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 I***				Discipline code	**32.00**
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	1	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	4	of which:	3.2 Course	2	3.3 Seminar	0	3.3 Laboratory	2	3.3 Project	0
3.4 Number of hours per semester	56	of which:	3.5 Course	28	3.6 Seminar	0	3.6 Laboratory	28	3.6 Project	0
3.7 Individual study										
(a) Manual, lecture material and notes, bibliography										10
(b) Supplementary study in the library, online and in the field										28
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										0
(d) Tutoring										3
(e) Exams and tests										28
(f) Other activities:										0

3.8 Total hours of individual study (sum of (3.3(a)...3.3(f)))	69
3.9 Total hours per semester (3.2+3.4)	125
3.10 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 Curriculum	System Theory I
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
Performance and evaluation of automatic control systems	2	Lecture, systematic exposition, classroom discussion, instructional	
Conventional and modern control system structures	2		
Controller design via the pole–zero placement method	2		
Synthesis of corrective compensation in control systems	2		
Design of PI, PD, and PID controllers using frequency domain methods based on the equivalent second-order model	4		

Controller tuning via quasi-optimal methods (the modulus criterion and the Kessler symmetry criterion)	2	demonstration, case study	
Controller design via frequency domain methods with phase margin specifications	2		
Experimental controller tuning methods (Offereins, Oppelt, Ziegler–Nichols)	2		
Controller design for processes with dead time	2		
Synthesis of control algorithms for cascade and feed-forward structures	2		
Fundamentals of multivariable control. Decentralized control	2		
Decoupling-based control	2		
Robustness and sensitivity of control systems	2		

Bibliography
1. PREITL, Stefan, PRECUP, Radu-Emil, Introducere in ingineria reglarii automate, Timisoara : Editura Politehnica, 2001 (Biblioteca UTCN - 1 exemplar)
2. SKOGESTAD Sigurd POSTLETHWAITE Ian, Multivariable feedback control: analysis and design, New York, 1997 (Biblioteca UTCN - 1 exemplar)
3. JOHNSON Michael A., editor MORADI Mohammad H., editor, PID control : new identification and design methods, London, 2005 (Biblioteca UTCN - 1 exemplar)
4. MORRIS Noel Malcolm, Control engineering, New York, 1991 (Biblioteca UTCN - 1 exemplar)
5. TEWARI Ashish, Modern control design: with MATLAB and SIMULINK, Chichester, West Sussex, England, 2003 (Biblioteca UTCN - 1 exemplar)
6. DORF Richard C. BISHOP Robert H., Modern control systems, Upper Saddle River, New Jersey, Ediţiile 2014, 2011, 2008, 2001 (Biblioteca UTCN - 5 exemplare)
7. PRECUP Radu-Emil PREITL Stefan, Sisteme de reglare avansata : [curs]. Vol. 1, Timisoara, 1995 (Biblioteca UTCN - 1 exemplar)
8. https://kosalmath.files.wordpress.com/2010/08/control-engineering-matlab.pdf

9.2 Aplications (seminar/laboratory/project/practical work)	No.hours	Teaching methods	Notes
Interpretation of steady-state errors in automatic systems	2	Brainstorming, case study, classroom discussion	
Performance metrics of automatic control systems	2		
Control structures designed via the pole-zero placement method	2		
Control structures designed via the compensation method	2		
Controller design via frequency domain methods	2		
Controller tuning via the modulus and symmetry methods	2		
Controller design based on phase margin criteria	2		
Cascaded control structures	2		
Controller design for processes with dead time using the Ziegler-Nichols method	2		
Controller implementation using PLCs. Applications	2		
Study on the influence of controller tuning parameters. Case study: ACS simulator	2		
Study on the influence of controller tuning parameters.	2		
Case study: speed and position control of a DC motor	2		
Case study: control structure design for a multivariable aerodynamic system	2		

Bibliography
1. Cristina I. Pop, Eva H. Dulf, Clement Feştilă, Ingineria Reglării Automate 1, îndrumător de laborator, (Biblioteca UTCN - 20 exemplare, De vânzare la Librăria Universităţii)
2. Dorf, R. C., Bishop, R. H., Modern Control Systems, Prentice Hall, Ediţiile 2014, 2011, 2008, 2001 (Biblioteca UTCN - 5 exemplare)
3. Ogata, K., Modern Control Engineering, Prentice Hall, 2010 (Biblioteca UTCN - 1 exemplar)
4. Astrom, K.J. Advanced PID control, Instrumentation, Systems, and Automation Society, 2006 (Biblioteca UTCN - 1 exemplar)
5. PREITL Stefan PRECUP Radu-Emil FOGARASI Angela, Teoria sistemelor si reglaj automat ; Ingineria reglarii automate. Vol. 1: Culegere de probleme, Timisoara, 1994 (Biblioteca UTCN - 1 exemplar)
6. https://www.mathworks.com

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	Oral assessment at each session / Evaluation of laboratory reports	40%
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