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	**Dynamical Systems with Discrete Event**			Discipline code	**33.00**
2.2 Course responsible/lecturer	Assoc. Prof. Camelia Avram – camelia.avram@aut.utcluj.ro				
2.3 Teachers in charge of applications	Assoc. Prof. Camelia Avram – camelia.avram@aut.utcluj.ro				
2.4 Year of study	3	2.5 Semester	5	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	46
(b) Supplementary study in the library, online and in the field	12
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	6
(d) Tutoring	2
(e) Exams and tests	3
(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	Systems Theory; Logic Design; Process Modelling
4.2 Competence	Computer Programming

5. Requirements (where appropriate)

5.1. For the course	
5.2. For the applications	

6. Specific competences

Professional competences	C3 Operating with fundamentals of control engineering, process modelling, simulation, identification and analysis methods. C5 Development and implementation of automatic control structures and algorithms based on project management principles, software environments and technologies based on programmable logic controllers
Cross competences	CT3. Identificarea oportunităţilor de formare continuă şi valorificarea eficientă a resurselor şi tehnicilor de învăţare pentru propria dezvoltare.

7. Expected learning outcomes

Knowledge	Describe, identify, and summarize fundamental concepts in automatic control systems, embedded and intelligent systems, computer science, and information technology, and explain their application to real-world problems.
Skills	Use programming languages, development environments, programming technologies, and domain-specific tools (e.g., algorithms, diagrams, models, protocols) to solve well-defined problems in systems engineering. The student/graduate interprets and explains automation problems associated with various types of processes by applying the fundamental principles of systems theory, automatic control engineering, modeling and simulation, computer-aided design techniques, and analysis methods specific to systems engineering. The student/graduate recognizes and implements complex architectures for intelligent autonomous systems; specifies system requirements, develops simulation scenarios, proposes solutions to control engineering problems, and analyzes and evaluates the performance of automated systems.
Responsibilities and autonomy	The student/graduate applies the values of professional engineering ethics and deontology and demonstrates logical reasoning, critical evaluation, and self-assessment in decision-making. The student/graduate communicates engineering activities effectively to a wide range of audiences; engages in lifelong learning to acquire and apply new knowledge as required, using appropriate learning strategies; and promotes dialogue, collaboration, respect for others, and intercultural understanding.

8. Course objectives

General objective	Understanding and applying formal methods for modelling, analysis, synthesis and control of discrete event systems
Specific objectives	• To use Petri net-based computer-aided tools, Grafcet method and flowcharts in modelling and control. • To develop advanced control techniques based on suitable formal models. • To use PLCs in discrete event systems control structures

9. Contents

9.1 Lecture	No.hours	Teaching methods	Notes
Introduction, approach methods, examples and applications of discrete event systems	2h	Interactive methods, examples, practical applications	
Grafcet method-based approach of discrete event systems	2h		
Petri nets: formal definitions, transitions firing, incidence matrix, examples	2h		
Modelling features: Subclasses of Petri nets	2h		
Behavioural properties of Petri nets	2h		
Analysis methods of Petri nets	2h		
Deterministic timed Petri nets	2h		
Stochastic timed Petri nets; Markov chains	2h		
Modelling of flexible manufacturing systems based on Petri nets	4h		
Petri nets-based languages	2h		
Supervision methods of discrete event systems; algebraic approach	2h		
Foundation for the use of PLCs	4h		

Bibliography

1. Leţia, T., Aştilean, A., „Sisteme cu evenimente discrete”, Editura albastră, Cluj-Napoca,1998
2. Avram, C., Lecturer Notes, 2026
3. Desel, J., Esparz, J., Free Choice Petri Nets, Cambridge University Press, 2005
4. Stenerson, J., “Fundamentals of Programmable Logic Controllers, Sensors and Communications”, Prentice Hall, 2004
5. Pawlewsk, P., Petri Nets Applications, IntechOpen, 2010

9.2 Aplications (seminar/laboratory/project/practical work)	No.hours	Teaching methods	Notes
Description and modelling of discrete event systems	2h	Interactive methods, examples,	Mandatory attendance
Grafcet method	2h		
Modelling of discrete event systems using Petri Nets; Simulation and analysis tools for Petri Nets	2h		

The evolution of the marking in Petri Nets	2h	practical applications	
Behavioural properties of Petri Nets	2h		
Analysis Methods of Petri Nets	4h		
Timed Petri Nets-based modelling	2h		
Stochastic Petri Nets	2h		
Supervision of discrete event systems- Case studies	2h		
PLCs programming- basic notions	2h		
PLC-based process controls I	2h		
PLC-based process control II	2h		
Final test	2h		

Bibliography
Bibliography
1. Leţia, T., Aştilean, A., „Sisteme cu evenimente discrete", Editura albastră, Cluj-Napoca,1998
2. Avram, C., Lecturer Notes, 2026
3. Pawlewski, P., Petri Nets Applications, IntechOpen, 2010
4. Stenerson, J., "Fundamentals of Programmable Logic Controllers, Sensors and Communications", Prentice Hall, 2004;
5. Laboratory eHandbook, 2026

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

11. Evaluation

Activity type	11.1 Assessment criteria	11.2 Assessment methods	11.3 Weight in the final grade
11.4 Course	The capacity to use knowledge, creativity Correct utilisation of techniques or means of expression specific to the field	Written exam/ or online on Teams platform	0.8
11.5 seminar/ laboratory/ project/ practical work	Choices consistent with the objective and with the intent developed The development of relevant skills	Methods of checking homework Assessment of laboratory work	0.2
11.6 Minimum performance standard			

Date of filling in:		Title Firstname NAME	Signature
7/7/2026	Course	Assoc. Prof.dr.ing. Camelia AVRAM	
	Aplications	Assoc. Prof.dr.ing. Camelia AVRAM	

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