# Syllabus

## 1. Data about the program of study

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| 1.1 Institution | Technical University of Cluj-Napoca |
| 1.2 Faculty | Automation and Computer Science |
| 1.3 Departament | Automation |
| 1.4 Field of study | Systems Engineering |
| 1.5 Cycle of study | Bachelor of Science |
| 1.6 Program of study/Qualification | Automation and Applied Informatics (English) |
| 1.7 Form of education | Full time |
| 1.8 Codul disciplinei | 38.00 |

## 2. Data about the subject

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| 2.1 Subject name | ***Control Engineering II*** | | | | |
| 2.2 Course responsible/lecturer | Prof.dr.ing. DULF Eva H. – Eva.Dulf@aut.utcluj.ro<br>Prof.dr.ing. MURESAN Cristina – Cristina.Muresan@aut.utcluj.ro | | | | |
| 2.3 Teachers in charge of applications | As.dr.ing. BIRS Isabela – Isabela.Birs@aut.utcluj.ro<br>Drd.ing. DANKU Alex– Alex.Danku@aut.utcluj.ro<br>Ing. BERCIU Alexandru– Alexandru.Berciu@aut.utcluj.ro | | | | |
| 2.4 Year of study | 3 | 2.5 Semester | 2 | 2.6 Assessment *(E/C/V)* | E |
| 2.7 Type of subject | *DF – fundamental, DD – in the field, DS – specialty, DC – complementary* | | | | DD |
| | *DI – compulsory, DO – elective, Dfac – optional* | | | | DI |

## 3. Estimated total time

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|---|---|---|---|---|---|---|---|---|---|---|
| 3.1 Number of hours per week | 5 | of which: | Course | 2 | Seminar | 0 | Laboratory | 2 | Project | 1 |
| 3.2 Number of hours per semester | 70 | of which: | course | 28 | Seminar | 0 | Laboratory | 28 | Project | 14 |
| 3.3 Individual study | | | | | | | | | | |
| (a) Manual, lecture material and notes, bibliography | | | | | | | | | | 13 |
| (b) Supplementary study in the library, online and in the field | | | | | | | | | | 0 |
| (c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays | | | | | | | | | | 14 |
| (d) Tutoring | | | | | | | | | | 0 |
| (e) Exams and tests | | | | | | | | | | 3 |
| (f) Other activities: | | | | | | | | | | 0 |

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| 3.4 Total hours of individual study (sum of (3.3(a)…3.3(f))) | 34 |
| 3.5 Total hours per semester (3.2+3.4) | 104 |
| 3.6 Number of credit points | 4 |

## 4. Pre-requisites (where appropriate)

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| 4.1 Curriculum | System Theory I, System Theory II, Control Engineering I |
| 4.2 Competence | Mathematics, Physics, Fundamental knowledge of automation |

## 5. Requirements (where appropriate)

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| 5.1. For the course | |
| 5.2. For the applications | Laboratory classes are compulsory<br>Project classes are compulsory |

## 6. Specific competences

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| 6.1 Professional competences | C3.1 Identification of basic concepts of system theory, control engineering, of fundamental principles of modelling and simulation, as well as of process analysis methods in order to explain the basic problems of the field.<br>C3.2 Explaining and interpreting some process automation problems through the application of automatic control fundamentals, of modelling, identification and simulation methods as well as of the computer aided design techniques. |

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| | C3.3 Solving some types of control problems through: use of modelling methods and principles, development simulation scenarios, application of methods for the identification and analysis of processes (including technological processes) and systems..<br>C3.4 Performance evaluation of automatic systems, of the strengths and weaknesses of projects (SWOT analysis),and of the consistency of methods and theoretical foundations<br>C3.5 Configuration and deployment of industrial process control, of robots and flexible manufacturing lines and choice of equipment, tuning and putting into service of related structures. |
| 6.2 Cross competences | |

**7. Course objectives**

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| 7.1 General objective | Development of skills for correct use of automation concepts and tuning of the controllers |
| 7.2 Specific objectives | • Identification of the control engineering related concepts<br>• Interpreting the automation problems for different types of processes<br>• Solving the tuning problem for different types of controllers<br>• Evaluating the closed loop performance<br>• Configuration and implementation of controllers |

**8. Contents**

| 8.1 Lecture | No.hours | Teaching methods | Notes |
|---|---|---|---|
| General aspects regarding the tuning of discrete-time control algorithms | 2 | PPT presentations, open discussions, demonstration, case studies | In case of major force classes will be held online using Teams |
| The problem, objectives and phases of discrete-time controller tuning. Comparison with continuous-time controllers | 2 | | |
| Discretization methods. Choice of the sampling period | 2 | | |
| Discrete-time controller tuning using „via –s” methods | 2 | | |
| Discrete-time controller tuning based on specifying s plane performance criteria into the z plane | 2 | | |
| Discrete-time controller tuning using root-locus technique | 2 | | |
| Discrete-time controller tuning using frequency domain methods | 2 | | |
| Discrete-time controller tuning in the z domain. Kalman algorithm | 2 | | |
| Discrete-time controller tuning in the z domain. Dahlin algorithm | 2 | | |
| Discrete-time controller tuning in the z domain. Dead-beat algorithm | 2 | | |
| Discrete-time controller tuning using state space representation. Pole placement method | 2 | | |
| Discrete-time controller tuning using state space representation. Observer design | 2 | | |
| The basics of advanced control | 2 | | |
| Case studies | 2 | | |


Bibliography

1. OGATA, Katsuhiko, Modern control engineering, 4th ed., Upper Saddle River, New Jersey: Prentice Hall, 2002 (Biblioteca UTCN - 1 exemplar)
2. TEWARI, Ashish, Modern control design : with MATLAB and SIMULINK, Chichester, West Sussex, England : John Wiley and Sons, 2003 (Biblioteca UTCN - 1 exemplar)
3. FESTILA, Cl., Dulf E.H.. – Structuri şi algoritmi de reglare, Note de curs, 2012, distribuit electronic
4. DORF, Richard C., BISHOP, Robert H., Modern control systems, Upper Saddle River, NJ : Pearson Education, Ediţiile 2014, 2011, 2008, 2001 (Biblioteca UTCN - 5 exemplare)

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|---|---|---|---|
| 5. SKOGESTAD, Sigurd, POSTLETHWAITE, Ian, Multivariable feedback control: analysis and design, John Wiley and Sons, 1997 (Biblioteca UTCN - 1 exemplar)<br>6. http://www.ece.mtu.edu/faculty/shiyan/EE4262Spring17/DigitalControlTextBook.pdf | | | |
| 8.2 Aplications (seminar/laboratory/project) | No.hours | Teaching methods | Notes |
| L1. Sampling period effects on closed loop response | 4 | Brainstorming, case study, conversation | In case of major force classes will be held online using Teams |
| L2. Discrete-time control algorithms. Via s method | 4 | | |
| L3. Direct tuning of discrete-time controllers. Microcontroller implementation | 4 | | |
| L4. Tank level control. Controller implementation on a PLC device | 4 | | |
| L5. DC motor speed control. Case study: Modular Servo System | 4 | | |
| L6. Tank level control. Control system design and implementation using DeltaV | 4 | | |
| L7. Case studies | 4 | | |
| Project: Tuning and implementation of control strategies for the processes available in the lab or in a HIL form. Analysis of results. Conclusions. | 14 | | |
| Bibliography<br>1. OGATA, Katsuhiko, Modern control engineering, 4th ed., Upper Saddle River, New Jersey: Prentice Hall, 2002 (Biblioteca UTCN - 1 exemplar)<br>2. TEWARI, Ashish, Modern control design : with MATLAB and SIMULINK, Chichester, West Sussex, England : John Wiley and Sons, 2003 (Biblioteca UTCN - 1 exemplar)<br>3. Dulf E., Muresan C., Ingineria Reglării Automate 2, note de laborator, distribuit electronic<br>4. https://www.arduino.cc/en/Guide/ArduinoLeonardoMicro<br>5. http://www.inteco.com.pl/products/modular-servo/<br>6. http://w3.siemens.com/mcms/automation-software/en/tia-portal-software/step7-tia-portal/Pages/default.aspx<br>7. http://www3.emersonprocess.com/systems/support/home/Index.aspx?mnu=resource&pl=2 | | | |

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

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| The content of the subject has been discussed with representative companies from Romania, Europe and USA and continuously evaluated by Romanian agencies (CNEAA, ARACIS) |

**10. Evaluation**

| Activity type | Assessment criteria | Assessment methods | Weight in the final grade |
|---|---|---|---|
| Course | Evaluation of the acquired skills, activity within lectures | Written exam / online exam using Teams | 60% |
| Seminar | | | |
| Laboratory | Evaluation of the practical skills, attendance, activity within laboratory classes | Practical assessment / online assessment using Teams | 20% |
| Project | Evaluation of project results | Practical assessment / online assessment using Teams | 20% |
| Minimum standard of performance:<br>Exam grade >5, laboratory grade>5, project grade>5 | | | |

| **Date of filling in:** | | **Title Firstname NAME** | **Signature** |
|---|---|---|---|
| 10.03.2023 | Course | Prof.dr.ing. Eva-H. DULF<br>Prof.dr.ing. Cristina I. MUREȘAN | |
| | Aplications | Asist. Dr. ing. Isabela BÎRS | |
| | | Drd.ing. Alex DANKU | |
| | | Ing. Alexandru BERCIU | |

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| Date of approval by the Department Board …….<br><br>_____ | Head of Departament .....<br>Prof.dr.ing. Honoriu VĂLEAN |
| Date of approval by the Faculty Council ……<br><br>_____ | Dean<br>Prof.dr.ing. Liviu Cristian MICLEA |