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 / CAICON
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]	Catalysis in organic industry / DS						
2.2 Coordinator (holder) of course activities	S.L.dr.ing. Sabina NIȚU / S.L.dr.ing. Cristina PAUL						
2.3 Coordinator (holder) of applied activities[5]	S.L.dr.ing. Sabina NIȚU / S.L.dr.ing. Cristina PAUL						
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 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	0.78
3.4* Total number of hours partially assisted / semester	of which:	**3.5*** training		**3.6*** hours for diploma project elaboration	0.78
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			1.58
		hours of individual study after manual, course support, bibliography and notes			
		training seminars / laboratories, homework and papers, portfolios and essays			
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			11
		hours of individual study after manual, course support, bibliography and notes			11
		training seminars / laboratories, homework and papers, portfolios and essays			22
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	•

[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	•

5. Conditions (where applicable)

5.1 of the course	• Classroom equipped with blackboard, projector and computer • Students will not attend lectures with mobile phones on • Loitering will not be tolerated, as it is disruptive to the educational process.
5.2 to conduct practical activities	• Functional UV-VIS Spectrophotometer • Functional Gas Chromatograph • Students will participate in the laboratory work in lab coats and will document the current session's laboratory work.

6. Specific competencies acquired through this discipline

Specific competencies	• Understand the concept of catalytic system, mode of action in a chemical reaction, catalyst/biocatalyst lifetime, deactivation and regeneration mechanisms. • Understand the main characteristics of catalysts: catalytic activity, selectivity, enantioselectivity and resistance to deactivation. • Use of the main types of catalytic processes and catalysts. • Apply engineering knowledge to organic chemical and enzymatic processes. • Use of analysis and characterization methods specific to organic chemical and enzymatic catalysis.
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	• The general objective of the discipline is the knowledge of the main aspects of industrial catalysis - organic chemistry and enzymatic
7.2 Specific objectives	• Knowledge of types of industrial catalytic systems • Knowledge of processes for obtaining catalysts • Knowledge of catalyst deactivation pathways • Training skills to test and characterize a catalyst/biocatalyst • Understanding enzyme immobilization and its use in industrial processes

8. Content [10]

8.1 Course	Number of hours	Teaching methods [11]

[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.).

Fundamentals – catalysts, catalytic reactions, catalytic activity, selectivity. Structural and textural catalytic promoters, cocatalysts Types of catalytic systems – homogeneous, heterogeneous, with fixed catalyst bed, with fluidized catalyst bed, with interphase transfer, in suspension, with biocatalysts	2	Interactive teaching with video support
Supported catalysts. Types of catalytic supports, specific surface area, porosity, average pore radius distribution. Obtaining catalysts by precipitation Obtaining catalysts by impregnation	2	
Skeletal Raney catalysts – characteristics, preparation, applications Supported metal catalysts for hydrogenation	2	
Catalyst deactivation pathways – coking and regeneration of coked catalysts, poisoning of catalysts, sintering of the catalytically active metal	2	
Reduction of the catalytic system activity by mechanical erosion of the fluidized bed catalyst and settling of the fixed catalyst bed. Recovery of the catalytically active metal from the catalytic support according to its nature.	1	
Catalysis with interphase transfer	2	
The study of some industrial catalytic chemical processes	3	
Enzyme catalysts - classification, coding and nomenclature	2	
Structure and specificity of enzymes	2	
Industrial production of enzyme catalysts	2	
Improving the properties of enzyme catalysts by immobilization	4	
Industrial use of enzymes	4	

Bibliography [12] [13] 1. R.J.Farrauto şi C.H. Bartholoew*, Fundamentals of Industrial Catalytic Processes*, Blackie A&P, Londra, 2000
2. Ch. N Satterfield, Heterogeneous Catalysis in practice, McGraw Hill, New York, 1992
3. S. Nițu, Universitatea Politehnica Timișoara, course support, 2020
4. C. Dăescu, Produse de bio- şi semisinteză, Editura Politehnica, Timişoara, 2006
5. F. Peter, Biotransformări enzimatice, Editura Politehnica, Timişoara, 2005.
6. A. Illanes (Editor), *Enzyme biocatalysis: principles and applications*, Springer Verlag, Heidelberg, 2008

8.2 Applied activities [14]	Number of hours	Teaching methods
Labor protection training of labor protection and PSI (prevention and firefighting) specific to the laboratory. Presentation of laboratory works	2	Presentation and explanation of the principle and method of carrying out the works, as well as the interpretation of the results and the calculation of work yields
Carrying out a chemical reaction using ion exchange resin catalysts and respectively a soluble acid catalyst. Comparison of results	4	
Obtaining a Raney-type skeletal catalyst;	4	
Obtaining a supported catalyst by precipitation. Obtaining a catalyst supported by impregnation	4	
Obtaining an insoluble enzyme catalyst by adsorption	4	
Immobilization by cross linking	4	
Immobilization by sol-gel entrapment	4	
Determination of the activity of the enzyme preparations obtained	2	

Bibliography [15] 1. Sabina-Violeta Niţu, “Procese tehnologice chimice - calcule şi lucrări practice”, Editura POLITEHNICA, Timișoara, 2016, ISBN: 978-606-350-081-7.
2. Ana Cristina Paul, *Biotehnologii în industria alimentară. Lucrări Practice*. Editura Politehnica, 2018
3. G. Preda, F. Peter, M. Dragomirescu, *Biocatalizatori enzimatici. Obținere, caracterizare, aplicații. Editura Mirton*, Timișoara, 2003.

[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] Cel puțin un un titlu trebuie să aparțină colectivului disciplinei iar cel puțin un titlu trebuie să se refere la o lucrare de referință pentru disciplină, de circulație națională și internațională, existentă în biblioteca UPT.
[14] 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".
[15] At least one title must belong to the discipline team.

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 subject was developed in consultation with decision-makers in the business sector.

10. Evaluation

Type of activity	**10.1** Evaluation criteria [16]	**10.2** Evaluation methods	**10.3** Share of the final grade
10.4 Course	Acquiring the main principles and aspects of industrial catalytic processes	Knowledge verification is done through a written exam (3 hours) based on knowledge verification topics and comparative process analysis topics	0,66
10.5 Applied activities	**S:** Delivery of reports with results and conclusions for the works performed. Obtaining experimental results comparable to standard ones.	Partial verification during the course. Discussions of the teaching staff with the students and the correction of the works reports	0,34
	L:		
	P[17]**:**		
	Pr:		
10.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified [18])			
• 60% of the subjects must be solved correctly • At least grade 5 in each written evaluation must be obtained to pass the subject. • Teaching the results of practical laboratory work, thus demonstrating the mastery of the knowledge of the work.			

Date of completion	**Course coordinator (signature)** Ș.L.dr.ing. Sabina-Violeta NIȚU / Ș.L.dr.ing. Ana Cristina PAUL	**Coordinator of applied activities (signature)** Ș.L.dr.ing. Sabina-Violeta NIȚU / Ș.L.dr.ing. Ana Cristina PAUL
Head of Department (signature) S.L.dr.ing. Andra TĂMAȘ	**Date of approval in the Faculty Council** [19]	**Dean (signature)** Ș.L.dr.ing. Mircea DAN

[16] 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.)

[17] 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.

[18] It will not explain how the promotion mark is awarded.

[19] The endorsement is preceded by the discussion of the board's view of the study program on the discipline record.