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 System (dual, in English language)
1.7 Form of education	IF – full-time education
1.8 Course code	49.00

2. Course information

2.1 Course title				**System Engineering 2**		
2.2 Course lecturer				Conf.Dr.Ing. Roxana Rusu-Both – *roxana.both@aut.utcluj.ro*		
2.3 Seminar / Laboratory / Project Lecturer				*Dr.ing. Sergiu Man (Emerson)* *Dr.ing.Adrian Olimpiu Neaga (Emerson)*		
2.4 Year of study	4	2.5 Semester	1	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	4	of which:	HEI	Lecture	2	Seminar	0	Laboratory	0	Project	0
			CO		0		0		1		1
3.2 Number of hours per semester	56	of which:	HEI	Lecture	28	Seminar	0	Laboratory	0	Project	0
			CO		0		0		14		14

3.3 Distribution of time allocation (hours per semester) for:	HEI	CO
(a) Study based on textbook, course support, bibliography, and notes	14	
(b) Additional documentation in library, specialized electronic platforms, and fieldwork	5	28
(c) Preparation of seminars/laboratories, assignments, papers, portfolios and essays		7
(d) Tutoring		7
(e) Examinations	3	3
(f) Other activities:		2
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	• Industrial Automation Platforms (Company project - sem1) • Digital Transformation (Company project - sem 3) • Creating Solutions with Integrated Technologies (Company project - sem 6) • System Engineering I
4.2 Competency Prerequisites	• Basic understanding of industrial control systems, knowledge of programming, fundamentals of automation system design from *System Engineering I.*

5. Conditions (where applicable)

5.1. Course Organization Conditions	• Lecture room equipped with video projector and internet access.

5.2. Seminar / Laboratory / Project organization conditions	• Laboratory equipped with DeltaV simulation environment, Syncade demo environment, access to virtualization infrastructure or cloud VMs. • Attendance at the laboratory is mandatory.

6. Specific Competencies Acquired

Professional Competencies	• PC01 Adjust engineering designs • PC02 Analyse test data • PC06 Define technical requirements • PC08 Design automation components • PC12 Gather technical information • PC13 Interact professionally in research and professional environments • PC21 Report analysis results • PC26 Use information technology tools • PC30 Design control systems
Transversal Competencies	• TC01 Apply knowledge of science, technology and engineering • TC03 Demonstrate responsibility • TC04 Work in teams

7. Learning outcomes

Knowledge:	Upon completion of the course, the student will be able to: • **Describe and summarize** the structure of industrial automation systems, including the ISA-88 and ISA-95 standards, distributed control systems (DCS), and manufacturing execution systems (MES), with emphasis on DeltaV and Syncade platforms. • **Explain** the interaction between physical and procedural models in batch automation and how these are implemented in DeltaV and Syncade environments. • **Identify and categorize** the architectural components of distributed control systems and their roles in industrial applications.
Skills:	The student will be able to: • **Apply** principles of ISA-88 and ISA-95 to the design and analysis of procedural and physical models in batch processing. • **Develop and simulate** unit procedures, operations, and phase logic modules in DeltaV Control Studio. • **Configure and test** Syncade workflows and recipe procedures aligned with pharma industry standards. • **Integrate** MES and DCS systems using standard protocols (e.g., OPC UA) and **troubleshoot** communication and execution errors. • **Utilize** dedicated tools (DeltaV Live, Batch Executive, Syncade modules) to monitor and control batch processes effectively.
Responsibility and autonomy:	At the end of the course, the student will: • **Demonstrate responsibility** in designing automation systems that comply with Good Manufacturing Practices (GMP) and ensure traceability and validation. • **Collaborate effectively** in multidisciplinary teams to complete project-based integration tasks involving both control and business layers.

	• **Document and justify** technical decisions in project reports and presentations, using industry-standard terminology and structure. • **Adapt and innovate** solutions in response to integration challenges and operational constraints found in regulated industrial environments.

8. Course Objectives

8.1 General objective of the course	• To provide students with advanced knowledge and practical skills in distributed control systems design, focusing on the integration between DeltaV DCS and Syncade MES under ISA-88 and ISA-95 standards.
8.2 Specific objectives	• Explain industrial automation architectures and standards. • Use DeltaV tools to implement batch control logic. • Understand and configure Syncade modules and workflows. • Enable secure communication and data flow between MES and DCS systems.

9. Contents

9.1 Lectures	**No. of hours**	**Teaching methods**	**Obs.**
1. Industrial Automation Overview	2	Comprehensive slides Blackboard annotations Oriented discussions on the subject	
2. DeltaV DCS – System Architecture & Design	2		
3. Physical control – EQM	2		
4. ISA-88 Batch Standards	2		
5. Procedural Control – UP, OP, PLM	2		
6. Complete UP Example – Layered Breakdown	2		
7. Introduction to MES – What Is Syncade?	2		
8. Syncade Architecture & Modules	2		
9. Syncade Recipe Procedures (RP)	2		
10. Syncade to DCS Communication	2		
11. Full MES-DCS Process Walkthrough	2		
12. Working with Multi-DCS Environments	2		
13. Batch Operation in Practice	2		
14. Operator Interface & Alarm Handling& Plant Admin & Engineering Tools	2		

Bibliography:

1. PAS002 – PCSD EQM
2. 7016 – DeltaV System Batch Implementation
3. ISA standards
4. PAS003 – PCSD Batch
5. MES training I
6. MES training II

9.2.1. Laboratory	**Hours HEI**	**Hours CO**	**Teaching methods**	**Obs.**
1. DeltaV Studio – Basic Setup and Simulation		2	Guided practical	
2. Modeling Physical & Procedural Elements in DeltaV - EQM		2	Hands-on modeling	
3. PLM/OP/UP Implementation in DeltaV		2	Task-based exercise	

4. Batch Recipe Execution Monitoring & Control		2	Simulation, monitoring and control	
5. Alarm Handling and Operator Intervention		2	Live analysis	
6. Syncade Simulation – User Roles and Material Flow		2	Guided navigation	
7. Syncade-DCS OPC Integration Demo		2	Integration setup	
9.2.2. Project - Design and simulate a pharmaceutical batch process integrating DeltaV and Syncade, including material tracking, operator interactions, alarm handling, and reporting.	**Hours HEI**	**Hours CO**	**Teaching methods**	
1. Requirements Analysis & Project Plan		2	Collaborative work	
2. DeltaV Functional Design Specification		2	Template-based design	
3. Control Strategy Modeling & Simulation		2	Implementation	
4. Syncade RP Workflow Design		2	Visual modeling,	
5. Integration Test Planning		2	Scenario setup	
6. End-to-End Simulation		2	Execution and debug	
7. Final Report and Presentation		2	Oral presentation and defense	

Bibliography

1. PAS002 – PCSD EQM
2. 7016 – DeltaV System Batch Implementation
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4. PAS003 – PCSD Batch
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6. MES training II

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 current demands in regulated industries such as pharmaceuticals, biotech, and food manufacturing. The curriculum incorporates Emerson technologies and ISA standards, ensuring high relevance to employers such as Emerson, Siemens, Honeywell, and digital transformation consultancies. The course supports job roles such as automation engineer, process control engineer, and MES/DCS integration specialist.

11. Evaluation

Activity Type	Evaluation criteria	Evaluation methods	Weight in final grade
11.1 Lecture	Understanding key concepts, terminology, and standards	Written final exam	50%
11.2.1 Laboratory	Practical skill in using DeltaV and Syncade	In-class evaluation	20%
11.2.2 Project	Integration ability, documentation quality, teamwork	Project report and oral presentation	30%

11.3 Minimum Performance Standard

Understand and apply basic ISA-88 concepts, demonstrate batch execution in DeltaV

- Final exam >=5
- Lab grade>=5 mandatory to be able to take the final exam
- Project grade>=5 mandatory to be able to take the final exam
- **50% Final exam + 20% Lab Grade + 30% Project grade > 5**

Date of completion:	Lecturers	Title First Name LAST NAME	Signature
15.09.2025	Course	Conf.Dr.Ing. Roxana Rusu-Both	
	Applications		

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