

COURSE SYLLABUS

1. Program information

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|---------------------|---------------------------------------------------------------|
| 1.1. Institution | Petroleum-Gas University of Ploiești |
| 1.2. Faculty | Petroleum Refining and Petrochemistry |
| 1.3. Department | Petroleum Processing Engineering and Environmental Protection |
| 1.4. Field of study | Chemical Engineering |
| 1.5. Study cycle | Master degree |
| 1.6. Study program | Chemical Engineering for Refineries and Petrochemistry |

2. Course information

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|----------------------------------------------------------------------|------------------------------------------------------------------------|--|--|
| 2.1. Course title | Dynamic simulation and advanced control systems for chemical processes | | |
| 2.2. Course coordinator | Lect. dr. eng. Popescu Marian | | |
| 2.3. Laboratory coordinator | Lect. dr. eng. Popescu Marian | | |
| 2.4. Project coordinator | | | |
| 2.5. Year of study | II | | |
| 2.6. Semester * | 3 | | |
| 2.7. Evaluation type | Exam | | |
| 2.8. Course type - formative category **/ Type of subject matter *** | SC/MND | | |

* The semester number is according to the curriculum.

** FC – Fundamental courses; SC – Specialization courses; CC – Complementary courses.

*** Mandatory/imposed = MND; Optional = OPT; Elective = ELE.

3. Total estimated time (teaching hours per semester)

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----------------------|----|-----------------|----|--------------|-----|
| 3.1. Number of hours per week | 3 | of which: 3.2. course | 2 | 3.3.Laboratory | 1 | 3.4.Project | |
| 3.5. Total hours from curriculum | 42 | of which: 3.6. course | 28 | 3.7. Laboratory | 14 | 3.8. Project | |
| 3.9. Total hours of individual study (Study of textbook, course support, bibliography, study of textbook, course support, further reading in the library, on online platforms, preparing seminars/laboratories, homework, portfolios and essays) | | | | | | | 138 |
| 3.10. Total hours per semester | | | | | | | 180 |
| 3.11. Number of credits | | | | | | | 6 |

4. Requirements (where applicable)

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| 4.1. Curriculum requirements | ➤ Basic Chemical Processes Control |
| 4.2. Course requirements: | ➤ Class room with table, multimedia equipment |
| 4.3.Seminar/Laboratory requirements: | ➤ Laboratory room, table, industrial control systems, chemical process simulator, distributed control system |

5. Specific competences acquired and learning achievements* outcomes

| Professional competences | Learning achievements* |
|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Develops and optimizes complex chemical processes | K1 - The student defines computational methods for process simulation and optimization. S1 - The student applies specialized software for process design and analysis. S2 - The student integrates experimental data with mathematical models for process optimization. |

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|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | LO1 - The student documents and presents results in technical-scientific reports |
| 2. Carries out research and innovation activities in chemical engineering | K1 - The student identifies innovative directions for the development of processes and products S1 - The student applies experimental and computational methods to obtain original results LO1 - The student demonstrates autonomy in carrying out research projects |
| Transversal competences | Learning achievements* |
| 1. Develops critical thinking and the ability to solve complex problems | K1 - The student identifies reasoning models applicable in interdisciplinary contexts S1 - The student applies methods of analysis and synthesis to solve complex problems LO1 - The student takes responsibility for the proposed solutions and their impact |

* K – knowledge; S – skills; LO – responsibility and autonomy.

6. Course objectives (derived from the list of specific competences acquired)

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| 6.1. General objective | <ul style="list-style-type: none"> ➤ Dynamic modelling and simulation of chemical processes ➤ Advanced control of chemical processes |
| 6.2. Specific objectives | <ul style="list-style-type: none"> ➤ Numerical solving of differential equations ➤ Dynamic modelling of simple chemical processes ➤ Dynamic modelling of automatic control systems ➤ Fundamentals of automatic control systems for chemical processes ➤ Structures of automatic control systems for chemical processes ➤ Design, operation and exploitation of automatic control systems ➤ Distributed control system configuration |

7. Contents

| 7.1. Course | Time | Teaching methods | Comments |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------------------------------------------|----------|
| Numerical solving of ordinary differential equations | 4 | Interactive, based on multimedia and student-centered techniques | |
| Dynamics of some simple chemical processes | 6 | | |
| Dynamic simulation using transfer functions | 4 | | |
| Concepts of hierarchical and distributed systems | 4 | | |
| Numerical control equipment | 4 | | |
| Distributed control systems | 6 | | |
| Bibliography | | | |
| <ol style="list-style-type: none"> 1. Basu S., Chapter 1 - General discussions on control systems, Editor(s): Basu S., Plant Intelligent Automation and Digital Transformation, Academic Press, Vol. 1, 2023, Pages 1-56. 2. Gillis A.S., Distributed Control System (DCS), TechTarget, 2023. 3. Kluever C. - Dynamic Systems: Modeling, Simulation and Control, Wiley, 2019. 4. Mehta B.R., Reddy Y.J., Distributed control system, In: Industrial Process Automation Systems (pp.75-133), Elsevier, 2015. 5. Patrascioiu C., Popescu M., <i>Dinamica sistemelor chimice</i>, Editura MatrixRom, Bucuresti, 2015. 6. Patrascioiu C., Popescu M., <i>Sisteme de conducere a proceselor chimice – Aplicatii</i>, Editura MatrixRom, Bucuresti, 2013. 7. Paraschiv N., Popescu M., Pătrășcioiu C. - Advanced real time control of an industrial mass transfer process, Proceedings of the International Conference on Computational Heat and Mass Transfer (ICCHMT09), Guangzhou, China, 2009, pp 602-607. 8. Paraschiv N., Achiziția și prelucrarea datelor, Editura UPG Ploiești, 2013. 9. Paraschiv N., Popescu M., Sisteme distribuite de supervizare și control, Editura UPG Ploiești, 2014. 10. Popescu M., Distillation Column Hierarchical Control, REV. CHIM. (Bucharest), 69, No. 9, p 2595-2600, 2018. | | | |

| 11. Raczynski S., Models for Research and Understanding Exploring Dynamic Systems, Unconventional Approaches, and Applications, Springer Nature Switzerland AG, 2022. | | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 7.2. Laboratory | Time | Teaching methods | Comments |
| Numerical solving of ordinary differential equations using MATLAB | 4 | Student-centered interactive teaching methods, in the sense of monitoring and verifying the student's understanding of the approached issues | |
| Modelling and simulation of some simple chemical processes | 4 | | |
| Transfer functions. System simulation using SIMULINK | 2 | | |
| Basic knowledge of DeltaV distributed system | 2 | | |
| Analog and digital inputs and outputs configuration | 8 | | |
| FOUNDATION fieldbus system configuration | 4 | | |
| Operating interfaces configuration | 4 | | |
| Bibliography | | | |
| <ol style="list-style-type: none"> Emerson Process Management – DeltaV™ M-series Traditional I/O, 2017. Fisher-Rosemount Systems, Inc. – DeltaV Books Online, 2013. Paraschiv N., Popescu M. – <i>Sisteme distribuite de supervizare și control</i>, Ed. Universității Petrol-Gaze din Ploiești, 2014. Patrascioiu C., Popescu M., <i>Dinamica sistemelor chimice</i>, Editura MatrixRom, Bucuresti, 2015. Patrascioiu C., Popescu M., <i>Sisteme de conducere a proceselor chimice – Aplicatii</i>, Editura MatrixRom, Bucuresti, 2013. Popescu M., <i>Sisteme distribuite de supervizare și control – Îndrumar de laborator</i>, Editura UPG Ploiești, 2018. | | | |
| 7.3 Project | Time | Teaching methods | Comments |
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| Bibliography | | | |

8. Correlation of the course contents with the demands of the epistemic community representatives, professional associations, and representative employers in the field of the program

The discipline is monitored by representatives of refineries and design firms in the chemical field

9. Evaluation

| Activity | 9.1. Evaluation criteria | 9.2. Evaluation methods | 9.3. Percentage of final grade |
|-------------|----------------------------------------------------------------------------------------|-------------------------|--------------------------------|
| 9.4. Course | Analytical solving and numerical solving algorithms of ordinary differential equations | Written test | 20% |
| | Knowledge of dynamic models of simple systems | Written test | 20% |
| | Understanding fundamentals of distributed control systems | Written test | 20% |

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| 9.5. Laboratory | Numerical solving of ordinary differential equations | Homework | 20% |
| | Modelling and numerical simulation of simple systems | Homework | 10% |
| | Understanding and implementation of distributed control systems configuration | Test | 10% |
| 9.6. Project | | | |
| 9.7. Minimum performance standard | | | |
| <ul style="list-style-type: none"> ➤ Analytical solving of an ordinary differential equation and graphical representation of the solution ➤ An example of a static characteristic of a process ➤ Basic knowledge of DeltaV distributed control system | | | |

Signature/date
22.09.2025

Course coordinator

Laboratory coordinator

Project coordinator

Date of approval in the
department
26.09.2025

Head of department
Assoc. prof. PhD. Eng.
Neagu Mihaela

Dean
Assist. prof. PhD. Eng. Duşescu-Vasile
Cristina