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	***Distributed Control Systems***			Discipline code	**46.00**
2.2 Course responsible/lecturer	Prof.dr.ing. Letia Tiberiu – Tiberiu.Letia@aut.utcluj.ro				
2.3 Teachers in charge of applications	As. dr.ing. Dahlia Al-Janabi – dahlia.aljanabi@aut.utcluj.ro				
2.4 Year of study	4	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		3.3 Laboratory	1	3.3 Project	1
3.4 Number of hours per semester	56	of which:	3.5 Course	28	3.6 Seminar		3.6 Laboratory	14	3.6 Project	14
3.7 Individual study										
(a) Manual, lecture material and notes, bibliography										15
(b) Supplementary study in the library, online and in the field										15
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										13
(d) Tutoring										3
(e) Exams and tests										3
(f) Other activities:										0

3.8 Total hours of individual study (sum of (3.3(a)...3.3(f)))	49
3.9 Total hours per semester (3.2+3.4)	105
3.10 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 Curriculum	• Computer programming, • Software engineering • Real time systems • Control engineering
4.2 Competence	Operation with basic concepts from computer science information and communication technologies

5. Requirements (where appropriate)

5.1. For the course	Presence 50 %
5.2. For the applications	Laboratory and project activities are compulsory

6. Specific competences

Professional competences	**C2** Operation with basic concepts from computer science information and communication technologies **C3** Operating with fundamentals of control engineering, process modelling, simulation, identification and analysis methods, and computer aided design. **C4** Design, implementation, testing, operation and maintenance of systems with generic and dedicated equipments, including computer networks for control engineering and applied informatics.

Cross competences	N/A

7. Expected learning outcomes

Knowledge	The student/graduate identifies, describes and summarizes basic concepts, principles and methods of large systems, distributed control systems, complex systems describes, identifies and summarizes the methods of modeling, identification, simulation and analysis of large systems as well as their application in concrete problems; designs, implements, tests, uses and knows how to ensure the maintenance of distributed control systems, intelligent systems, large systems, including computer networks or IoT for applications of automation and applied informatics; develops application development and implementation of algorithms and automated driving structures, using project management principles, programming environments, develops applications for control of mobile robots and robots, including artificial intelligence techniques;
Skills	Analyze systems using the theories studied and design, implement, diagnose and troubleshoot digital systems. Develops models for different components of computer systems, hardware and software and evaluates functional and non-functional features Designs and implements functional systems of complexity Choose and explain specific concepts of algorithm design, object-oriented programming, logical and functional programming
Responsibilities and autonomy	Runs processes in the management of computer projects and information technology, with taking over different team roles and clear and concise description, verbally and in writing, of the results. It assumes responsibility for the quality, security and correctness of developed solutions and shows autonomy in organizing design and learning activities, collaborating effectively in teams and adapting to new requirements and technologies.

8. Course objectives

General objective	• conceiving of the large control systems • distributed and complex process control
Specific objectives	• Using hardware - software codesigns and software engineering as development methodologies, including the system level modelling. • acquiring of distributed control methods • conceiving of the distributed control algorithms • distributed control algorithm implementation

9. Contents

9.1 Lecture	No.hours	Teaching methods	Notes
Distributed Control Systems (DCS). Introduction to DCS and Cyber-Physical Systems	2	Interactive	
Distributed control systems characteristics and principles	2		
Specification and verification of DCS (Fuzzy Logic Enhanced Time Petri Nets, Distributed Time Petri Nets, Object Enhanced Time Petri Nets)	2		
Quantum Fuzzy Logic Petri Net (QFLPN) models	2		
Design of DCS (component diagram with OETPN and FLETPN)	2		
Distributed processes coordination and resources allocation	2		
Distributed control system implementations (TCP/IP, UDP, RMI)	2		
Digital twins	2		
Control networks	2		
Cooperative control	2		
Intelligent methods for distributed control systems	2		
Urban vehicle traffic control	2		
Railway traffic control; Lake system control, Power systems	2		
Resilience of DCS (rail traffic)	2		
Bibliography			

1. T.Letia, M. Hulea. Sisteme de control distribuit. Ed. Mediamira Cluj-Napoca ISBN 973-713-080-4, 2005, (270 pag.).
2. T. Leţia. Programarea avansată în Java. Editura Albastră (Microinformatica), ISBN 973-650-063-2, 2002 (281 pag.).
3. T. Letia, A. Astilean. Sisteme cu evenimente discrete: modelare, analiză şi control. Editura Albastră (Microinformatica), Cluj-Napoca, ISBN. 973-9215-76-9, 1998 (228 pag.), 1998.
4. G. Coullouris. Distributed Systems. Concepts and Design. Addison-Wesley Company Press, 1994
5. T. Letia, A.O. Kilyen. Method of approaching the cyber-physical systems, IEEE Digital Library, 2016.
6. T. Leția, D. Al-Janabi.. Object enhanced time Petri net models, AQTR 2018, Cluj-Napoca, Romania, 978-1-5386-2205-6/18; DOI: 10.1109/AQTR.2018.8402743;WOS: 000450065900041
7. T.S. Letia, D. Al-Janabi, M.F. Enache. Hindsight of the Order to Chaos Edges for Traffic Systems, IEEE Conf. AQTR, Cluj-Napoca, 2020
8. M.F. Enache, D. Al-Janabi, T.S. Letia. Conceiving of Resilient Railway Systems, IEEE Conf. AQTR, Cluj-Napoca, 2020
9. T.S.Letia,O. Cuibus, D. Al-Janabi, M.M. Santa. Quantum Fuzzy Logic Petri Nets. AQTR, 2026

9.2 Aplications (seminar/laboratory/project/practical work)	No.hours	Teaching methods	Notes
Laboratory L1. Network communication with TCP/IP and UDP protocol: sockets, client-server applications with single and multi-threaded server	2	interactive	
L2. Fuzzy Logic Enhanced Time Petri Nets (FLETPN) models and components	2		
L3. Applications with FLETPN components	2		
L4. Distributed Object Enhanced Real-Time Petri Net (OETPN) models	2		
L5. Cooperative control systems – applications implemented with OETPN models	2		
L6. Applications implemented with Quantum Fuzzy Logic Petri Nets (QFLPN)	2		
L7. Compensatory and final tests	2		
Project P1. Development methodology	2		
P2. Specification of Distributed Control Application (DCA) (optional: specification using QFLPN)	2		
P3. Controlled plant model and identification (optional: modelling using QFLPN)	2		
P4. Synthesis of Distributed Control System (DCS)	2		
P5. DCS implementation (optional: implementation of QFLPN)	2		
P6. Verification and testing	2		
P7. Project defending and assessment	2		
	2		
Bibliography			

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

Lecturers, laboratory and project subjects are correlated with applications developed in companies like Accenture Siemens, Arobs, Emerson, Bosch etc.

11. Evaluation

Activity type	11.1 Assessment criteria	1.2 Assessment methods	11.3 Weight in the final grade
11.4 Course	Final exam (E)	Written exam / online exam using Teams	0,5
11.5 Laboratory/ Project	Test (L) Test (P)	Written test + source code+ implementation/ online exam using Teams	0.25(L)and 0.25(P)
11.6 Minimum performance standard: E≥5, M≥ 5, L≥5, P≥5			

Date of filling in:		Title Firstname NAME	Signature
15.6.2026	Course	Prof.dr.eng. Tiberiu LETIA	
	Applications	As. Dr. Eng. Dahlia Al-Janabi	

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