

SYLLABUS

1. Information about the program

1.1 Higher education institution	Politehnica University Timisoara
1.2 Faculty ¹ / Department ²	Industrial Chemistry and Environmental Engineering / 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	Design and modeling of chemical reactors / DS						
2.2 Coordinator (holder) of course activities	Ș.I.dr.ing. Pană Ana-Maria						
2.3 Coordinator (holder) of applied activities ⁵	Ș.I.dr.ing. Pană Ana-Maria						
2.4 Year of study ⁶	IV	2.5 Semester	7	2.6 Type of evaluation	E	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	4.5 of which:	3.2 course	2	3.3 seminar / laboratory / project	0/1/1
3.1* Total number of fully assisted hours / semester	63 of which:	3.2* course	35	3.3* seminar / laboratory / project	0/1/4/1/4
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	4.43 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			1.4/3
		hours of individual study after manual, course support, bibliography and notes			1.5
		training seminars / laboratories, homework and papers, portfolios and essays			1.5
3.7* Number of hours of unassisted activities / semester	62 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			20
		hours of individual study after manual, course support, bibliography and notes			21
		training seminars / laboratories, homework and papers, portfolios and essays			21
3.8 Total hours / week ⁹	8.93				
3.8* Total hours /semester	125				
3.9 Number of credits	5				

4. Prerequisites (where applicable)

4.1 Curriculum	<ul style="list-style-type: none"> Physical Chemistry, Transfer phenomena (Hydrodynamics, Heat Transfer, Mass transfer), Chemical Kinetics, Automation of processes in Chemical industry
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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	<ul style="list-style-type: none"> • Basic knowledge in the field of chemical engineering
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5. Conditions (where applicable)

5.1 of the course	<ul style="list-style-type: none"> • Classroom provided with writing board and videoprojector
5.2 to conduct practical activities	<ul style="list-style-type: none"> • Laboratory class equipped with experimental assemblies and laboratory class provided with computers and adequate software, respectively

6. Specific competencies acquired through this discipline

Specific competencies	<ul style="list-style-type: none"> • Ability to acknowledge the types of reactors used in chemical engineering and their proper handling. • Mathematical modeling of reactors for quantitative assessment of chemical transformation of species depending on the type of equipment. • Identification of proper reactor type and its dimension assessment.
Professional competencies ascribed to the specific competencies	<ul style="list-style-type: none"> • - 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	<ul style="list-style-type: none"> • - 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	<ul style="list-style-type: none"> • The main objective resides in development of students' know-how in the design and analysis of different types of reactors
7.2 Specific objectives	<ul style="list-style-type: none"> • Ability to identify different types of reactors. • Design of a reactor based on energy and mass balance. • Identification of different flow patterns. • Mathematic modeling of main working parameters for chemical reactors.

8. Content ¹⁰

8.1 Course	Number of hours	Teaching methods ¹¹
Chemical reactions on an industrial scale. Basics on stoichiometry, thermodynamics and chemical kinetics. Thermal effect of chemical and biochemical reactions. Reactors classification.	6	Interactive teaching skills, lecture, demonstration, problem solving, cooperation teaching. Video-projector lecture and black-board explanations for knowledge consolidation.
Types of flow and shuffle regimes in chemical reactors. Homogeneous reactors. Mathematical modeling of flow regime	4	
Homogeneous reactors. Classification. Continuously stirred tank reactors and plug flow reactors. Batch reactor. Reactors with non-ideal flow. Mass and heat balance in steady-state and continuous flow. Reactor efficiency assessment.	4	
Heterogeneous catalytic reactors. Types of catalysts, chemical	6	

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.).

kinetics in heterogeneous reactors, mass and energy balance. Types of catalytic reactors: fixed bed, fluidized bed and tri-phasic operation. Catalyst deactivation.		
Gas-liquid reactors. Gas-liquid kinetics at industrial scale. Types of gas-liquid reactors, mass and energy balances.	6	
Operation of different types of reactors in chemical industry. Mathematical modeling and design–Case studies	9	

Bibliography ¹² ¹³ 1. Bozga G., Muntean O., Reactoare chimice, Editura Tehnică, București, 2000
2. Todinca T., Geantă M., Modelarea și simularea proceselor chimice. Aplicații în Matlab, Editura Politehnica, Timișoara, 1999
3. Todinca T., Pană A., Dumitrel G.A., Reactoare în industria chimică, note de curs, disponibil online, <https://cv.upt.ro/course/view.php?id=3629>
4. Froment G., Bischoff K.B., De Wilde J., Chemical Reactor Analysis and Design, 3rd Edition, Wiley and Sons, 2011
5. Smith R. Chemical Process Design and Integration, Wiley and Sons, 2005
6. Mandenius C.F., Bioreactors: Design, Operation and Novel Applications, Wiley VCH, Weinheim Germany, 2016
7. Bailey J.A., Ollis D.F., Biochemical Engineering Fundamentals, McGraw Hill, 1986

8.2 Applied activities ¹⁴

	Number of hours	Teaching methods
Safety working measures in the laboratory. Types of reactors. Continuous flow and batch operation. Independent stoichiometric reactions. Numerical applications	4	Mathematical modeling of chemical reactors using specific software (Matlab). Experimental stand displaying continuous flow reactors and batch reactors.
Mathematical model of a real reactor (Chollette-Cloutier model). Mathematical model of three continuous stirred tank reactors cascade. Experimental assessment and Matlab simulation.	6	
Thermal effect of catalytic chemical reactions. Numerical application for fixed bed reactor.	4	
Project: Modeling and simulation of chemical reactors. Case studies: batch, continuous stirred and plug-flow reactors, fixed bed catalytic reactors	14	

Bibliography ¹⁵ 1. Todinca T., Geantă M., Modelarea și simularea proceselor chimice. Aplicații în Matlab, Editura Politehnica, Timișoara, 1999
2. Todinca T., Pană A., Dumitrel G.A., Reactoare în industria chimică, note de curs, disponibil online,
3. Matlab, Simulink & Toolboxes, Mathworks Inc, 2008
4. Muntean O., Woinarowschy A., Bozga G., Aplicații la calculul reactoarelor chimice, Editura tehnică, București, 1984

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 syllabus is developed according to the requirements in the chemical engineering field, being similar to other disciplines from Romanian universities and abroad.
- The syllabus was written considering the requirements and expectations of the employers in the field. These aspects were identified during discussions between Chemical Engineering Board members; economical environment is well represented with distinguished representatives among this Board.
- The competencies acquired will be of great use for employes working in chemical plants, but also in research and development facilities, including design of chemical equipment.

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.

10. Evaluation

Type of activity	10.1 Evaluation criteria ¹⁶	10.2 Evaluation methods	10.3 Share of the final grade
10.4 Course	Fundamentals of chemical dimensioning, mass and energy balance assessment depending on the process flow and reactor type	Written examination	0.5
10.5 Applied activities	S:		
	L: Applicative activities attendance. Mathematical modeling of reactors using Matlab	Quiz	0.25
	P¹⁷: Dimensioning a reactor using mathematical modeling in Matlab	Power point presentation of obtained results	0.25
	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)			
<ul style="list-style-type: none">• Basic knowledge in the field of chemical/biochemical reactors;• Attendance at all laboratory sessions and successful project presentation.			

Date of completion

**Course coordinator
(signature)**

Ş.I.dr.ing. Pană Ana-Maria

**Coordinator of applied activities
(signature)**

Ş.I.dr.ing. Pană Ana-Maria

**Head of Department
(signature)**

S.L.dr.ing. Andra TĂMAŞ

Date of approval in the Faculty Council ¹⁹

**Dean
(signature)**

Ş.I.dr.ing. Micea-Laurenţiu 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.