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 II (Corrosion and Anticorrosion Protection)/ DS				
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]	IV	**2.5** Semester	7	**2.6** Type of evaluation	D	**2.7** Regime of discipline[7]	DO

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	4.5 of which:	**3.2** course	2	**3.3** seminar / laboratory / project	0/2.5/0
3.1* Total number of fully assisted hours / semester	63 of which:	**3.2*** course	28	**3.3*** seminar / laboratory / project	0/35/0
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	2.64 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			0.64
3.7* Number of hours of unassisted activities / semester	37 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			9
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	• Inorganic chemistry, physical chemistry, electrochemistry

[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.

4.2 Competencies	• Description, analysis and use of fundamental concepts and theories in the field of 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 the basic notions and concepts related to corrosion and corrosion protection • Identify electrode processes during corrosion • Use the Pourbaix diagrams to assess the thermodynamic stability of a metal or alloy at given conditions • Explain different corrosion mechanism and factors affecting corrosion rate • Recognize different corrosion forms and classes of corrosion inhibitors • Analyze and compare corrosion protection methods
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.

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

7.1 The general objective of the discipline	• Acquiring knowledge about the mechanism of corrosion processes, monitoring corrosion of metals and alloys, applying adequate corrosion protection methods
7.2 Specific objectives	• Defining the basic notions, concepts and theories of corrosion of metals and alloys and corrosion protection methods • Explain and interpret corrosion processes and corrosion protection methods • Identify and apply the concepts, methods and theories needed to solve corrosion and corrosion protection problems • Critical analysis and use of principles, methods and working techniques for quantitative and qualitative evaluation of corrosion processes • Explanation and interpretation of principles and methods used in corrosion protection of industrial installations • Exploitation of corrosion protection technologies, monitoring corrosion processes, identify abnormal situations and propose solutions • Critical evaluation of processes, equipment, procedures and products used in corrosion protection

8. Content [10]

8.1 Course	Number of hours	Teaching methods [11]
1. Introduction. Definition of corrosion. Economic impact of corrosion	2	Presentation and discussion, active participation to discussions, demonstration, problem-solving, electronic resources available at cv.upt.ro
2. Thermodynamic aspects of corrosion processes: galvanic cells, change of Gibbs free energy, corrosion tendency, Pourbaix diagrams, corrosion potential, corrosion rate. Calculation of corrosion rate.	6	
3. Kinetics of corrosion processes: polarization, Evans diagrams. Calculation of corrosion rates from polarization data.	3	
4. Corrosion mechanisms: homogeneous and heterogeneous corrosion mechanism. Factors influencing corrosion rate.	6	
5. Types of corrosion damage: uniform and localized corrosion, pitting corrosion, stress cracking corrosion, types of corrosive environments (atmosphere, water, soil).	5	
6. Corrosion protection methods: Treatment of water and steam. Corrosion inhibitors. Electrochemical protection methods. Cathodic protection with impressed current or sacrificial anode. Anodic protection. Passivity of metals and alloys. Coatings	6	

Bibliography [12]

1. Vaszilcsin, N., Introducere în electrochimie, Editura Politehnica, Timisoara, 2009
2. Revie, R.W, Uhlig, H.H., Corrosion and Corrosion Control, John Willey&Sons, Hoboken New Jersey, 2008
3. Marcus, Ph., Corrosion mechanism in theory and practice, CRC Press, Boca Raton, 2012
4. Schweitzer, Ph.A., Fundamentals of corrosion: mechanism, causes and preventative methods, CRC Press, Boca Raton, 2010
5. Roberge, P.R., Corrosion Engineering: principles and practice, McGraw-Hill, New York, 2008

8.2 Applied activities [13]	Number of hours	Teaching methods
Laboratory	35	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 corrosion lab. Working safety rules. Reviewing the concepts of electrochemistry.	4	
2. Electrode reactions in corrosion: Hydrogen overpotential. *Influence of the electrode material on the polarization curves. *Extracting kinetic parameters from the Tafel equation	4	
3. Corrosion of metals: *Galvanic corrosion mechanism. *Recording of anodic and cathodic polarization curves. *Determination of corrosion rate by weight loss method.	4	
4. Corrosion of metals: *Polarization curves and determination of corrosion parameters using the potentiostat. *Corrosion of iron and stainless steel in sulfuric acid, hydrochloric acid and sodium chloride solutions. *Corrosion of copper in sulfuric acid and nitric acid solution. * Determination of corrosion rate from polarization data.	8	
5. Corrosion protection methods: *Anodic passivation of iron. *Influence of inhibitors of the corrosion rate of iron.	8	
6. Corrosion protection methods: *Impressed current cathodic protection of iron. *Protection against corrosion by coating surfaces. Galvanizing.	7	

[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.).

[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. M. Nemes, N.Vaszilcsin, A. Kellenberger, Electrochimie. Principii şi experienţe, Editura Politehnica Timisoara, 2009 2. R. Holze, Experimental electrochemistry: a laboratory textbook, Wiley-VCH, Weinheim, 2009 3. N.Vaszilcsin, M.Nemes, Introduction to electrochemistry by problems, 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 corrosion processes and mechanisms and corrosion protection methods	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 corrosion and corrosion protection methods; 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.L.dr.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.