

# SYLLABUS

## 1. Information about the program

1.1 Higher education institution	Politehnica University Timisoara
1.2 Faculty <sup>1</sup> / Department <sup>2</sup>	Chemical Engineering, Biotechnologies and Environmental Protection / CAICON
1.3 Field of study (name/code <sup>3</sup> )	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 <sup>4</sup>	Transfer Phenomena II. Heat Transfer / DD						
2.2 Coordinator (holder) of course activities	S.L.dr.ing. Andra TĂMAȘ						
2.3 Coordinator (holder) of applied activities <sup>5</sup>	S.L.dr.ing. Andra TĂMAȘ						
2.4 Year of study <sup>6</sup>	III	2.5 Semester	5	2.6 Type of evaluation	E	2.7 Regime of discipline <sup>7</sup>	DI

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

3.1 Number of fully assisted hours / week	4 of which:	3.2 course	2	3.3 seminar / laboratory / project	0/1/1
3.1* Total number of fully assisted hours / semester	56 of which:	3.2* course	28	3.3* seminar / laboratory / project	0/14/14
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			
		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			
		hours of individual study after manual, course support, bibliography and notes			
		training seminars / laboratories, homework and papers, portfolios and essays			
3.8 Total hours / week <sup>9</sup>	7.14				
3.8* Total hours /semester	100				
3.9 Number of credits	4				

## 4. Prerequisites (where applicable)

4.1 Curriculum	• Mathematics, Physics
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<sup>1</sup> The name of the faculty which manages the educational curriculum to which the discipline belongs

<sup>2</sup> The name of the department entrusted with the discipline, and to which the course coordinator/holder belongs.

<sup>3</sup> The code provided in HG - on the approval of the Nomenclature of fields and specializations / study programs, annually updated.

<sup>4</sup> 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).

<sup>5</sup> Application activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr).

<sup>6</sup> Year of studies in which the discipline is provided in the curriculum.

<sup>7</sup> 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).

<sup>8</sup> 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:  $(3.1) + (3.4) \geq 28$  hours / wk. and  $(3.8) \leq 40$  hours / wk.

<sup>9</sup> 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	•
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## 5. Conditions (where applicable)

5.1 of the course	<ul style="list-style-type: none"> <li>• Appropriately equipped classroom – blackboard, video projector, internet connection</li> </ul>
5.2 to conduct practical activities	<ul style="list-style-type: none"> <li>• Appropriately equipped laboratory. The students must be dressed with their lab coats and their mobile phones must be switched off. They will be trained and will respect the rules of labor protection and PSI</li> </ul>

## 6. Specific competencies acquired through this discipline

Specific competencies	<ul style="list-style-type: none"> <li>• Knowledge of conservation relations – mass and energy balances</li> <li>• Description of the basic methods by which heat transfer is carried out, calculation of specific thermal resistances</li> <li>• Knowing how to calculate the average temperature difference between two fluids; types of heat exchangers used in the chemical industry</li> <li>• Choosing the right type of heating/cooling agent.</li> </ul>
Professional competencies ascribed to the specific competencies	<ul style="list-style-type: none"> <li>• - Analyse production processes for improvement;</li> <li>• - Manage chemical testing procedures;</li> <li>• - Test materials;</li> <li>• - Write technical reports</li> <li>• -Performs chemical experiments</li> <li>• -Approve engineering design</li> <li>• -Assess environmental impact</li> </ul>

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	<ul style="list-style-type: none"> <li>• Ensuring the acquisition of basic knowledge regarding heat transfer in chemical and biochemical engineering.</li> </ul>
7.2 Specific objectives	<ul style="list-style-type: none"> <li>• Ability to design a heat exchanger/evaporator/condenser based on energy and mass balance.</li> <li>• Identifying the ways of heat transmission.</li> </ul>

## 8. Content<sup>10</sup>

8.1 Course	Number of hours	Teaching methods <sup>11</sup>
1.Introductory notes: the driving force of heat transfer processes, the general relations for the calculation of transferred heat, ways of heat transfer – conduction, convection, radiation, thermal resistances.	2	Participatory lecture

<sup>10</sup> 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 "(\*)".

<sup>11</sup> Presentation of the teaching methods will include the use of new technologies (e-mail, personalized web page, electronic resources etc.).

2.Heat transfer by conduction: conductive heat transfer equations, thermal conductivity, hydraulic modeling of conductive heat transfer. Heat transfer by conduction through plane, cylindrical and spherical walls.	4	
3.Heat transfer by convection: Fourier-Kirchhoff differential equation, heat transfer coefficient, criterial relations, dimensionless criteria specific to heat transfer. Particular cases of heat transfer by convection. Boiling and condensation.	7	
4.Heat transfer by radiation: laws of radiation, heat transferred by radiation, absolute black body, shielding effect.	2	
5.Heat exchangers: total heat transfer coefficient, thermal diagrams for the calculation of average temperature difference, construction and operation of heat exchangers and their thermal dimensioning.	7	
6.Simple and multiple evaporation. Types of evaporators.	3	
7.Heat production and transport. Heat carriers.	3	
Bibliography <sup>12</sup> 1.Em.A.Bratu – Operații unitare în ingineria chimică, vol.II, Ed. Tehnică, București, 1984 2.Z. Groșșian, M.Medeleanu, D. Kohn, Fenomene de transfer și utilaje în industria chimică-Procese termice, Litografia IPTV Timisoara, 1985 3.L. Gabor, D. Gabor, Transfer termic în ingineria chimică, Ed. Politehnica, Timișoara, 2002 4. L. Gavrilă, Fenomene de transfer, vol. I și II, Ed. Alma Mater, Bacău, 2000 5.H. Necula, A. Badea, C. Ionescu, Schimbătoare de căldură compacte, Ed. A.G.I.R., 2006 6. Agrawal S.K., Heat and Mass Transfer, Anshan Limited UK, 2005 7. J.H.Lienhard IV, J.H.Lienhard V, A Heat Transfer Handbook, 3rd ed. Phlogiston Press, Cambridge, 2003.		
<b>8.2 Applied activities</b> <sup>13</sup>	Number of hours	Teaching methods
<b>Laboratory</b> – 1. Heat transfer modeling by hydraulic analogy. The hydraulic integrator	2.5	Participatory lecture
2. Heat transfer by conduction	2	
3. Experimental determination of the partial and total heat transfer coefficients for air	3	
4. Thermal dimensioning of heat exchangers – double pipe, shell and tube, finned tube heat exchanger	4	
5. The evaporation of aqueous solutions	2.5	
<b>Project</b> – 1. Thermal dimensioning of a multitubular heat exchanger	7	Discussing the project theme, collecting the various data (physical properties, mechanical dimensions, standards) necessary to perform calculations, interpreting the obtained results
2. Thermal dimensioning of a chemical reactor equipped with stirrer and shell or coil for heating/cooling.	7	

<sup>12</sup> 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.

<sup>13</sup> 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<sup>14</sup>
1. A. Tămaş, Transfer termic cu aplicații în ingineria chimică, Ed. Politehnica, Timișoara, 2014
  2. Pavlov K.P., Romankov P.G., Noskov A.A., Procese și aparate în ingineria chimică - Exerciții și probleme, Ed. Tehnică, București, 1981
  3. J.R. Perry, D.W. Green, Perry's Chemical Engineer's Handbook, 7th Ed., Mc Graw-Hill International Edition, New York, 1998
  4. O. Floarea, G. Jinescu, C. Balaban, P. Vasilescu, R. Dima, Operații și utilaje în industria chimică-Probleme, Ed. Didactica și Pedagogica, București, 1980.
  5. \*\*\*, Manualul inginerului chimist, Ed. Tehnică, București, 1956.

**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 topic of the subject is correlated with the curriculum of the corresponding subjects from other faculties in the country and abroad.

**10. Evaluation**

Type of activity	10.1 Evaluation criteria <sup>15</sup>	10.2 Evaluation methods	10.3 Share of the final grade
10.4 Course	Checking the correct and complete acquisition of the basic theoretical notions, the coherence, the logical correlation of the notions, the degree of involvement	Written exam lasting 3 hours. Half of the time is allocated to solving the applications, and the other half to the treatment of theoretical subjects.	60%
10.5 Applied activities	<b>S:</b>		
	<b>L:</b> The ability to operate with the notions learned in the course, the ability to calculate and interpret the obtained results, conscientiousness and seriousness	Checking the reports that include the experimentally determined data, the related calculations and the interpretation of the results, for each laboratory work performed. The interest shown by the student for the experimental determinations is counted. The grade for the laboratory activity represents 50% of the grade for the course activity.	20%
	<b>P<sup>16</sup>:</b> Calculation skills, the ability to search/use the necessary data in the bibliography provided, rigor and correctness in writing the material, coherent and correct presentation of the project.	The correctness of the calculations, the use of measurement units, the way of writing, the method of citing the references, the general aspect of the project are checked. Each student presents his project in front of the teaching staff and colleagues. The grade for the project represents 50% of the grade for the activity during the semester.	20%
	<b>Pr:</b>		
<b>10.6 Minimum performance standard</b> (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified <sup>17</sup> )			
<ul style="list-style-type: none"> <li>• Minimum passing condition: performance of all laboratory work, elaboration and support of the project, minimum grade 5 in the laboratory, minimum grade 5 in the project, minimum grade 5 in the written exam.</li> </ul>			

**Date of completion**

**Course coordinator  
(signature)**

Ș.L.dr.ing. Andra TĂMAȘ

**Coordinator of applied activities  
(signature)**

Ș.L.dr.ing. Andra TĂMAȘ

**Head of Department  
(signature)**

S.L.dr.ing. Andra TĂMAȘ

**Date of approval in the Faculty Council<sup>18</sup>**

**Dean  
(signature)**

Ș.L.dr.ing. Mircea Laurențiu DAN

<sup>14</sup> At least one title must belong to the discipline team.

<sup>15</sup> 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.)

<sup>16</sup> 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.

<sup>17</sup> It will not explain how the promotion mark is awarded.

<sup>18</sup> The endorsement is preceded by the discussion of the board's view of the study program on the discipline record.