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
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	• 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	N/A
5.2. For the applications	Laboratory and project activities are compulsory

6. Specific competences

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.

	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	• conceiving of the large control systems • distributed and complex process control
7.2 Specific objectives	• 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. Architectures for DCS	2		
4. Specification and verification of DCS (Fuzzy Logic Enhanced Time Petri Nets, Distributed Time Petri Nets, Object Enhanced Real-Time Petri Nets)	2		
5. Design of distributed control applications with OETPN	2		
6. Time in distributed systems	2		
7. Coordination of distributed processes and resource allocation	2		
8. Distributed control system implementations (TCP/IP, UDP, RMI)	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. 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
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			
OETPN models • Definition • Properties • Capabilities • Components with OETPN			
Specification • Controlled process models • System requirements			
Design • Control algorithm synthesis • Component diagram conception • Each component OETPN model • OETPN guards and maps • Token types • Component ports • Port protocols			
Implementation • Synchronous approach • Asynchronous approach			
Integration and Testing • Component integration • Tests conceptions • Test experimentation			
Maintenance • Improvement proposal • Improvement			
Project defending			

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**
15.03.2023	Course	Prof.dr.eng. Tiberiu LETIA	
	Applications	As. Dr. Eng. Dahlia Al-Janabi	

Date of approval by the Department Board ……..

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Head of Departament .....
Prof.dr.ing. Honoriu VĂLEAN

Date of approval by the Faculty Council ……

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Dean
Prof.dr.ing. Liviu Cristian MICLEA