COURSE DESCRIPTION

Process Modelling and Artificial Intelligence

Academic year 2026 - 2027

1. Programme-related data

1.1. Higher Education Institution	Babeș-Bolyai University
1.2. Faculty	Faculty of Chemistry and Chemical Engineering
1.3. Department	Department of Chemical Engineering
1.4. Field	Chemical Engineering
1.5. Level of study	Master
1.6. Degree programme / Qualification	Advanced Chemical Process Engineering
1.7. Form of education	Full time education

2. Course-related data

2.1. Course title	**Process Modelling and Artificial Intelligence**				Course code	**CME7312**
2.2. Course coordinator	Assoc. Prof. Dr. Eng. Elisabeta Cristina Timis					
2.3. Seminar coordinator	Assoc. Prof. Dr. Eng. Elisabeta Cristina Timis					
2.4. Year of study	I	2.5. Semester	1	2.6. Type of assessment	Exam	
2.7. Course status		Compulsory		2.8. Course type	Core subject	

3. Total estimated time (hours per semester of teaching activities)

3.1. Number of hours per week	**4**	of which: 3.2. course	2	3.3. laboratory	2
3.4. Total of hours in the curriculum	56	of which: 3.5. course	28	3.6. laboratory	28
Time allocation for individual study (IS) and self-taught activities (ST)					**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)					25
Additional research in the library, on subject-specific electronic platforms, and on-site					18
Preparing laboratories/ projects, assignments, reports, portfolios, and essays					20
Tutoring (professional guidance)					3
Examinations					3
Other activities					-
3.7. Total hours of individual study (IS) and self-taught activities (ST)				**69**	
3.8. Total hours per semester				**125**	
3.9. Number of credits				**5**	

4. Prerequisites

4.1. curriculum-related	Basic science, mathematics, engineering knowledge (including systems theory, mass, heat, and momentum transfer phenomena, process control/automation, process kinetics, and thermodynamics)
4.2 skills-related	The use of Microsoft Office and programming in MATLAB English language knowledge

5. Specific conditions

5.1. course-related	• The course room must facilitate video-projection. • The course may take place on site or online, employing Microsoft Teams in the limits allowed by the University regulations. • Students must switch off the mobile phones during courses. • Audio and/or video recording during the course is not allowed. • Students are allowed to enter and exit at the courses anytime according to their needs; the active participation in courses contributes to the final evaluation.
5.2. laboratory-related	• The laboratory room must facilitate video-projection and workstations featuring

	MATLAB. • The laboratory activities may take place on site or online, employing Microsoft Teams, providing students use computers featuring MATLAB or use MATLAB online and in the limits allowed by the University regulations. • Students should switch off the mobile phones during laboratories. • Audio and/or video recording during the laboratory is not allowed. • Students should be present at the laboratories, as they are compulsory according to Art. 29 of "Statutul Studentului din Universitatea Babes-Bolyai", revised at 13.01.2013. • The deadline for presenting the homework/projects will be agreed between the lecturer and the students and tasks will be posted as Microsoft Teams Assignments. Delays are accepted in the cases when well-founded reasons are proven before the deadline. In case of presenting the homework with delay, the grade will be penalized (0.5p/week).

6.1. Competencies resulting from the completion of the degree programme *(as referred to in the curriculum)*

Professional competencies	
Competency code	**Competency**
PC1	Description, analysis and use of elaborate theories and concepts in the fields of chemistry and process advanced chemical engineering.
PC3	Development and use of mathematical models and simulators in process engineering for diagnosis of problems, analysis of optimum operating systems and control of (bio)chemical processes.
PC5	Identifying and defining a research theme in the field of chemical engineering process, elaboration and implementation of a plan for achieving the objectives proposed and valuing the scientific research results obtained.
Transversal competencies	
Competency code	**Competency**
TC1	Independent execution of complex professional assignments and autonomous development of project-research activities by using computer-assisted techniques and by observing the norms of professional ethics and moral conduct.

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)

Learning outcomes targeted by the subject		
Competency code	**Knowledge and comprehension**	**Specific academic skills**
PC1 **TC1**	1. Formulation of solutions to solve complex chemical engineering problems based on knowledge, identification and application of advanced concepts, methods and theories in the field of chemical engineering and chemistry	1. Critical analysis and application of advanced principles, methods, and techniques for the evaluation, design, and development of new products and technologies.
PC1 **PC3** **TC1**	2.Explain and understand the operation of devices, equipment and processes in the chemical process industries based on software environments that describe their behavior using complex analytical or statistical mathematical models.	2.Use of mathematical models for technological design and their implementation in automatic control systems, in order to obtain optimal solutions for economically and energetically operation, associated to low environmental impact.
PC5	3. Knowledge of scientific research strategies, setting the program of experiments and simulations, explanation and interpretation of the results for the elaboration of research projects	3. Use of fundamental and applied concepts of scientific investigation in order to develop research projects for the development of new products/technologies with practical applications

7. Subject-specific learning outcomes

Knowledge and comprehension
1. Explain and integrate advanced principles of process modelling for simple and complex chemical, biochemical, environmental and other process engineering systems, including lumped and distributed parameter systems, based on mass, energy, and momentum conservation laws and constitutive equations.
2. Demonstrate in-depth understanding of dynamic and steady-state models used to describe, analyse, and predict the behaviour of chemical engineering equipment and of (bio)chemical and environmental processes.
3. Explain the role, principles, and limitations of artificial intelligence techniques in modelling, simulation and decision support for process systems, highlighting their assumptions, strengths, limitations, and domains of applicability in process systems engineering.
4. Describe and justify scientific research strategies in process modelling and artificial intelligence, including problem formulation, experimental and simulation design, data processing, model calibration and validation, interpretation of results, and assessment of model reliability for engineering decision-making.
Specific academic skills
1. Formulate, implement, and analyse mathematical models of chemical, biochemical, environmental processes and other process engineering systems using professional software environments (e.g., MATLAB with Simulink, PDE Toolbox, AI toolboxes), using physical laws and data-driven methods, as appropriate.
2. Apply model analysis techniques (degrees of freedom analysis, stiffness, differential index, stability and sensitivity analysis) to assess model validity, solvability, and suitability for simulation, optimization, and control purposes.
3. Design, train, and implement AI-based models (e.g. ANN, fuzzy systems) for parameter estimation, process optimization, fault detection, and decision support in chemical, biochemical, environmental and other process engineering applications.
4. Critically evaluate modelling and AI approaches by comparing analytical, numerical, and data-driven solutions with respect to accuracy, robustness, computational effort, and applicability to real industrial processes.
5. Develop and apply modelling and optimization strategies aimed at improving model parameters and model performance.
6. Plan (including problem identification) and execute a mathematical modelling or AI-based mini-project, including data acquisition or generation, model development, calibration, verification, and interpretation of results using sound scientific and engineering judgement aligned with scientifically rigorous methods.
7. Communicate modelling assumptions, methodologies, results, and conclusions clearly and professionally, through technical reports, mathematical formulations, software models, and oral presentations in English.

8. Contents

8.1. Course	Teaching and learning methods	Remarks
8.1.1. Introduction to modelling. Modelling goal and model application areas. Modelling steps. Balance volumes for engineering applications. Scalar and vector fields. Intensive and extensive properties. Case studies.	Lecture, explanation, conversation, description, exemplification, problematization, debate	
8.1.2. Short comparison on the conventional process modelling and data-driven modelling. Conventional modelling. General formulation of the conservation principles: integral and differential form. Case studies.	Lecture, explanation, conversation, description, exemplification, problematization, debate	
8.1.3. A logical methodology to model development. Models' classification. Case studies.	Lecture, explanation, conversation, description, exemplification, problematization, debate	
8.1.4. Constitutive relationships in modelling. Transfer and reaction rates. Thermodynamics. Balance volume relations. Equipment and control relations. Case studies.	Lecture, explanation, conversation, description, exemplification, problematization, debate	
8.1.5. Modelling lumped parameter systems (LPS). The general conservation equation. Writing balance equations for the conservation of mass, energy, and momentum.	Lecture, explanation, conversation, description, exemplification, problematization, debate	
8.1.6. Modelling lumped parameter systems (DPS), part I. Balance volumes representation. General conservation equation for DPS. The use of microscopic balance volumes. Initial conditions. Boundary conditions. Case studies.	Lecture, explanation, conversation, description, exemplification, problematization, debate	
8.1.7. Modelling DPS, part II. Classification of DPS models. The use of coupled LPS models to represent DPS. Case study.	Lecture, explanation, conversation, description, exemplification, problematization, debate	

8.1.8. LPS and DPS model analysis. Analysis of ODE, DAE and PDE. Also, probably, one of the following: (a) PLS modelling of a complex system; (b) PCA and multivariate methods for fault detection.	Lecture, explanation, conversation, description, exemplification, problematization, debate	Expert in the field may be invited on site or online.
8.1.9. LPS and DPS model solving. Methods for solving ODE, DAE and PDE. Analytical vs. numerical solutions. Implementation. Also, probably, one of the following: (a) PLS modelling of a complex system; (b) PCA and multivariate methods for fault detection.	Lecture, explanation, conversation, description, exemplification, problematization, debate	Expert in the field may be invited on site or online.
8.1.10. Short introduction to AI. Turing test. Milestones in the field of AI. A selection of AI techniques and applications. Automated Reasoning. Models using fuzzy logic. Case Based Reasoning. Case studies.	Lecture, explanation, conversation, description, exemplification, problematization, debate	
8.1.11. Machine Learning (ML) introduction. Types of learning. ML Applications. ML in process systems engineering. Methodology.	Lecture, explanation, conversation, description, exemplification, problematization, debate	
8.1.12. Artificial Neural Networks (ANNs), part 1. Neuron. ANN structures. Building ANNs. ANN learning and generalization.	Lecture, explanation, conversation, description, exemplification, problematization, debate	
8.1.13. ANNs, part 2. Widely discussed applications of ANNs. Widespread types of ANNs and newer developments.	Lecture, explanation, conversation, description, exemplification, problematization, debate	
8.1.14. Automated Reasoning. Fuzzy Logic. Case Based Reasoning. Data mining (DM). Process engineering applications. Open-source DM software and applications.	Lecture, explanation, conversation, description, exemplification, problematization, debate	

Bibliography

1. Timis, E.C., 2026, Process Modelling and Artificial Intelligence: Microsoft PowerPoint slide show performed during course classes.
2. CAPE Centre, University of Queensland, Hungarian Academy of Sciences, 2013. Course CHEE3007: Process modelling and dynamics, available online: https://www.coursehero.com/sitemap/schools/2697-Queensland/courses/9008835-CHEE3007/, accessed on 02.04.2020.
3. Hangos K.M., Cameron I.T., 2001, Process Modelling and Model Analysis, Volume 4, 1st Edition, Academic Press, pp. 543.
4. Russell, S., Norvig, P., 2021. Artificial Intelligence: A Modern Approach 4th edition [AIMA], Pearson Education, http://aima.eecs.berkeley.edu/
5. Agachi, P.S., Cristea, V.M., Csavdari, A., Szilagyi, B., 2024. Advanced Process Engineering Control. Berlin, Boston: De Gruyter. https://doi.org/10.1515/9783110789737
6. Agachi, P.S., Cristea, V.M., Makhura, E., 2020. Basic Process Engineering Control. Berlin, Boston: De Gruyter. https://doi.org/10.1515/9783110647938
7. Agachi, P.S., Nagy, Z.K., Cristea, V.M., Imre-Lucaci, A., 2006, Model Based Control - Case Studies in Process Engineering, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.
8. Al Aani, S., Bonny, T., Hasan, S.W., Hilal, N., 2019, Can machine language and artificial intelligence revolutionize process automation for water treatment and desalination? Desalination, 258, 84-96.
9. Andasari, V. 2015. Numerical Methods and Modeling in Biomedical Engineering, Course at Boston University, http://people.bu.edu/andasari/courses/Fall2015/be503703Fall2015.html
10. Ani, E.C., 2009. Minimization of the experimental workload for the prediction of pollutants propagation in rivers. Mathematical modelling and knowledge re-use. Acta Universitatis Lappeenrantaensis 355, Lappeenrannan teknillinen yliopisto, Digipaino, Lappeenranta, Finland, pp. 189, available online: http://urn.fi/URN:ISBN:978-952-214-830-8
11. Awogbemi, O., Kallon, D.V.V., 2022. Application of Tubular Reactor Technologies for the Acceleration of Biodiesel Production. Bioengineering 9, 347. https://doi.org/10.3390/bioengineering9080347
12. Bagheri, M., Akbari, A., Mirbagheri, S.A., 2019. Advanced control of membrane fouling in filtration systems using artificial intelligence and machine learning techniques: A critical review, Process Safety and Environmental Protection, 123, 229-252.
13. Brunton, S.L. and Kutz, J.N., 2019, Data Driven Science & Engineering. Machine Learning, Dynamical Systems, and Control, University of Washington, pp. 552. https://databookuw.com/ and http://databookuw.com/databook.pdf Available also as video course by Brunton, S.L., 2022. Intro to Data Science (https://www.youtube.com/playlist?list=PLMrJAkhIeNNQV7wi9r7Kut8liLFMWQOXn); Control Bootcamp (https://www.youtube.com/playlist?list=PLMrJAkhIeNNR20Mz-VpzgfQs5zrYi085m)
14. Darmiana, M.D., Monfareda, S.A.H., Azizyana, G., Snyderb, S.A., Giesyd, J.P., 2018. Assessment of tools for protection of quality of water: Uncontrollable discharges of pollutants, Ecotoxicology and Environmental Safety, 161, 190–197.

15. Dincer I., Ezan M.A., 2018. Fundamental Aspects of Thermodynamics and Heat Transfer. In: Heat Storage: A Unique Solution for Energy Systems. Green Energy and Technology. Springer, Cham, 1-34.
16. Califf, M.E., 2010. Introduction to Artificial Intelligence, ITK 340, Course at Illinois State University.
17. Ceccaroni, L., 2008, Artificial Intelligence Introduction, Course at Universidad Politecnica de Cataluna.
18. desJardins, M., 2005. Principles of Artificial Intelligence. Course at University of Maryland, Baltimore, http://www.cs.umbc.edu/courses/graduate/671/fall05/slides/c1_intro.ppt
19. Finn, T., 2016. Introduction to Artificial Intelligence, Course at University of Maryland, Baltimore, https://www.csee.umbc.edu/courses/undergraduate/471/spring19/01/notes/01_introduction/01.pdf
20. Howard, P., 2005. Partial Differential Equations in MATLAB 7.0. Lecture Notes. Course at Texas A&M University, http://www.tem.uoc.gr/~marina/pdemat.pdf and also https://www.math.tamu.edu/~phoward/
21. Itti, L., 2005. Artificial Intelligence. Course at University of Southern California, http://iLab.usc.edu/classes/2005cs561
22. Ismini, L., 2017. Introduction to Deep Learning, http://times.cs.uiuc.edu/course/510f17/ppt/deep-learning.pptx, part of Zhai, Z.X., 2017, Advanced Information Retrieval, Course at University of Illinois at Urbana-Champaign, http://times.cs.uiuc.edu/course/510f17/schedule.html
23. Ling, W., 2017. Deep Neural Networks are our Friends, Oxford Deep NLP 2017 course, https://github.com/oxford-cs-deepnlp-2017/lectures/raw/master/Lecture%201b%20-%20Deep%20Neural%20Networks%20Are%20Our%20Friends.pdf
24. Liu, Y., Zhao, T., Ju, W., Shi, S., 2017. Materials discovery and design using machine learning, Journal of Materiomics, 3, 3, 159-177.
25. Maclin, R., 2001. Machine Learning, Course at University of Minnesota Duluth, https://www.d.umn.edu/~rmaclin/cs5751/index.html, text after Mitchell T., 1997, Machine Learning, McGraw Hill.
26. Maloof, M., 2017, Articial Intelligence: An Introduction, Course at Georgetown University.
27. Matuszek, P., 2010. Artificial Intelligence. Introduction and Intelligent Agents. Course at Villanova University, Philadelphia.
28. Pokutta, S., 2016. Machine Learning in Engineering Applications and Trends, NASA Workshop Machine Learning Technologies and Their Applications to Scientific and Engineering Domains Workshop, http://www.nianet.org/wp-content/uploads/2016/06/Pokutta_20160816_NASA.pdf
29. Sipos, A., Cristea, V.M., Mudura, E., Imre-Lucaci, A., Bratfalean, D., 2014, Modelarea, simularea si conducerea avansată a bioproceselor fermentative, Vol. II. Editura Universităţii "Lucian Blaga", Sibiu.
30. Subasi, A., 2011-2012, Machine Learning Course Introduction, International Burch University.
31. Visa, A., 2005. Neural Computation Introduction. Course at Tampere University of Applied Sciences, available online: http://www.cs.tut.fi/~avisa/2806nn1.ppt
32. Wei, J., Chu, X., Sun, X.Y, Xu, K., Deng, H.X., Chen, J., Wei, Z., Lei, M., 2019. Machine learning in materials science, InfoMat, 1, 338–358.
33. Welling, 2007. Introduction to AI, Course at University of California, Irvine, available online: http://www.ics.uci.edu/~welling/teaching/ICS171spring07/ICS171spring07.html
34. Yanikoglu, B., 2017. Machine Learning, Course at Sabanci University, Turkey, http://people.sabanciuniv.edu/berrin/cs512/lectures/ (1-ml-ch1-intro.pdf and 7-nn1-intro.ppt.pdf)
35. Zabihi, R., Mowla, D., Karami, H.R., 2019, Artificial intelligence approach to predict drag reduction in crudeoil Pipelines, Journal of Petroleum Science and Engineering 178, 586–593.
36. Zhang, Z., Qi, H., 2018. Neural Network Background, in Pattern Recognition, Course at University of Tennessee, Knoxville, http://web.eecs.utk.edu/~hqi/ece471-571/syllabus.htm and http://web.eecs.utk.edu/~qi/ece471-571/lecture16_nn_background.pptx

Other online resources

37. http://aima.eecs.berkeley.edu/slides-pdf/
38. http://www.alanturing.net/turing_archive/pages/Reference%20Articles/TheTuringTest.html
39. https://plato.stanford.edu/entries/turing-test/

Note. Bibliography items may be found at one of the following: (1) the "Lucian Blaga" Central Library of Babes-Bolyai University; (2) online on the scientific databases available from the intranet of Babes-Bolyai University and "Lucian Blaga" Central Library; (3) online using specified links; (4) online on the Microsoft Teams group dedicated to the discipline.

8.2. Laboratory	**Teaching and learning methods**	**Remarks**
8.2.1. Getting knowledge on MATLAB functions and s-functions. Getting knowledge on Simulink. Recap model writing and programming in MATLAB, including Simulink.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	
8.2.2. Write and solve functions for systems with 1 and 2 ODE. Implement in parallel in MATLAB and Simulink. Compare results.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	

8.2.3. Application of the model development logical methodology to LPS, part I: e.g., liquid accumulation in a tank; continuous stirred tank reactor (CSTR) systems; evaporator.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	
8.2.4. Application of the model development logical methodology to LPS, part II: e.g., liquid accumulation in a tank; continuous stirred tank reactor (CSTR) systems; evaporator	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	
8.2.5. Application for modelling DPS, part I. The use of MATLAB PDE Toolbox, pdepe solver for 1D dynamic PDE (FEM). The 1D heat transfer in a long metal rod. 1D modelling of a system with 2 output variables.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	
8.2.6. Application for modelling DPS, part II. The use of MATLAB PDE Toolbox with GUI Interface for 2D PDE. Models of heat equation in a metal plate and along a long metal rod.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	
8.2.7. Model development, calibration and verification using field data, LPS or DPS case study. Part I. Model development, implementation, solve the model with initial parameters (scalar), plot and analyse results.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	
8.2.8. Model development, calibration and verification using field data, LPS or DPS case study. Part II. Parameter optimization exemplified on scalars, calibration and verification. Or the implementation of one of the following: (a) PLS modelling of a complex system; (b) PCA and multivariate methods for fault detection.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	Expert in the field may be invited on site or online.
8.2.9. Model development, calibration and verification using field data, LPS or DPS case study. Part III. Parameter optimization exemplified on dynamic series testing multiple techniques. Calibration using the models for parameters and verification. Or the implementation of one of the following: (a) PLS modelling of a complex system; (b) PCA and multivariate methods for fault detection.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	Expert in the field may be invited on site or online.
8.2.10. The exploration and improvement of a predefined case study using MATLAB Fuzzy Logic.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	
8.2.11. The implementation of an industrial drying process decision support tools using the MATLAB Fuzzy Logic Toolbox.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	
8.2.12. Case study on parameter estimation models. ANN design, training and implementation using Neural Networks Toolbox, part I.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	
8.2.13. Case study on parameter estimation models. ANN design, training and implementation using Neural Networks Toolbox, part II.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	
8.2.14. The implementation of a case study (it can be proposed by students) using mathematical modelling, AI techniques exemplified during sections 8.2.1 to 8.2.13. Or the exemplification of a model employed for industrial process simulation and control using Mimic and/or DeltaV.	Implementation of case studies, coaching via dialog, application building, learning by discovery, teamwork, students' presentations, inter-evaluation, evaluation	

Bibliography

1. All course bibliography
2. The solved case studies proposed at the laboratories will be later uploaded by the lecturer on the Microsoft Teams group dedicated to the discipline after each problem has been solved in class or as homework.
3. Berk, Z., 2009. Chapter 21 - Evaporation, In Food Science and Technology, Food Process Engineering and Technology, Academic Press, 429-458.
4. Glover, W.B., 2004. Chemical Engineering Progress, AIChE, December 2004, 26-33,

https://lcicorp.com/test_design/selecting_evaporators_for_process_applications/
5. Shi, Z., 2019. Advanced Computing Seminar. Data Mining and its Industrial Applications. Chapter 6. Neural Networks, University of South Australia, http://www.intsci.ac.cn/en/shizz/dm.html
6. Sipos, A., Cristea, V.M., Mudura, E., Imre Lucaci A., Bratfalean, D., 2014. Modelarea, simularea si conducerea avansată a bioproceselor fermentative, carte de specialitate; Editura Universității "Lucian Blaga" din Sibiu; Vol. II.
7. Xue, D., Chen Y., 2009. Solving applied mathematical problems with MATLAB. Chapman & Hall/CRC, Boca Raton, USA.
8. Partial Differential Toolbox, MATLAB, User Guide.
9. COMSOL Mutiphysiscs 3.1, UserGuide.
10. Neural Network Toolbox, MATLAB, User Guide.
11. Fuzzy Logic Toolbox, MATLAB, UserGuide.
Note: titles of the bibliography items may be found at one of the following: (1) the "Lucian Blaga" Central Library of Babes-Bolyai University; (2) online on the scientific databases available from the intranet of Babes-Bolyai University and "Lucian Blaga" Central Library; (3) online using specified links; (4) online on the Microsoft Teams group dedicated to the discipline.

9. Evaluation

Type of activity	9.1 Evaluation criteria	9.2 Evaluation methods	9.3 Percentage in the final grade
9.4. Course	The final examination consists of a presentation detailing the resolution stages and results of a mathematical modelling and/or AI problem. This includes the submission of a report (DOC or PDF), a PowerPoint presentation, and the source files containing the implementation in the programming language, followed by a Q&A session regarding the solved problem. The evaluation criteria include: • The acquisition of course knowledge, as demonstrated by the accuracy of the answers; • The analytical thinking process, the accuracy, and the substantiation of the solutions relative to the exam topic; • The systematic breakdown of the problem-solving stages, along with the correctness and justification of the chosen solutions; • The quality and technical content of both the report and the presentation; • The relevance and comprehensiveness of the information provided for the specific problem; • The logical organization and structure of the information; • The delivery and professional communication of the presentation.	Oral examination Organized on site or online according to university regulations. Specific instructions for the preparation of the examination materials will be provided to students at the beginning of the semester.	50%
9.5. Laboratory	Correctness of answers as proof of understanding and applying the knowledge taught during laboratory. The active participation to laboratory activities. The quality and accuracy of solving the laboratory projects/ problems/ exercises / tasks, including homework.	The results of homework and projects started in class and finished at home must be presented according to the specific agreed schedule. Organized on site or online according to university regulations	50%
9.6 Minimum standard for passing			

- The ability to apply conventional modelling methods and artificial intelligence methods to chemical, biochemical environmental and process engineering case studies (e.g. CSTR and PFR type).
- The capacity to write mathematical models in MATLAB.
- Capability to present and critically analyse own approach for solving mathematical modelling and AI problems.
- The use of computer and English language for continuous learning.
- 5 is the minimum grade accepted to pass the evaluation.
- The consequence of the attempted fraud and / or plagiarism are followed by the exclusion of the student from the exam.

10. SDG labels (Sustainable Development Goals)

	○	Sustainable Development Generic Label						
1 FĂRĂ SĂRĂCIE	2 FOAMETE „ZERO"	3 SĂNĂTATE ȘI BUNĂSTARE	4 EDUCAȚIE DE CALITATE	5 EGALITATE DE GEN	6 APĂ CURATĂ ȘI SANITAȚIE	7 ENERGIE CURATĂ ȘI LA PREȚURI ACCESIBILE	8 MUNCĂ DECENTĂ ȘI CREȘTERE ECONOMICĂ	9 INDUSTRIE, INOVAȚIE ȘI INFRASTRUCTURĂ
○	○	○	○	○	○	○	○	X
10 INEGALITĂȚI REDUSE	11 ORAȘE ȘI COMUNITĂȚI DURABILE	12 CONSUM ȘI PRODUCȚIE RESPONSABILE	13 ACȚIUNE CLIMATICĂ	14 VIAȚA ACVATICĂ	15 VIAȚA TERESTRĂ	16 PACE, JUSTIȚIE ȘI INSTITUȚII EFICIENTE	17 PARTENERIATE PENTRU REALIZAREA OBIECTIVELOR	No label applies
○	○	○	○	○	○	○	○	○

Date of entry:
23.04.2026

Signature of course coordinator
Assoc. Prof. Dr. Ing. Elisabeta Cristina Timiș

Signature of seminar coordinator
Assoc. Prof. Dr. Ing. Elisabeta Cristina Timiș

Date of approval in the department:
27.04.2026

Signature of the head of department
Prof. Dr. Ing. Graziella Liana Turdean