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	39.00

2. Data about the subject

2.1 Subject name			*Real Time 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	3	2.5 Semester	2	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	2	Project	
3.2 Number of hours per semester	104	of which:	course	28	Seminar		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 (sum of (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
4.2 Competence	Computer programming

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		
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	interactive	
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. Leţia. Sisteme de timp-real. Editura Albastră (Microinformatica), ISBN 973-9443-49-4, 2001 (363 pag.).
2.   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.).
3.   B. Bărbat, F.G. Filip. Informatică industrială. Ingineria programării în timp-real. Ed. Tehnică, Bucureşti, 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, JhonWiley ans Sons, 2002
7.   G. Buttazzo. Real-Time Systems. Predicatble Scheduling and Applications. Springer, 2005.
8.   Bruce Powel Douglass. Real-Time UML. Third Edition. Advances in The UML for Real-Time Systems. Ed. AddisonWesley. 2007.
9.   E.J.Brubo şi Greg Bollella. Real_Time Java Programming with Java RTS. Sun Micorsystems, 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, JohnWiley 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 Aplications (seminar/laboratory/project)	No.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**

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: 15.06.2024		Title Firstname NAME	Signature
	Course	Prof.dr.ing. Tiberiu LETIA	
	Applications	As.dr.ing 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. Mihaela Dânşoreanu