SYLLABUS

1. Program Information

1.1 Higher education institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Department of Automation
1.4 Field of study	Automation, Applied Informatics and Intelligent Systems
1.5 Cycle of studies	Bachelor
1.6 Study Programme/Qualification	Intelligent Automation Systems (dual, in English language)
1.7 Form of education	IF – full-time education
1.8 Course code	39.00

2. Course information

2.1 Course title					**Control Engineering 2**	
2.2 Course lecturer					*Prof.Dr.Ing. Cristina I. Muresan – cristina.muresan@aut.utcluj.ro*	
2.3 Seminar / Laboratory / Project Lecturer					*Prof.Dr.Ing. Cristina I. Muresan – cristina.muresan@aut.utcluj.ro*	
2.4 Year of study	3	2.5 Semester	2	2.6 Type of assessment		E
2.7 Course status	Formative category *(DF, DS, DC)*					DS
	Optionality *(DOB, DOP, DFac)*					DOB

3.Total estimated time

3.1 Number of hours per week	5	of which:	HEI	Lecture	2	Seminar	0	Laboratory	2	Project	1
			CO		0		0		0		0
3.2 Number of hours per semester	70	of which:	HEI	Lecture	28	Seminar	0	Laboratory	28	Project	14
			CO		0		0		0		0

3.3 Distribution of time allocation (hours per semester) for:	HEI	CO
(a) Study based on textbook, course support, bibliography, and notes	2	
(b) Additional documentation in library, specialized electronic platforms, and fieldwork		
(c) Preparation of seminars/laboratories, assignments, papers, portfolios and essays		
(d) Tutoring		
(e) Examinations	3	
(f) Other activities:		
3.4 Total individual study hours (sum (3.3(a)... 3.3(f)))	5	
3.5 Total hours per semester (3.2+3.4)	75	
3.6 Number of credits per semester	3	

(HEI = Higher Education Institution, CO = Company)

4. Prerequisites (where applicable)

4.1 Curriculum Prerequisites	• Introduction to System Theory and Control Systems • Control Engineering I
4.2 Competency Prerequisites	• Mathematics • Physics • Fundamental knowledge of automation

5. Conditions (where applicable)

5.1. Course Organization Conditions	-
5.2. Seminar / Laboratory / Project organization conditions	• Laboratory classes are compulsory • Project classes are compulsory

6. Specific Competencies Acquired

Professional Competencies	• PC02 Analyse test data • PC05 Conduct quality control analysis • PC08 Design automation components • PC12 Gather technical information • PC26 Use information technology tools • PC27 Execute analytical mathematical calculations • PC30 Design control systems • PC32 Perform data analysis
Transversal Competencies	• TC01 Apply knowledge of science, technology and engineering • TC02 Think analytically • TC05 Interpret mathematical information

7. Learning outcomes

Knowledge:	• The student is able to describe, identify and summarize the fundamental concepts of automation, the methods of simulation and analysis of processes and computer-aided design techniques of classical and intelligent automatic systems and their application in concrete problems.
Skills:	• The student is able to interpret and explain automation related problems for certain types of processes using basic principles from control engineering, computer-aided design techniques and analysis methods specific to systems engineering. • The student is able to implement control structures for various types of processes. • The student is able to specify performance criteria for various types of processes, can identify problems and establish solutions for control related problems.
Responsibility and autonomy:	• The student has an honorable, responsible and ethical behavior, to ensure the reputation of the profession.

8. Course Objectives

8.1 General objective of the course	• Development of skills for correct use of automation concepts and tuning of discrete-time controllers
8.2 Specific objectives	• Identification of the control engineering related concepts • Interpreting the automation problems for different types of processes • Solving the tuning problem for different types of controllers • Evaluating the closed loop performance • Configuration and implementation of controllers

9. Contents

9.1 Lectures	No. of hours	Teaching methods	Obs.
Discrete-time control systems. Closed loop diagrams and preliminaries regarding discrete-time controller tuning	2	PPT presentations, open discussions,	
Mapping between the s plane and the z plane. The digital PID controller	2		

Design of discrete-time controllers using "via s" methods. A frequency domain approach	2	demonstration, case studies	
Discrete-time controller tuning using Kalman's algorithm	2		
Discrete-time controller tuning using the dead beat algorithm	2		
Discrete-time controller tuning using Dahlin's algorithm. Ringing phenomena. Vogel-Edgar tuning algorithm	2		
Discrete-time root locus. Part 1	2		
Discrete-time root locus. Part 2	2		
Discrete-time controller design based on indirect autotuning methods. The CHR autotuner, the Cohen Coon autotuner, the SIMC controller. Case studies	2		
Discrete-time controller design based on direct autotuning methods. The sine based autotuner, the relay test and Astrom and Hagglund autotuning. Case studies.	2		
Discrete-time controller design based on direct autotuning methods. The KC tuner. Comparative case studies.	2		
Discrete-time PID controllers using the IMC method	2		
Event-based PID control. Case studies	2		
Event-based PID control. 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. Vilanova, Ramón and Antonio Visioli. “PID control in the Third Millennium: lessons learned and new approaches.” (2012)
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. Karl J. Astrom, Tore Hagglund, PID Controllers: Theory, Design, and Tuning, USA: ISA, 2n edition, 1995
6. Karl J. Astrom, Tore Hagglund, Advanced PID Control, USA: ISA, 2006
7. José David Rojas , Orlando Arrieta , Ramon Vilanova, Industrial PID Controller Tuning, With a Multiobjective Framework Using MATLAB, London: Springer Cham, 2021
8. Robin De Keyser, Cristina I. Muresan, Validation of the KC Autotuning Principle on a Multi-Tank Pilot Process, IFAC-PapersOnLine, Volume 52, Issue 1, 2019, Pages 178-183, ISSN 2405-8963, https://doi.org/10.1016/j.ifacol.2019.06.057.

9.2 Seminar / laboratory / project	Hours HEI	Hours CO	Teaching methods	Obs.
L1. Effect of the sampling period upon closed loop perfromance	4		Brainstorming, case study, conversation	
L2. Discrete-time control algorithms. „Via s” method	4			
L3. Direct tuning of discrete-time controllers. Kalman’s and Dahlin’s algorithms	4			
L4. Event-based control of a time delay system	4			
L5. Tank level control	4			
L6. DC motor speed control	4			
L7. Control of batch processes	4			
Project: Tuning and implementation of control strategies for the industrial processes. Analysis of results.	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)
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7. José David Rojas , Orlando Arrieta , Ramon Vilanova, Industrial PID Controller Tuning, With a Multiobjective Framework Using MATLAB, London: Springer Cham, 2021
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10. Correlation of course content with the expectations of the epistemic community representatives, professional associations, and major employers in the field related to the program

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

11. Evaluation

Activity Type	**Evaluation criteria**	**Evaluation methods**	**Weight in final grade**
11.1 Lecture	Evaluation of the acquired skills	Written exam	60%
11.2 Seminar/ Laboratory/Project	Evaluation of the practical skills, activity within laboratory classes	Practical assessment	40%
11.3 Minimum Performance Standard			
Exam grade >5, laboratory grade>5, project grade>5			

Date of completion:	Lecturers		Signature
zz.ll.aaaa	Course	Prof. Dr. Ing. Cristina I. Muresan	
	Applications	Prof. Dr. Ing. Cristina I. Muresan	

Date of approval by the Department of Automation Council 24.11.2025	Director of the Department of Automation Prof.dr.ing. Honoriu VĂLEAN
Date of approval by the Faculty of Automation and Computer Science Council 28.11.2025	Dean Prof.dr.ing. Vlad MUREȘAN