Course Title	Embedded Systems & Laboratory				
Course Code	ECE310				
Course Type	Compulsory				
Level	Bachelor (1st Cycle)				
Year / Semester	3rd Year / 6th Semester				
Teacher's Name	TBA				
ECTS	6	Lectures / week	3 hours / 14 weeks	Laboratories / week	3 hours / 14 weeks
Course Purpose and Objectives	The aim of this course is to provide students with the necessary skills which will allow them to design, interface, configure, and program Microcontroller Unit (MCU)-based Embedded Systems. During the laboratory part of the course, students will gain hands-on experience on the programming and configuration of real-life embedded systems by utilizing an MCU integrated development environment.				
Learning Outcomes	Upon successful completion of this course, students should be able to: • Describe how an embedded system compares to a general-purpose computer system and explain its significance in modern technological applications • Describe the typical functions and attributes of embedded systems • Design typical embedded systems applications and implement them using high-level and assembly programming languages • Describe how digital interfacing is implemented in modern embedded systems using both parallel and asynchronous / synchronous serial approaches • Describe how analogue interfacing is implemented in modern embedded systems, as well as the basic techniques for digital-to-analogue (DAC) and analogue-to-digital conversion (ADC)				
Prerequisites	ECE210	Co-requisites	None		
Course Content	**Theoretical part** <u>Introduction</u>: Definition of an MCU-based embedded system, embedded systems versus general-purpose computer systems, fundamental embedded system concepts, attributes, and operations, typical examples of embedded systems. <u>Input / Output Peripheral</u>: General description and characteristics of the I/O peripheral, I/O configurations, I/O signals, interrupts and event triggering, peripheral interrupt configuration, periodic interrupts and hardware timers.				

	Embedded systems programming: High-level programming languages and assembly programming languages, translating high-level language statements to equivalent assembly language, program translation (compilation, assembly, linking), memory considerations, debugging techniques, developing practical programming applications in embedded systems. Analogue Interfacing: Basic analogue interfacing concepts, quantization, sampling, Digital-to-Analogue (DAC) conversion, DAC concepts, DAC architectures, Analogue-to-Digital (ADC) conversion, ADC concepts, ADC architectures, analogue comparator. Serial Communications: Definition of serial communication, serial communication versus parallel communication, fundamental serial communication concepts (timing, framing, error detection, acknowledgments), asynchronous and synchronous serial communication protocols, timing diagrams for asynchronous and synchronous serial communication. **Laboratory part** The laboratory part of the course comprises of a set of experiments which complement the theoretical material covered in class. The experiments focus on the programming of a target physical embedded system using high-level / assembly programming languages. Laboratory tasks that students will be required to perform include: - Design simple embedded systems applications that include subroutines and functions - Perform program debugging for embedded systems applications - Develop programs that demonstrate general I/O operations for the target platform - Develop programs that demonstrate asynchronous serial communication operations for the target platform - Develop programs that demonstrate synchronous serial communication operations for the target platform - Develop programs that utilize external sensors for measuring physical properties - Develop programs that control a physical actuator through the target platform. - Develop complete real-life embedded systems application for the target platform utilized in the laboratory
Teaching Methodology	Face- to- face

<table>
<tr><td>Bibliography</td><td>“Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach”, by Alexander G. Dean

“Introduction to Embedded Systems: Using Microcontrollers and the MSP430”, by Manuel Jiménez, Rogelio Palomera, Isidoro Couvertier

“Introduction to Embedded Systems”, by K.V. Shibu

“Introduction to Embedded Systems: Using ANSI C and the Arduino Development Environment”, by David Russell and Mitchell Thornton

“Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C”, by Yifeng Zhu</td></tr>
<tr><td>Assessment</td><td><table>
<tr><td>Examinations</td><td>55%</td></tr>
<tr><td>Assignments/Lab</td><td>35%</td></tr>
<tr><td>Class Participation and Attendance</td><td>10%</td></tr>
<tr><td></td><td>100%</td></tr>
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<tr><td>Language</td><td>English</td></tr>
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