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	26.00

2. Course information

2.1 Course title	**Electric and Electronic Control Equipment**				
2.2 Course lecturer	*SL.dr.ing. Isabela Birs*				
2.3 Seminar / Laboratory / Project Lecturer	*Eng. Raluca Andrei (Emerson)*				
2.4 Year of study	2	2.5 Semester	4	2.6 Type of assessment	E
2.7 Course status	Formative category *(DF, DS, DC)*				DS
	Optionality *(DOB, DOP, DFac)*				DI

3.Total estimated time

3.1 Number of hours per week	4	of which:	HEI	Lecture	2	Seminar	0	Laboratory	2	Project	0
			CO		0		0		0		0
3.2 Number of hours per semester	56	of which:	HEI	Lecture	28	Seminar	0	Laboratory	0	Project	0
			CO		0		0		28		0

3.3 Distribution of time allocation (hours per semester) for:	HEI	CO
(a) Study based on textbook, course support, bibliography, and notes	8	10
(b) Additional documentation in library, specialized electronic platforms, and fieldwork	2	12
(c) Preparation of seminars/laboratories, assignments, papers, portfolios and essays	5	8
(d) Tutoring	5	10
(e) Examinations	2	7
(f) Other activities:	0	0
3.4 Total individual study hours (sum (3.3(a)... 3.3(f)))	22	47
3.5 Total hours per semester (3.2+3.4)	50	75
3.6 Number of credits per semester	2	3

(HEI = Higher Education Institution, CO = Company)

4. **Prerequisites** (where applicable)

4.1 Curriculum Prerequisites	Fundamentals of Electronic Circuits, Computer Programming and Algorithm Design, Electrotechnics, Measurement and transducers, Physics
4.2 Competency Prerequisites	• Understanding of electrical circuits, wiring, and safety procedures. Familiarity with measurement instruments (multimeter, oscilloscope). • Knowledge of control system concepts (open-loop, closed-loop, feedback) • Basic understanding of process variables (temperature, pressure, flow, level) • Experience with any programming language (e.g., C, Python, or structured text)

5. Conditions (where applicable)

5.1. Course Organization Conditions	-
5.2. Seminar / Laboratory / Project organization conditions	• Attendance at the laboratory is mandatory.

6. Specific Competencies Acquired

Professional Competencies	• PC02 Analyse test data • PC08 Design automation components • PC10 Develop electronic test procedures • PC20 Record test data • PC25 Use technical drawing software • PC28 Use testing equipment • PC31 Use remote control equipment
Transversal Competencies	• TC01 Apply knowledge of science, technology and engineering • TC02 Think analitically

7. Learning outcomes

Knowledge:	• Understands the architecture, principles, and operation of industrial automation systems, including PLCs and DCS. Can explain the roles of sensors, actuators, controllers, and communication networks in process automation. Familiarity with industrial PID blocks and various methods for tuning/autotuning.
Skills:	• Is able to design, configure, and implement automation solutions using PLC programming and DCS integration. Can select and calibrate industrial sensors, develop and debug PLC programs, tune PID controllers, and ensure reliable system operation.
Responsibility and autonomy:	• Can independently or collaboratively manage automation projects: identify requirements, propose and implement solutions, document processes, and evaluate system performance. Demonstrates responsibility for safety, quality, and continuous improvement in industrial environments.

8. Course Objectives

8.1 General objective of the course	• To provide students with comprehensive theoretical and practical knowledge in the field of industrial automation, focusing on the design, implementation, and integration of Programmable Logic Controllers (PLC) and Distributed Control Systems (DCS), and to develop the competencies required to solve real-world automation challenges in modern industrial environments.
8.2 Specific objectives	• Acquire foundational knowledge of industrial control system architectures, including the roles and functions of PLCs and DCS. • Develop the ability to select, configure, and integrate industrial sensors and actuators for process automation. • Gain practical skills in PLC programming using standard languages and methodologies. • Understand and apply PID control theory to real-world process control problems.

	• Learn methods for integrating PLCs with DCS, including communication protocols and system interoperability. • Analyze, design, and implement automation solutions for typical industrial applications. • Foster the ability to document, present, and critically evaluate automation projects, considering safety, efficiency, and sustainability.

9. Contents

9.1 Lectures	No. of hours	Teaching methods	Obs.
1. Introduction to Electric and Electronic Control Systems *Overview of control system types, components, and their roles in automation.*	2	Theoretical presentations, discussions and interpretations, proofs. Aplications and examples for each lecture.	
2. Industrial Sensors: Types and Measurement Principles *Thermocouples, thermistors, flow sensors, and pressure sensors-operation and selection.*	2		
3. Signal Conditioning for Temperature Sensors *Signal adapters and interfaces for temperature measurement devices.*	2		
4. Signal Conditioning for Pressure, Flow, and Level Sensors *Techniques and devices for adapting pressure, flow, and level sensor outputs.*	2		
5. PID Control: Principles and Industrial Applications *Fundamentals of PID control, typical use cases, and system integration.*	2		
6. Implementing PID Controllers in Automation Systems *Practical aspects of integrating PID controllers into real-world systems.*	2		
7. PID Controller Tuning: Methods and Autotuning Tools *Overview of manual and automatic tuning techniques for PID loops.*	2		
8. Programmable Logic Controllers (PLCs): Architecture and Hardware *PLC basics, hardware components, and configuration.*	2		
9. PLC Programming: GRAFCET and Sequential Function Charts *Modeling processes and designing control sequences using GRAFCET.*	2		
10. PLC Programming: Ladder Diagrams and Logic Implementation *Developing and troubleshooting automation logic with ladder diagrams*.	2		

11. PLC Applications: Sequential Process Control *Case studies and examples of PLCs in managing sequential operations.*	2		
12. PLC Applications: Continuous Process Control *Strategies for using PLCs in continuous process industries.*	2		
13. Industrial Digital Systems and Communication Protocols *Numerical systems, Profinet, Profibus, and their roles in industrial automation.*	2		
14. Distributed Control Systems (DCS): Concepts and Integration with PLCs *Introduction to DCS, practical applications, and comparison/correlation with PLC-based systems.*	2		

Bibliography

1. 1. IDC Technologies. Design of Industrial Automation Functional Specifications for PLCs, DCSs and SCADA Systems. Perth: IDC Technologies, 2025.
2. Astrom, Karl J., and Tore Hägglund. Advanced PID Control. Philadelphia: ISA – The Instrumentation, Systems, and Automation Society, 2006.
3. Bolton, W. Programmable Logic Controllers (4th Edition). Amsterdam: Elsevier Newnes, 2006.

9.2 Seminar / laboratory / project	Hours HEI	Hours CO	Teaching methods	Obs.
1. Fundamentals of Electric and Electronic Control Systems: Hands-On Introduction	0	4	Aplications and solved exercises, discussions and interpretation.	
2. Industrial sensors, signal conditioning and adaptors	0	4		
3. PID Control Loops: Practical Implementation and Auto-Tuning	0	4		
4. PLC Fundamentals: I/O Configuration, Programming, and Troubleshooting	0	4		
5. PLC Applications: Automated Sorting System Design	0	4		
6. PLC Applications: Length-Based Cutting System Automation	0	4		
7. Integrating PLCs with Distributed Control Systems (DCS): Communication and Practical Challenges	0	4		

Bibliography

4. Petruzella, Frank D. Programmable Logic Controllers (6th Edition). New York: McGraw Hill, 2022.
5. Collins, Kevin. PLC Programming for Industrial Automation. Milton Keynes: Lightning Source Inc., 2007.
6. Jack, Hugh. Automating Manufacturing Systems with PLCs. Morrisville: Lulu Press, Inc., 2009.
7. IDC Technologies. Design of Industrial Automation Functional Specifications for PLCs, DCSs and SCADA Systems. Perth: IDC Technologies, 2025.
8. Astrom, Karl J., and Tore Hägglund. PID Controllers. 2nd Edition. Philadelphia: ISA – The Instrumentation, Systems, and Automation Society, 2006.
9. Bolton, W. Programmable Logic Controllers (4th Edition). Amsterdam: Elsevier Newnes, 2006.

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

This course aligns with the expectations of epistemic communities, professional associations, and major employers by integrating globally recognized standards (IEC 61131-3 for PLC programming), industry-driven skills (PID tuning, PLC/DCS integration via Modbus TCP/OPC-UA). Labs simulate real-world

scenarios (e.g., Ovation DCS communication, safety-critical system design), preparing students for employer demands related to expertise in automation systems.

11. Evaluation

Activity Type	**Evaluation criteria**	**Evaluation methods**	**Weight in final grade**
11.1 Lecture	Understanding of concepts Application and Problem-Solving Critical Thinking and Synthesis Engagement and Communication	Partial exam -written Final exam - written	40% 60%
11.2 Seminar/ Laboratory/Project	Practical skills Problem-solving	Lab tests (optional)	20%(optional)
11.3 Minimum Performance Standard			
40% Partial exam + 60% Final Exam + 20% Lab grade > 5			

Date of completion:	Lecturers	Title First Name LAST NAME	Signature
10.05.2025	Course	*SL.dr.ing. Isabela Bîrs*	

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