

Syllabus

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Computer Science
1.4 Field of study	Computer Science and Information Technology
1.5 Cycle of study	Bachelor of Science
1.6 Program of study / Qualification	Computer science / Engineer
1.7 Form of education	Full time
1.8 Codul disciplinei	107

2. Data about the subject

2.1 Subject name	<i>Real Time Systems</i>				
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	III	2.5 Semester	2	2.6 Assessment (E/C/V)	E
2.7 Type of subject	<i>DF – fundamental, DID – in the field, DS – specialty, DC – complementary</i>				DS
	<i>DOB – compulsory, DOP – elective, FAC – optional</i>				DOB

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminars	-	Laboratory	2	Project	-
3.2 Number of hours per semester	104	of which:	Course	28	Seminars	-	Laboratory	2	Project	-
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										26
(d) Tutoring										3
(e) Exams and tests										3
(f) Other activities:										0
3.4 Total hours of individual study (suma (3.3(a)...3.3(f)))				48						
3.5 Total hours per semester (3.2+3.4)				104						
3.6 Number of credit points				4						

4. Pre-requisites (where appropriate)

4.1 Curriculum	Basic programming Software engineering Discrete event systems
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4.2 Competence	Computer programming
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5. Requirements (where appropriate)

5.1. For the course	Presence 50%
5.2. For the applications	Presence 100%

6. Specific competences

6.1 Professional competences	C2 – Fundamental operation concepts from computer science information and communication technologies C5 Application development, algorithm implementations and control structures using project management principles, programming environment and microcontroller based technologies, DSP, PLC an embedded systems
6.2 Cross competences	N/A

7. Course objectives

7.1 General objective	Conceiving of reactive applications
7.2 Specific objectives	Specification, design, implementation and testing of control applications

8. Contents

8.1 Lecture	No.hours	Teaching methods	Notes
Real-Time Systems (RTS). Introduction to RTS	2	interactive	
Paradigms, basic definitions, RTS characteristics, real-time control, temporal parameters	2		
Specification of real-time applications (RTAs)	2		
Modeling of RTAs using Petri nets	2		
Design of RTAs with Unified Modeling Language	2		
Real-Time operating systems	2		
Interprocess communication	2		
Interrupt handling	2		
Concurrent programming in standard Java	2		
Implementation using Realtime Java	2		
Evaluation and measuring of execution times	2		
Scheduling (tests and verification)	2		
Verification and test of RT implementation	2		
Reliability of RTAs	2		

Bibliography

1. 1. T. Leția. Sisteme de timp-real. Editura Alabastră (Microinformatica), ISBN 973-9443-49-4, 2001 (363 pag.).
2. T. Letia, A. Astilean. Sisteme cu evenimente discrete: modelare, analiză și control. Editura Alabastră (Microinformatica), Cluj-Napoca, ISBN. 973-9215-76-9, 1998 (228 pag.).
3. B. Bărbat, F.G. Filip. Informatică industrială. Ingineria programării în timp-real. Ed. Tehnică, București, 1997.
4. J.E. Cooling. Software Design for Real-time Systems. International Thomson Computer Press, London, 1991.
5. Alan Burns, A. Wellings. Real-Time Systems and Programming Languages. Addison Wesley, 2001
6. A.M.K. Cheng. Real-Time Systems. Scheduling, Analysis and Verification, John Wiley and Sons, 2002
7. G. Buttazzo. Real-Time Systems. Predictable Scheduling and Applications. Springer, 2005.
8. Bruce Powell Douglass. Real-Time UML. Third Edition. Advances in The UML for Real-Time Systems. Ed. AddisonWesley. 2007.
9. E.J.Bruba și Greg Bollella. Real-Time Java Programming with Java RTS. Sun Microsystems, 2009.
10. B.P. Douglass. Real Time UML Third Edition. Advances in the UML for Real-Time Systems. Addison-Wesley, 2007
11. A.M.K. Cheng. Real-Time Systems Scheduling, Analysis, and Verification. Ed. Wiley Interscience, John Wiley and Sons, 2002.
12. G.C. Buttazzo. Hard Real-Time Computing. predictable Scheduling Algorithms and Application. Second Edition. Ed. Springer. 2005.
13. T. S. Letia, D. Al- Janabi, "Object Enhanced Time Petri Nets", 3rd International Conference on Event-Based Control, Communication and Signal Processing (EBCCSP), DOI: 10.1109/EBCCSP.2017.8022831, 2018.

8.2 Applications (seminar/laboratory/project)	Hours	Teaching methods	Notes
L1. Introduction – Tool and development environment	2	Interactive	
L2. Threads in Java SE – General concepts	2		
L3. Threads in Java SE – Classic synchronization mechanisms	2		
L4. Applications with threads in Java SE – Petri nets and Time Petri nets implementations and tests using classic synchronization mechanisms	2		
L5. Threads in Java SE – Package java.util.concurrent - Part 1	2		
L6. Threads in Java SE – Package java.util.concurrent - Part 2	2		
L7. Applications with threads in Java SE - Petri nets and Time Petri nets implementations and tests using synchronization mechanisms from the package java.util.concurrent	2		
L8. Implementation of OETPN models	2		
L9. Conceiving the applications with OETPN models	2		
L10. Verification of temporal properties of RTAs	2		
L11. Scheduling on monoprocessor systems	2		
L12. Scheduling on multiprocessor systems	2		
L13. Compensatory activities	2		
L14. Final test -	2		

Bibliography

1. Radu Miron, M.M Santa, T.S. Letia. Real Time Systems. Laboratory training lessons. TUCN

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

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10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Final exam (E)	Written test/ online exam on Teams platform under COVID situation	0,66
Seminar			
Laboratory	Test(L)	Written test + source code + implementation/ online exam on Teams platform under COVID situation	0,33
Project			
Minimum standard of performance: E≥5, M≥ 5, L≥5			

Date of filling in: 26.02.2025	Responsible	Title, First name Last name	Signature
	Course	Prof.dr.eng. Tiberiu LETIA	
	Applications	As.dr.eng Dahlia AL-JANABI	

Date of approval in the department	Head of department, Prof.dr.eng. Rodica Potolea
Date of approval in the Faculty Council	Dean, Prof.dr.eng. Vlad Mureşan