pct.6)

7.1 The general objective of the discipline	• Understand and apply fundamental concepts of electrochemical phenomena; acquire knowledge on electrochemistry and corrosion
7.2 Specific objectives	• Define the basic notions, concepts, theories and models of electrochemistry (electrical conductors, electrodes, anode, cathode, electrochemical cells) • Explain and understand electrochemical phenomena and processes that occur when electric current passes through electrolyte solutions • Apply the laws of electrolysis to solve specific problems • Describe, analyze and apply the concepts and methods for determining the electrical conductivity of solutions • Describe and understand the construction and practical use of different types of electrodes, use of the standard potentials series to evaluate redox / corrosion reactions • Describe and apply potentiometric methods for pH measurement

8. Content [10]

8.1 Course	Number of hours	Teaching methods [11]
1. Introduction. Electrical conductors: conduction mechanism, electronic / ionic conductors, chemical bonds	3	Presentation and discussion, active participation to discussions, demonstration,
2. Charge transport through interfaces and electrolyte solutions: Electrodes, electrode reactions; Electrochemical / galvanic cells; Faraday's laws of electrolysis	4	

[10] It details all the didactic activities foreseen in the curriculum (lectures and seminar themes, the list of laboratory works, the content of the stages of project preparation, the theme of each practice stage). The titles of the laboratory work carried out on the stands shall be accompanied by the notation "(*)".
[11] Presentation of the teaching methods will include the use of new technologies (e-mail, personalized web page, electronic resources etc.).

3. Charge transport in electrolyte solutions: Ionic mobility and transference number	3	problem-solving, electronic resources available at cv.upt.ro
4. Electrical conductivity of solutions: conductante, conductivity and molar conductivity of solutions; Conductometric titration	3	
5. Electrochemical thermodynamics: types of electrodes, Nernst equation; Experimental measurement of electrode potentials, reference electrodes; Electrochemical series of standard electrode potentials; Reversibile / irreversibile galvanic cells; Electromotive force of galvanic elements; Potentiometric titration; Potentiometric pH measurement	9	
6. Electrochemical kinetics: Polarization, overpotential; Polarization curves in electrolysis cells and galvanic elements; Minimum electrolysis voltage	3	
7. Basics of corrosion.	3	

Bibliography [12]

1. Vaszilcsin, N., Nemes, M., Introduction to electrochemistry by problems, Editura Politehnica, Timisoara, 2009
2. Gileadi, E., Physical electrochemistry: fundamentals, techniques and applications, Wiley-VCH, 2011
3. Hamann, C.H., Hamnett, A., Vielstich, W., Electrochemistry, Wiley-VCH, Weinheim, 2007
4. Bagotsky, V.S., Fundamentals of Electrochemistry, John Wiley & Sons, Inc., Hoboken, New Jersey, 2006
5. Schweitzer, Philip A., Fundamentals of corrosion: mechanisms, causes and preventative methods, CRC Press, 2010
6. Roberge, Pierre R., Corrosion Engineering: principles and practice, McGraw-Hill, 2008

8.2 Applied activities [13]	Number of hours	Teaching methods
Laboratory	28	Discussion of theoretical aspects, experimental work, experimental data processing and analysis, electronic resources available at cv.upt.ro. Individual work in groups of 3-4 students
1. Introduction to electrochemistry lab. Working safety rules. Measurement of physical quantities used in electrochemistry	4	
2. Faraday's laws of electrolysis. *Calibration of ammeter using a copper coulometer. *Determination of molar volume using a gas coulometer	4	
3. Ionic mobility and transference number. *Evaluation of transference number by Hittorf's method	4	
4. Conductivity of electrolyte solutions. *Measuring the conductivity of electrolyte solutions. *Variation of molar conductivity with concentration. *Conductometric titration	4	
5. Electrode potential, types of electrodes. Nernst equation. *Dependence of electrode potential on solution concentration *Variation of redox potential in dependence of pH.	4	
6. Potentiometric applications: *Measurement of pH using the glass electrode. *Determining the pH of metal hydroxide precipitation. *Variation of electrode potential during potentiometric titration.	4	
7. Electrode kinetics. *Recording polarization curves. *Determining the minimum voltage for electrolysis	4	

[12] At least one title must belong to the discipline team and at least one title should refer to a reference work for discipline, national and international circulation, existing in the UPT library.

[13] Types of application activities are those specified in footnote 5. If the discipline contains several types of applicative activities then they are sequentially in the lines of the table below. The type of activity will be in a distinct line as: "Seminar:", "Laboratory:", "Project:" and / or "Practice/training".

Bibliography [14]

1. Holze, R., Experimental electrochemistry: a laboratory textbook, Wiley-VCH, Weinheim, 2009
2. Vaszilcsin, N., Nemes, M., Introduction to electrochemistry by problems, Editura Politehnica, Timisoara, 2009
3. Nemes, M., Vaszilcsin, N., Kellenberger, A., Electrochimie. Principii şi experienţe, Editura Politehnica Timisoara, 2009
4. Revie, R.W., Uhlig, H.H., Corrosion and corrosion control, Wiley-VCH, Hoboken, 2008

9. Corroboration of the content of the discipline with the expectations of the main representatives of the epistemic community, professional associations and employers in the field afferent to the program

- The content of the discipline was established following discussions in the Board of Chemical Engineering field, considering the requirements of the employers and labor market. The discipline corresponds to the curricula of other chemical engineering faculties both nationally and internationally.

10. Evaluation

Type of activity	**10.1** Evaluation criteria [15]	**10.2** Evaluation methods	**10.3** Share of the final grade
10.4 Course	Evaluation of theoretical knowledge. Evaluation of the capacity to comprehend and analyze electrochemical systems and to solve electrochemistry problems	2 written/online tests to verify theoretical knowledge, scheduled during the semester	0.67
10.5 Applied activities	**S:**		
	L: Evaluation of: - involvement in experimental work; - presentation of results; - accuracy of data interpretation	Discussion with students, follow-up of practical works, lab reports and laboratory tests	0.33
	P[16]**:**		
	Pr:		
10.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified [17])			
• Acquisition of basic concepts related to electrochemistry and corrosion; a minimum grade of 5 in each of the 2 written / online evaluation tests. • A minimum grade of 5 for the applied activities, provided that all laboratory works are carried out and all related reports are handed over.			

Date of completion	**Course coordinator (signature)** Conf.dr.ing. Andrea KELLENBERGER	**Coordinator of applied activities (signature)** Conf.dr.ing. Andrea KELLENBERGER
Head of Department (signature) Conf.dr.ing. Andrea KELLENBERGER	**Date of approval in the Faculty Council** [18]	**Dean (signature)** Ș.Ldr.ing. Mircea Laurențiu DAN

[14] At least one title must belong to the discipline team.
[15] Syllabus must contain the procedure for assessing the discipline, specifying the criteria, methods and forms of assessment, as well as specifying the weightings assigned to them in the final grade. The evaluation criteria shall be formulated separately for each activity foreseen in the curriculum (course, seminar, laboratory, project). They will also refer to the forms of verification (homework, papers, etc.)
[16] In the case where the project is not a distinct discipline, this section also specifies how the outcome of the project evaluation makes the admission of the student conditional on the final assessment within the discipline.
[17] It will not explain how the promotion mark is awarded.
[18] The endorsement is preceded by the discussion of the board's view of the study program on the discipline record.