

## Syllabus

### 1. Data about the program of study

|                                      |                                     |
|--------------------------------------|-------------------------------------|
| 1.1 Institution                      | Technical University of Cluj-Napoca |
| 1.2 Faculty                          | Automation and Computer Science     |
| 1.3 Department                       | Automation                          |
| 1.4 Field of study                   | Systems Engineering                 |
| 1.5 Cycle of study                   | Bachelor's Degree                   |
| 1.6 Program of study / Qualification | Automation and Applied Informatics  |
| 1.7 Form of education                | FT – Full-time learning             |

### 2. Data about the subject

|                                                           |                                                                                                                    |              |   |                                                                     |              |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------|---|---------------------------------------------------------------------|--------------|
| 2.1 Subject name                                          | <b>Continuous Plant Control</b>                                                                                    |              |   | Subject code                                                        | <b>48.00</b> |
| 2.2 Course responsible / lecturer                         | Conf. Dr. ing. Ioana Naşcu – ioana.nascu@aut.utcluj.ro                                                             |              |   |                                                                     |              |
| 2.3 Teachers in charge of seminars / Laboratory / project | Conf. Dr. ing. Ioana Naşcu – ioana.nascu@aut.utcluj.ro<br>Ing. Drd.. Tudor Plugaru –Tudor.Plugaru@campus.utcluj.ro |              |   |                                                                     |              |
| 2.4 Year of study                                         | 4                                                                                                                  | 2.5 Semester | 1 | 2.6 Type of assessment (E - exam, C - colloquium, V - verification) | E            |
| 2.7 Subject category                                      | Formative category: DF – fundamental, DS – speciality, DC – complementary                                          |              |   |                                                                     | DS           |
|                                                           | Optionality: DOB – mandatory, DOP – optional (alternative), DFA – optional (free choice)                           |              |   |                                                                     | DOB          |

### 3. Estimated total time

|                                                                                      |    |           |            |     |             |   |                |    |             |    |
|--------------------------------------------------------------------------------------|----|-----------|------------|-----|-------------|---|----------------|----|-------------|----|
| 3.1 Number of hours per week                                                         | 5  | of which: | 3.2 Course | 2   | 3.3 Seminar | 0 | 3.3 Laboratory | 2  | 3.3 Project | 1  |
| 3.4 Total hours in the teaching plan                                                 | 70 | of which: | 3.5 Course | 28  | 3.6 Seminar | 0 | 3.6 Laboratory | 28 | 3.6 Project | 14 |
| 3.7 Time distribution (hours per semester) for:                                      |    |           |            |     |             |   |                |    |             |    |
| (a) Manual, lecture material and notes, bibliography                                 |    |           |            |     |             |   |                |    |             | 20 |
| (b) Supplementary study in the library, online and in the field                      |    |           |            |     |             |   |                |    |             | 12 |
| (c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays |    |           |            |     |             |   |                |    |             | 12 |
| (d) Tutoring                                                                         |    |           |            |     |             |   |                |    |             | 5  |
| (e) Exams and tests                                                                  |    |           |            |     |             |   |                |    |             | 6  |
| (f) Other activities:                                                                |    |           |            |     |             |   |                |    |             | 0  |
| 3.8 Total hours individual study hours (sum of (3.3(a)...3.3(f)))                    |    |           |            | 55  |             |   |                |    |             |    |
| 3.9 Total hours per semester (3.2+3.4)                                               |    |           |            | 125 |             |   |                |    |             |    |
| 3.10 Number of credits points                                                        |    |           |            | 5   |             |   |                |    |             |    |

### 4. Pre-requisites (where appropriate)

|                |                                                                                                                        |
|----------------|------------------------------------------------------------------------------------------------------------------------|
| 4.1 Curriculum | System theory, Process modeling, Control engineering, System identification, Electric and electronic control equipment |
| 4.2 Competence | Systems theory, sensors and transducers, process modeling, control engineering, control instrumentation                |

### 5. Requirements (where appropriate)

|                          |                                                                                                                         |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------|
| 5.1 For the course       | The student needs to be present at 70% of the total number of lectures in order to have the right to take the exam.     |
| 5.2 For the applications | The student is allowed to participate in an application class only by presenting a report for the previous application. |

## 6. Specific competences

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Professional competences | <p>C5 – Development and implementation of automatic control structures and algorithms based on project management principles, software environments and technologies based on signal processors, programmable logic controllers and embedded systems.</p> <p>C5.1 – Identification of the concepts and methods for project management and of specific languages for application development (sequential, concurrent, real-time, non-real-time, distributed, embedded, non-embedded, mobile, on-line, etc.)</p> <p>C5.2 – Explaining and interpreting the relation project–real system using the basic principles and methods of algorithms and automatic control structures design and implementation, including those of embedded or distributed systems built on signal processors, programmable logic controllers, etc.</p> <p>C5.3 – Selecting the technologies and the equipment appropriate for automatic systems, computer applications and operating conditions.</p> <p>C5.4 – Assessment of the implementation of automation and IT applications using automatic control structures, algorithms, programming environments and technologies based on signal processors, programmable logic controllers, embedded systems, etc.</p> <p>C5.5 – Transposing the results of the sizing computations in technical documents of the project, specific to applied informatics and automatic systems.</p> |
| Cross competences        | <p><b>CT1</b> – Applying, in the context of respecting intellectual property rights (including technology transfer), product certification methodology, and the principles, norms and values of the professional code of ethics within a rigorous, efficient and responsible work strategy.</p> <p><b>CT2</b> – Identifying roles and responsibilities in a multi-specialized team, making decisions and assigning tasks, with the application of relationship and teamwork techniques.</p> <p><b>CT3</b> – Identifying continuous training opportunities and efficiently using learning resources and techniques for personal development.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## 7. Expected learning outcomes

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Knowledge | <p>Students gain a solid understanding of the fundamental concepts of automatic control, including process modeling, identification, simulation, and analysis, along with the use of simulation and design tools for classical automatic control systems, applied to concrete engineering problems.</p> <p>Students are able to design, implement, test, and maintain control systems using both general-purpose and dedicated equipment, including PLC-based and embedded platforms, for automation and applied informatics applications.</p> <p>Students develop practical skills in the implementation of automatic control algorithms and structures, using appropriate programming environments and technologies based on PLCs and signal processors.</p>                                                                                                                                                                                                                                                                                                        |
| Skills    | <p>Students are able to analyze and solve automation problems for specific process types, applying principles of systems theory, automatic control engineering, process modeling and simulation, and appropriate simulation and design tools.</p> <p>Students can specify requirements, develop simulation scenarios, propose solutions for control problems, and assess the performance of automatic control systems.</p> <p>Students are able to configure and implement control systems for continuous industrial processes (temperature, pressure, flow, level), select appropriate equipment, and commission the associated structures.</p> <p>Students can model and simulate processes using mathematical foundations, collect and process experimental data using appropriate sensors and signal processing techniques, and apply PID and advanced control strategies (cascade, feedforward, ratio, selective, split-range).</p> <p>Students are able to design, program, and test control applications using PLCs systems for real industrial processes.</p> |

|                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Responsibilities and autonomy</b> | <p>Students apply the values of engineering ethics and professional deontology, practicing logical reasoning, critical evaluation, and self-assessment in decision-making.</p> <p>Students take responsibility for the quality, safety, and ethical implications of their engineering work, being aware of its social, legal, and environmental impact.</p> <p>Students can plan, execute, and manage engineering tasks autonomously — from problem definition to validated solution — showing initiative in adopting new tools, methods, and technologies.</p> |
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## 8. Course objectives

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|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General objective</b>   | Assimilation of knowledge on basic principles and functional design solutions of control systems for the main technological parameters of continuous processes.                                             |
| <b>Specific objectives</b> | <p>Measurement of the main technological parameters of continuous processes, process identification and PID controller design.</p> <p>Implementation of the real-time process control system using PLC.</p> |

## 9. Contents

| 9.1 Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | No. hours | Teaching methods                                                                | Notes                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| C1. Defining the concept of continuous process, control systems structure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2         | Slides presentation, explanations and demonstrations on whiteboard, discussions | In cases of extreme situations, the courses will take place online on the Teams platform |
| C2. Standards, measurement units, graphic symbols. The characteristics of continuous industrial systems.                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2         |                                                                                 |                                                                                          |
| C3. The design of continuous control systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2         |                                                                                 |                                                                                          |
| C4. The design of digital control systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2         |                                                                                 |                                                                                          |
| C5. Case study.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2         |                                                                                 |                                                                                          |
| C6. Automatic control of the main technological parameters: design of automatic control systems for thermal processes, temperature control in heat exchangers.                                                                                                                                                                                                                                                                                                                                                                                      | 2         |                                                                                 |                                                                                          |
| C7. The design of pressure control systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2         |                                                                                 |                                                                                          |
| C8. The design of flow control systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2         |                                                                                 |                                                                                          |
| C9. The design of level control systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2         |                                                                                 |                                                                                          |
| C10. The control systems design for neutralization processes; control system design for chemical reactors.                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2         |                                                                                 |                                                                                          |
| C11. Advanced control structures: cascade control, feedforward control.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2         |                                                                                 |                                                                                          |
| C12. Advanced control structures: selective control, ratio control, override control, split-range control, inferential control.                                                                                                                                                                                                                                                                                                                                                                                                                     | 2         |                                                                                 |                                                                                          |
| C13. Plant-wide control.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2         |                                                                                 |                                                                                          |
| C14. Case study.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2         |                                                                                 |                                                                                          |
| <b>Bibliography</b><br>1. Essentials of Process Control, William Luyben, McGraw-Hill, 1997.<br>2. Practical Process Control for Engineers and Technicians, Wolfgang Altmann, Elsevier, 2005.<br>3. The Control Handbook, William Levine, CRC Press, 1996.<br>4. Conducerea automată a proceselor industriale, M. Vinătoru, Craiova, 2001.<br>5. Process Dynamics and Control, D. Seborg et al., International Student Version, John Wiley, 2011.<br>6. I. Naşcu, Sisteme de conducere a proceselor continue, material de curs în format electronic. |           |                                                                                 |                                                                                          |

| 7. Ioana Nascu, Ioan Nascu, Sisteme de Conducere a Proceselor Continue I, UTPRESS, Cluj, 2025.                                                                                                                                                                                                                                  |           |                                                                                                                          |                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| 9.2 Applications (seminar / laboratory / project / practical work)                                                                                                                                                                                                                                                              | No. hours | Teaching methods                                                                                                         | Notes                                                                        |
| <b>Laboratory</b>                                                                                                                                                                                                                                                                                                               |           | Implementing and testing the applications on the lab stands. Explanations and demonstrations on whiteboard, discussions. | In cases of extreme situations, will take place online on the Teams platform |
| L1. Programmable logic controllers – PLCs. Analog inputs/outputs, blocks for PID control.                                                                                                                                                                                                                                       | 4         |                                                                                                                          |                                                                              |
| L2. Temperature control of an electric soldering iron. Description, data acquisition, process identification, PID control with PLC.                                                                                                                                                                                             | 4         |                                                                                                                          |                                                                              |
| L3. Temperature control for ventilated air in a tube. Description, data acquisition, process identification, PID control with PLC.                                                                                                                                                                                              | 4         |                                                                                                                          |                                                                              |
| L4. Level control. Description, data acquisition, process identification, PID control with PLC.                                                                                                                                                                                                                                 | 4         |                                                                                                                          |                                                                              |
| L5. Speed control for an electric motor. Description, data acquisition, process identification, PID control with PLC.                                                                                                                                                                                                           | 4         |                                                                                                                          |                                                                              |
| L6. Advanced control structures for level control: cascade control, feedforward control.                                                                                                                                                                                                                                        | 4         |                                                                                                                          |                                                                              |
| L7. Modeling and simulation of a continuous stirred tank reactor. Design and testing of control algorithms.                                                                                                                                                                                                                     | 4         |                                                                                                                          |                                                                              |
| <b>Project</b>                                                                                                                                                                                                                                                                                                                  |           |                                                                                                                          |                                                                              |
| P1. Mathematical modeling, model calibration, automatic control with PID, advanced control structures for a level control pilot plant.                                                                                                                                                                                          | 14        |                                                                                                                          |                                                                              |
| <b>Bibliography</b><br>1. R. Crișan, I. Nașcu, Sisteme de conducere a proceselor continue, Îndrumător de laborator, ISBN 978-973-662-794-1, Editura U.T. Press, 2013.<br>2. Ioan Nașcu, Gabriel Harja, Izabela Birs, Sisteme de conducere a proceselor continue – Îndrumător de proiect, UTPRESS, 2015. ISBN 978-606-737-100-0. |           |                                                                                                                          |                                                                              |

#### 10. Bridging the course contents with the expectations of the representatives of the community, professional associations and employers in the field

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| Lectures and applications content was discussed with field experts. Over the years the course has been favourably assessed by various rating agencies: National Council for Academic Evaluation and Accreditation, Romanian Agency for Quality Assurance in Higher Education. |
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#### 11. Evaluation

| Activity type          | 11.1 Assessment criteria | 11.2 Assessment methods                              | 11.3 Weight in the final grade |
|------------------------|--------------------------|------------------------------------------------------|--------------------------------|
| <b>11.4 Course</b>     | Theory, problems         | Written exam / online exam using Teams               | 50%                            |
| <b>11.5 Laboratory</b> | Individual work results  | Practical assessment / online assessment using Teams | 30%                            |
| <b>11.5 Project</b>    | Individual work results  | Practical assessment / online assessment using Teams | 20%                            |

**11.6 Minimum performance standard:** Synthesis of systems that control the main values specific to continuous industrial processes.

| Date of filling in: |              | Title Firstname NAME       | Signature |
|---------------------|--------------|----------------------------|-----------|
| 22.06.2026          | Course       | Conf. Ioana NAȘCU          |           |
|                     | Applications | Conf. Dr. ing. Ioana Nașcu |           |
|                     |              | Drd. Ing. Tudor Plugaru    |           |

Date of approval by the Department Board

Head of Departament  
Prof.dr.ing. Honoriu VĂLEAN

Date of approval by the Faculty Council

Dean  
Prof.dr.ing. Vlad MUREȘAN