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 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

2. Data about the subject

2.1 Subject name	***Control Engineering II***			Discipline code	**38.00**
2.2 Course responsible/lecturer	Prof. Dr. Ing. Cristina I. Muresan, Cristina.Muresan@aut.utcluj.ro				
2.3 Teachers in charge of applications	Drd. Ing. Marcian D. Mihai, Marcian.Mihai@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, DS – specialty, DC – complementary*				DS
	DOB – compulsory, DOP – elective, DFA – optional				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 Number of hours per semester	70	of which:	3.5 Course	28	3.6 Seminar	0	3.6 Laboratory	28	3.6 Project	14
3.7 Individual study										
(a) Manual, lecture material and notes, bibliography										0
(b) Supplementary study in the library, online and in the field										14
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										0
(d) Tutoring										3
(e) Exams and tests										13
(f) Other activities:										0

3.8 Total hours of individual study (sum of (3.3(a)...3.3(f)))	30
3.9 Total hours per semester (3.2+3.4)	100
3.10 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 Curriculum	System Theory I, System Theory II, Control Engineering
4.2 Competence	Using knowledge in mathematics and physics; the use of the fundamentals of automation, and methods for process modeling, simulation, identification, and analysis

5. Requirements (where appropriate)

5.1. For the course	Reviewing the bibliographic materials specified for the course.
5.2. For the applications	Prior preparation for laboratory sessions; attendance at the laboratory is mandatory

6. Specific competences

Professional competences	C3. The use of the fundamentals of automation, methods for process modeling, simulation, identification, and analysis, and computer-aided design techniques. C5. The development of applications and implementation of automatic control algorithms and structures, using project management principles, programming environments, and technologies based on microcontrollers, signal processors, programmable logic controllers, and embedded systems.
Cross competences	CT2. Identifying roles and responsibilities within a multi-disciplinary team, decision-making, and task assignment, while applying relationship-building techniques and efficient teamwork strategies. CT3. Identifying lifelong learning opportunities and effectively utilizing resources and learning techniques for personal and professional development.

7. Expected learning outcomes

Knowledge	The student/graduate describes, identifies, and summarizes concepts and methods related to systems in general; describes, identifies, and summarizes fundamental concepts in automatic systems, embedded and intelligent systems, computer science, and information technology, as well as their application to concrete problems; describes, identifies, and summarizes fundamental concepts of automation, methods for process modeling, identification, simulation, and analysis, and computer-aided design techniques for conventional and intelligent automatic systems, along with their application to concrete problems; utilizes the fundamentals of automation, methods for process modeling, simulation, identification, and analysis, and computer-aided design techniques, both conventional and artificial intelligence-based; develops applications and implements automatic control algorithms and structures, using project management principles, programming environments, and technologies based on microcontrollers, signal processors, programmable logic controllers, and embedded systems.
Skills	The student/graduate interprets and explains the automation problems of various types of processes using basic principles from systems theory, automatic control engineering, modeling and simulation, computer-aided design techniques, and analysis methods specific to systems engineering; recognizes and implements complex architectures for intelligent autonomous systems; specifies requirements, develops simulation scenarios, proposes solutions to control problems, and analyzes and evaluates the performance of automatic systems. The student/graduate configures and implements control systems for industrial processes, robotics, and flexible manufacturing lines, including modern Internet of Things (IoT) and Industry 4.0 approaches; develops software solutions that integrate algorithm design, data management, and workflow automation for engineering and administrative tasks; designs and implements control systems based on both conventional algorithms and artificial intelligence; designs, simulates, and tests digital systems; designs and programs embedded systems for control.
Responsibilities and autonomy	The student/graduate communicates effectively about engineering activities with a wide range of audiences; is engaged in lifelong learning to acquire and implement knowledge as needed, using appropriate learning strategies; works effectively as a team member or leader; behaves honorably, responsibly, ethically, and in accordance with the law to ensure the reputation of the profession; contributes constructively to multidisciplinary teams; takes responsibility for the quality, safety, and ethical implications of engineering work, considering social, legal, and environmental impacts; pursues personal progress in learning, seeks feedback, and adopts strategies for continuous professional and personal development.

8. Course objectives

General objective	Acquiring the theoretical knowledge and practical competencies necessary for the analysis, design, implementation, and evaluation of automatic control systems, utilizing control systems engineering principles and modern modeling and computer-aided design tools.
Specific objectives	• Learning the fundamental concepts and principles underlying control systems engineering. • Application of controller design methods and techniques to ensure the specified performance of control systems. • Analysis of stability, dynamic performance, and robustness of control systems under various operating conditions. • Utilization of specialized software environments for the simulation, design, and validation of control systems. • Configuration, implementation, and testing of automatic control solutions for engineering processes and systems. • Development of the capability to select and integrate appropriate control strategies based on application requirements.

9. Contents

9.1 Lecture	No.hours	Teaching methods	Notes
Introduction to Digital and Intelligent Control of Systems	2	Lecture, systematic exposition, classroom discussion, instructional demonstration, case study	
Design of digital controllers via methods based on the discretization of continuous models	2		
Design of digital controllers in the z-plane	2		
Design of digital controllers via the root locus method	4		
Controller design in state space. Pole placement. Estimators	2		
Event-based control	2		

Model predictive controllers. The IMC method	2		
Autotuning and adaptive tuning of PID controllers	2		
Fractional-order controllers and their applications	2		
Intelligent control methods based on learning and optimization	2		
Reinforcement Learning control. Principles and applications in automation	2		
Integration of intelligent methods into modern control architectures	2		
Case studies and applications of intelligent control systems	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)
5. SKOGESTAD, Sigurd, POSTLETHWAITE, Ian, Multivariable feedback control: analysis and design, John Wiley and Sons, 1997 (Biblioteca UTCN - 1 exemplar)
6. http://www.ece.mtu.edu/faculty/shiyan/EE4262Spring17/DigitalControlTextBook.pdf

9.2 Aplications (seminar/laboratory/project/practical work)	No.hours	Teaching methods	Notes
The influence of the sampling period on the system response	4	Brainstorming, case study, classroom discussion	
Digital control algorithms for single-variable processes. The "via s" method	4		
Direct digital control algorithms. The Kalman and Dahlin algorithms. Practical implementation on a microcontroller	4		
Tank level control. Practical implementation on a PLC	4		
Motor speed control. Practical application on a Modular Servo System	4		
Position control of an aerodynamic system	4		
Case studies on the intelligent control of dynamic systems	4		
Project assignment: Design of control structures for laboratory-equipped or Hardware-in-the-Loop (HIL) processes. Performance analysis. Conclusions	14		

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. Dulf E., Muresan C., Ingineria Reglării Automate 2, note de laborator, distribuit electronic
4. https://www.arduino.cc/en/Guide/ArduinoLeonardoMicro
5. http://www.inteco.com.pl/products/modular-servo/
6. http://w3.siemens.com/mcms/automation-software/en/tia-portal-software/step7-tia-portal/Pages/default.aspx
7. http://www3.emersonprocess.com/systems/support/home/Index.aspx?mnu=resource&pl=2

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

The course content was discussed with representatives of prestigious companies in the field from Romania, Europe, and the United States of America, and has been repeatedly evaluated by Romanian Government Agencies (CNEAA, ARACIS).

11. Evaluation

Activity type	11.1 Assessment criteria	1.2 Assessment methods	11.3 Weight in the final grade
11.4 Course	Verification of acquired skills. Course participation	Written exam	60%
11.5 seminar/ laboratory/ project/ practical work	Verification of acquired skills. Laboratory activity Verification of project	Oral assessment at each session / Evaluation of laboratory reports	20%+20%
11.6 Minimum performance standard			

Date of filling in:		Title Firstname NAME	Signature
	Course	Prof. Dr. Ing. Cristina I. MURESAN	
30.06.2026	Aplications	Drd.Ing. Marcian D. MIHAI	

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