SYLLABUS

1. Data about the program of study

1.1	Institution	Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Electrical Engineering
1.3	Department	Electrotechnics and Measurements
1.4	Field of study	Electrical Engineering
1.5	Cycle of study	Bachelor of Science
1.6	Program of study/Qualification	Engineer
1.7	Form of education	Full time
1.8	Subject code	53.10

2. Data about the subject

2.1	Subject name			Microcontrollers and Embedded Systems			
2.2	Course responsible/lecturer			Prof. dr. ing. Calin Gh. RUSU *calin.rusu@emd.utcluj.ro*			
2.3	Teachers in charge of seminars			sl. dr. ing. SACLU Ionut Sorin			
2.4 Year of study	4	2.5 Semester	1	2.6 Assessment			C
2.7 Subject category	Formative category						DS
	Optionality						DO

3. Estimated total time

3.1 Number of hours per week	4	of which	3.2 Course	2	3.3 Seminar	-	3.3 Laboratory	2	3.3 Project	-
3.4 Total hours in the curriculum	56	of which	3.5 Course	28	3.6 Seminar	-	3.6 Laboratory	28	3.6 Project	-

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	10
(b) Supplementary study in the library, online and in the field	10
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	10
(d) Tutoring	10
(e) Exams and tests	4
(f) Other activities	

3.8 Total hours of individual study (summ (3.7(a)...3.7(f)))	44
3.9 Total hours per semester (3.4+3.8)	100
3.10 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1	Curriculum	Electronics and Power Electronics, Control System Engineering, Programming in C, Modeling with Matlab/Simulink, Sensors and Transducers
4.2	Competence	Operational Amplifiers, DC-DC Converters, Power Converters, Computer programming in C and C++, Matlab/Simulink, Math Modelling of electric/mechanical systems

5. Requirements (where appropriate)

5.1	For the course	Course classroom with blackboard and multi media projector/On-line TEAMS, ZOOM, Skype
5.2	For the applications Seminar /Laboratory/Project	Lab Classroom with 10 computer network, 10 embedded systems with ARM microcontrollers, Matlab/Simulink academic licences/On-line TEAMS, Teaching by Doing (Do It Yourself – DIY)

6. Specific competences

Professional competences	C6.1. Fundamental principles and concepts for microcontroller systems C6.2. Explaining the embedded systems as a technological solution in solving control problems and communication between objects C6.3. Applying the principles of distributed and hierarchical system with open architecture that embedded systems provide as a technological solution C6.4. Interconnection facilities in the local area or extended network for microcontroller systems as a technological solution C6.5. Explaning the concept of Internet of Things - IoT and Industrial Internet of Things - IIoT which is reached through the interconnection facility. C6.6. Digitization society and Industry 4.0
Cross competences	CT 1. Identification of the objectives to be achieved, of the available resources, the conditions for their completion, the working stages, the working times, the accomplishment terms and the related risks. CT 2. Identifying the roles and responsibilities in a multidisciplinary team and applying relationship techniques and efficient work within the team. CT 3. Efficient use of information sources and communication resources and assisted professional training (Internet portals, applications.

7. Discipline objectives (as results from the *key competences gained*)

7.1	General objective	➢ to understand the role and importance of embedded systems as a technological solution that offers superior versatility and interconnect ability regardless of the field and area of application. ➢ to develop some educational applications that highlight the connection between the hard and soft component that constitutes the fundamental structure of an embedded system. ➢ to understand the essential role of the embedded system in realizing versatile control, self-testing and interfacing with other subsystems through communications through wired or wireless industrial protocols. ➢ to implement the PID type control for simple educational applications in SISO type system.
7.2	Specific objectives	➢ to determine the mathematical model for a physical system in the form of a transfer function ➢ to analyze and design a control system with PID type regulator ➢ to implement the digital PID controller on an Arduino Uno / Mega / DUE or compatible system ➢ to analyze the real behavior of the control system based on the system response

8. Contents

8.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
Course # 1: Introduction to Embedded Systems and Microcontrollers. Basics, Features and Structure, Differences between microcontrollers and microprocessors.	2	Prezentare in PPT, videoproiector, On-line Teams	
Course # 2: Microcontrollers on 8/16/32 bits, RISC Architecture. Internal structure and Interface. Raspberry PI	2		
Course # 3: Arduino Uno / Mega / DUE and / ST32 microsystem. Presentation and Structure of ARM arhitecture.	2		
Course # 4: C and C ++ programming with Arduino DUE. Program structure. Libraries. Programming techniques	2		
Course # 5: Integrated development environment for embedded system application. Model based development with Matlab/Simulink.	2		
Course # 6: Application programming. Digital Input / Output Interfaces. Displaying messages and communicating via USB/WiFi/Bluetooth.	2		
Course # 7: Application Programming. Analog Input and PWM interfaces. Display of purchased values. Acquisition and conversion of data from different types of sensors. PWM unit. Command an MCC and MPP.	2		
Course # 8: Programming Applications with GUI Interfaces using Matlab / Simulink / LabVIEW	2		
Course # 9: Communication interfaces with and/or without USB, I2C, Bluetooth, WiFi, RS422 / RS485, CAN	2		
Course # 10: Internet of Things IoT and Industrial IoT. Ethernet communication. Development of Distributed applications.	2		
Course # 11: Mobile robots with wireless control (Bluetooth WiFi) and Web Cam Vision System.	2		
Course # 12: Implementing of a digital PID controller for Temperature regulation.	2		
Course # 13: Adjusting the speed of an MCC. Digital Control of DC-DC Converters, Self-balancing control for mobile robots	2		
Course # 14: Networks of hierarchical and distributed microsystems.	2		

Bibliography

1. Microcontrolere si Sisteme Integrate, Călin RUSU, note de curs 2016, PPTX si PDF.
2. Programarea in Matlab a Aplicatiilor cu Arduino, Călin RUSU, UTPress CD ISBN 978-606-737-412-4
3. Digital control system design, Călin RUSU, Casa cartii de stiinta, 2000, 973-686-092-2, Cluj Napoca
4. Ingineria robotilor : cinematica, dinamica si control, Călin RUSU, Mediamira, 2001, 973-9358-36-5, Cluj Napoca
5.

Materiale didactice

1. Calin G RUSU, SZŐKE Enikő, KREISZER RADIAN Melinda – Matlab in modelarea simularea si controlul sistemelor. Ghid practic pentru studenti, Editura UT PRESS 2008, ISBN 978-973-662-364-6
2. Călin RUSU, Aplicatii Matlab in controlul sistemelor, Ed Mediamira, Cluj, 2006
3. Călin RUSU, Matlab in controlul sistemelor. Ghid practic pentru studenti si ingineri, Ed Mediamira, Cluj, 2005
4. Matlab 8.3 Student version release 14 with Service Pack3, Matworks 2015 , www.matworks.com
5. Simulink 8.3 Student version release 14 with Service Pack3, Matworks 2015, www.matworks.com
6. Calin G. RUSU. – Teoria Sistemelor, note de curs, http://bavaria.utcluj.ro/~rcalin

8.2. Seminar /Laboratory/Project	Number of hours	Teaching methods	Notes
The structure of an embedded system and communication with the application development system.	4	Practical laboratory works with implementation and experimentation using educational platforms type Arduino MEGA/DUE	
Presentation of the application development environment and the structure of an application. Programming simple applications that use digital I/O interfaces. Displaying messages.	4		
Programming the applications that use an analog I/O and PWM interfaces. Displaying or graphical representation of values or/and messages.	4		
Microsystem communication through I2C and SPI interfaces. Applications. Ethernet communication. WebServer - Iot and IIoT	4		
CAN-Bus communication and Automotive applications	4		
Applications with GUI interfaces using Matlab / Simulink. Acquisition data system with storage and monitoring.	4		
Analysis of a SISO system and control of the output size. Model base development for the DC Motor Speed control using an encoder. Digital PI controller with graphical interface. Example.	4		

Bibliography

1. Microcontrolere si Sisteme Integrate, Călin RUSU, note de curs 2016, PPTX si PDF.
2. Programarea in Matlab a Aplicatiilor cu Arduino, Călin RUSU, UTPress CD ISBN 978-606-737-412-4
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1. Calin G. RUSU, SZŐKE Enikő – Matlab in modelarea simularea si controlul sistemelor. Ghid practic pentru studenti, Editura UT PRESS 2008, ISBN 978-973-662-364-6
2. Călin RUSU, Aplicatii Matlab in controlul sistemelor, Ed Mediamira, Cluj, 2006
3. Călin RUSU, Matlab in controlul sistemelor. Ghid practic pentru studenti si ingineri, Ed Mediamira, Cluj, 2005
4. Matlab 8.3 Student version release 14 with Service Pack3, Matworks 2015 , www.matworks.com
5. Simulink 8.3 Student version release 14 with Service Pack3, Matworks 2015, www.matworks.com
6. Calin G. RUSU. – Teoria Sistemelor, note de curs, http://bavaria.utcluj.ro/~rcalin

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

- understanding and analysis of embedded systems as a technical solution regardless of the field of application
- approach design issues based on a systemic vision as an embedded solution

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	Knowledge and ability to use creatively the acquired knowledge		50%
10.5 Seminar/ Laboratory/Project	Homework / Laboratory Theme /Course project	verification	50%
10.6 Minimum standard of performance			

Date of filling in: 15.04.2024	09.04.2021	Title Surname Name	Signature
	Lecturer	Prof. Dr. eng. Calin Gh. Rusu	
	Teachers in charge of application	Lec. Dr. eng. Salcu Sorin Ionut	

Date of approval in the department ……..

_ September 2024

Head of Department:
Prof. Eng. MICU Dan Doru, PhD

Date of approval in the faculty ……

September 2024

Dean
Conf.dr.ing. Cziker Andrei Cristinel