# SYLLABUS

## 1. Information about the program

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| **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

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|---|---|---|---|---|---|---|---|
| **2.1** Name of discipline/ formative category[4] | | | Technological process optimization / DD | | | | |
| **2.2** Coordinator (holder) of course activities | | | Prof.dr.ing. Gabriela-Alina DUMITREL | | | | |
| **2.3** Coordinator (holder) of applied activities[5] | | | Ş.l.dr.ing. Pană Ana-Maria | | | | |
| **2.4** Year of study[6] | III | **2.5** Semester | 6 | **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]

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|---|---|---|---|---|---|
| **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 | 4.93 of which: | additional documentary hours in the library, on the specialized electronic platforms and on the field | | | 1 |
| | | hours of individual study after manual, course support, bibliography and notes | | | 1.93 |
| | | training seminars / laboratories, homework and papers, portfolios and essays | | | 2 |
| **3.7*** Number of hours of unassisted activities / semester | 69 of which: | additional documentary hours in the library, on the specialized electronic platforms and on the field | | | 14 |
| | | hours of individual study after manual, course support, bibliography and notes | | | 27 |
| | | training seminars / laboratories, homework and papers, portfolios and essays | | | 28 |
| **3.8 Total hours / week** [9] | 8.93 | | | | |
| **3.8* Total hours /semester** | 125 | | | | |
| **3.9 Number of credits** | 5 | | | | |

## 4. **Prerequisites** (where applicable)

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| **4.1** Curriculum | • Physical Chemistry, Hydrodynamics, Heat and mass transfer, Automation in chemical industry |

[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.

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| **4.2** Competencies | • Basic knowledge in the field of chemical and biochemical engineering |

**5. Conditions** (where applicable)

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| **5.1** of the course | • Classroom provided with writing board, internet access and video-projector |
| **5.2** to conduct practical activities | • Laboratory class provided with computers and adequate software |

**6. Specific competencies** acquired through this discipline

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| Specific competencies | • Development of mathematical models which describe equipment or technological installation functioning from chemical and biochemical industry.<br>• Use of programing skills specific for Matlab software.<br>• The ability to recognize the steps and methods of the optimization process.<br>• Solving real optimization problems for obtaining an optimal solution from economic, environmental and technological point of view. |
| Professional competencies ascribed to the specific competencies | • - Analyse production processes for improvement;<br>• - Manage chemical testing procedures;<br>• - Test materials;<br>• - Write technical reports<br>• -Performs chemical experiments<br>• -Approve engineering design<br>• -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)

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| **7.1** The general objective of the discipline | • The general objective of this discipline is to introduce students to the optimization steps and methods applied in chemical/biochemical technology and to familiarize them with the specific software Matlab, respectively |
| **7.2** Specific objectives | • Understanding the steps of an optimization process.<br>• Knowledge of Matlab programing language and theoretical and practical modeling and simulation notions for the chemical processes.<br>• Knowledge of numerical methods applied in mathematical modeling of different equipment and technological processes.<br>• Acquisition of necessary elements for solutioning real optimization problems. |

**8. Content** [10]

| **8.1** Course | Number of hours | Teaching methods [11] |
|---|---|---|
| Definition of technological process optimization. Steps in optimization of a technological process | 4 | Interactive teaching skills, lecture, demonstration, |
| Analytical mathematical models: balance frontiers, dynamic or | 2 | |

[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.).

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| stationary operation. | | problem solving, cooperation teaching. Video-projector lecture and black-board explanations for knowledge consolidation. |
| Analytical mathematical models: mass and energy balance of a technological installation | 2 | |
| Analytical mathematical models. Case studies: variable flow hydraulic tank, continuously stirred tank reactor, absorber, distillation column | 4 | |
| Elaboration of experimental mathematical model in stationary status. Regression analysis considering one or several independent variables. | 4 | |
| Scope function. Optimization methods and criteria. Classification | 4 | |
| Numerical optimization methods for scope functions depending on one independent variable (Golds section method, Equi-distant method, etc.) | 4 | |
| Numerical optimization methods for scope functions depending on several independent variables (Box method, Gradient method, Successive variation of variables | 4 | |
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Bibliography [12] 1. Nocedal J., Wright S.J., Numerical Optimization, 2nd Edition, Springer, 2006
2. Todinca T., Geantă M., Modelarea şi simularea proceselor chimice. Aplicaţii în Matlab, Editura Politehnica, Timişoara, 1999
3. Todinca T., Pană A., Dumitrel G.A., Optimizarea proceselor chimice, note de curs, disponibil online, https://cv.upt.ro/course/view.php?id=3628
4. Lucaci M., Agachi S., Optimizarea proceselor din industria chimică, Editura Tehnică, Bucureşti, 2002
5. Edgar T.F., Himmelbrau D.M., Optimization of chemical processes, McGraw Hill, New York, 2001

| **8.2** Applied activities [13] | Number of hours | Teaching methods |
|---|---|---|
| Safety measures in the software laboratory. Matlab software. Variables, matrix, vectors. 2D and 3D graphics in Matlab. Function m-files. Logical function | 4 | Optimization of chemical/biochemical industrial processes using specific software (Matlab). |
| Mathematical models of equipment used in chemical and biochemical industry. Solving differential equations by numerical methods. Case studies: Euler algorithm. Ode solvers in Matlab | 6 | |
| Mathematical model of continuously stirred tank reactor. Solving non-linear equations system by numerical methods. | 4 | |
| Linear and non-linear mathematical models. Solving linear and non-linear regression equations in Matlab | 8 | |
| Optimization methods. Finding the minimum value of functions depending on one variable or several variables, respectively. Optimization toolbox in Matlab | 6 | |
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Bibliography [14] 1. Todinca T., Geantă M., Modelarea şi simularea proceselor chimice. Aplicaţii în Matlab, Editura Politehnica, Timişoara, 1999
2. The Matthworks INC, Optimization Toolbox. User's guide. Version 3, Natick, USA, 2007
3. Palm W.J., Introduction to Matlab for Engineers, 3rd Edition, McGraw Hill, 2011

**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**

[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".
[14] At least one title must belong to the discipline team.

- The syllabus is developed according to the requirements in the chemical/biochemical 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; the economic environment is well represented with distinguished representatives on 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.

**10. Evaluation**

| Type of activity | **10.1** Evaluation criteria [15] | **10.2** Evaluation methods | **10.3** Share of the final grade |
|---|---|---|---|
| **10.4** Course | Knowledge of fundamentals in optimization of technological processes | Written examination | 0.66 |
| **10.5** Applied activities | **S:** | | |
| | **L:** Attendance to applicative activities. Knowledge of optimization software used in chemical industry (Matlab) | Quiz | 0.34 |
| | **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]) | | | |
| • Basic knowledge in optimization of technological processes;<br>• Attendance at all laboratory sessions. | | | |

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| **Date of completion** | **Course coordinator (signature)**<br>prof.dr.ing. Dumitrel Gabriela-Alina | **Coordinator of applied activities (signature)**<br>Ş.l.dr.ing. Pană Ana-Maria |
| **Head of Department (signature)**<br>S.L.dr.ing. Andra TĂMAȘ | **Date of approval in the Faculty Council** [18] | **Dean (signature)**<br>Ș.L.dr.ing. Mircea Laurențiu DAN |

[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.