

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 Department	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
1.8 Codul disciplinei	46.00

2. Data about the subject

2.1 Subject name	Distributed Control Systems				
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, DID – in the field, DS – specialty, DC – complementary				DS
	DOB – compulsory, DOP – elective, FAC – optional				DOB

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminar		Laboratory	1	Project	1
3.2 Number of hours per semester	56	of which:	course	28	Seminar		Laboratory	14	Project	14
3.3 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
3.4 Total hours of individual study (sum of (3.3(a))...(3.3(f)))										49
3.5 Total hours per semester (3.2+3.4)										105
3.6 Number of credit points										5

4. Pre-requisites (where appropriate)

4.1 Curriculum	<ul style="list-style-type: none"> • Computer programming, • Software engineering • Real time systems
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6.1 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.
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	<ul style="list-style-type: none"> 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	N/A
5.2. For the applications	Laboratory and project activities are compulsory

6. Specific competences

	C4 Design, implementation, testing, operation and maintenance of systems with generic and dedicated equipments, including computer networks for control engineering and applied informatics.
6.2 Cross competences	N/A

7. Course objectives

7.1 General objective	<ul style="list-style-type: none"> conceiving of the large control systems distributed and complex process control
7.2 Specific objectives	<ul style="list-style-type: none"> Using hardware -software codesign 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

8. Contents

8.1 Lecture	No.hours	Teaching methods	Notes
1. Distributed Control Systems (DCS). Introduction to DCS	2	Interactive	
2. Distributed control systems characteristics and principles	2		
3. Specification and verification of DCS (Fuzzy Logic Enhanced Time Petri Nets, Distributed Time Petri Nets, Object Enhanced Real-Time Petri Nets)	2		
4. Design of distributed control applications with OETPN	2		
5. Coordination of distributed processes and resource allocation	2		
6. Distributed control system implementations (TCP/IP, UDP, RMI)	2		
7. Digital twins	2		
8. Predictive control in DCS	2		
9. Control networks	2		
10. Cooperative control	2		
11. Intelligent methods for distributed control systems	2		
12. Urban vehicle traffic control	2		
13. Railway traffic control; Lake system control, Power systems	2		
14. 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. Leția. 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 și 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, 978-15386-2205-6/18; DOI: [10.1109/AQTR.2018.8402743](https://doi.org/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, ClujNapoca, 2020
1. <http://control.aut.utcluj.ro>
2. C. Walls, Spring in Action, Fourth Edition, Mannings, 2004
3. <https://spring.io/guides> **Error! Hyperlink reference not valid.**
4. <http://developer.android.com/training/index.html>.

8.2 Applications (seminar/laboratory/project)	No.hours	Teaching methods	Notes
Laboratory			
L1. Network communication with TCP/IP protocol	2		
L2. Network communication with UDP protocol. Application level HTTP protocol	2		
L3. Fuzzy logic, fuzzification and defuzzification	2		
L4. Applications with Fuzzy Logic Enhanced Time Petri Net (FLETPN) models	2		
L5.Distributed Object Enhanced Real-Time Petri Net models	2		
L6. Cooperative control of a lake system	2		
L7. Compensatory and final tests	2		
Project			
P1. Development methodology			
P2. Specification of Distributed Control Application (DCA)			
P3. Controlled plant model and identification			
P4. Synthesis of Distributed Control System (DCS)			
P5. DCS implementation			
P6. Verification and testing			
Project defending and assessment			

9. 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.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Final exam (E)	Written exam / online exam using Teams	0,5
Seminar			
Laboratory	Test (L)	Written test + source code+ implementation/ online exam using Teams	0,25
Project	Test (P)	Written test + source code + implementation/ online exam using Teams	0,25

Minimum standard of performance: E≥5, M≥ 5, L≥5, P≥5
 When online assessment is required, the project has to be sustained in an online interview manner.
 Laboratory assessment (i.e. implementation verification) is performed during the final exam on the provided problem.

Date of filling in:		Title Firstname NAME	Signature
15.06.2024	Course	Prof.dr.ing. Tiberiu LETIA	
	Applications	As.dr.ing. Dahlia Al-Janabi	

Date of approval by the Department Board	Head of Department
_____	Prof.dr.ing. Honoriu VĂLEAN
Date of approval by the Faculty Council	Dean
_____	Prof.dr.ing. Mihaela Dâșoreanu