

Course Unit	Embedded Systems			Field of study	Electronics and Instrumentation	
Bachelor in	Electrical and Computers Engineering			School	School of Technology and Management	
Academic Year	2023/2024	Year of study	3	Level	1-3	ECTS credits 6.0
Туре	Semestral	Semester	1	Code	9112-742-3104-00-23	
Workload (hours)	162	Contact hours	T 15 TP T - Lectures; TP - Lectures a	15 PL 30 T nd problem-solving; PL - Problem-	C - S - solving, project or laboratory; TC	Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s)

José Luís Sousa de Magalhaes Lima

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

Analyse simple architectures of popular microprocessors and microcontrollers through block diagrams and practical implementation schematics. Program and handle microcontroller based systems.

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- . Program embedded systems with low and high level languages, such as C and Python. . Develop microcontroller based applications with both components: software and hardware.
- 5. Understand the communication protocols between microcontrollers, peripherals and IoT.

### Prerequisites

Before the course unit the learner is expected to be able to: Develop basic projects based on Digital electronics.

# Course contents

Basic architecture of an 8 bit microprocessor based system, Low and high level languages programming, Microprocessors and microcontrollers, Memories, interruptions, IO system. 32 bit microcontroller architecture.

### Course contents (extended version)

- 1. Embedded system architecture
- Embedded system architecture

   8 bit microcontroller family AVR
   Registers, memory and instructions.

   Programming of a microcontroller based system

   Low level and high level languages
   Microcontrollers and microprocessors. Differences on architectures
   Prototyping platforms
   Sensors and actuators I/O to control processes (examples and practical cases)
   I/O for digital and analog signals

   Interruptions (internal and external)
   Communication protocols

   UART, SPI, I2C, 1-wire.
   Ethernet

- Ethernet 5. 32 bits microcontrollers and high level languages. IoT introduction.

### Recommended reading

- 1. John P. Hayes, Digital System Design and Microprocessors, McGraw-Hill. Fredrick J. Hill, Gerard R. Peterson, Digital Logic and Microprocessors, John Wiley and Sons.
- 2. Herbert Taub, Circuitos Digitais e Microprocessadores, McGraw-Hill. Douglas V. Hall, Microprocessors and Interfacing: Programming and Hardware, McGraw-Hill International Editions.
- José Manuel Martins Ferreira, Introdução ao Projecto com Sistemas Digitais e Microcontroladores, FEUP edições.

#### Teaching and learning methods

The unit will be taught using a combination of lectures, self guided learning and practice classes. Practical assignments will be focused on practical use cases and project based learning.

## Assessment methods

- Alternative 1 (Regular) (Final, Supplementary, Special)

   Final Written Exam 40% (Theoretical questions)
   Practical Work 60% (Two practical works)

   Alternative 2 (Student Worker) (Final, Supplementary, Special)

   Final Written Exam 40% (Theoretical questions)
   Practical Work 60% (Two practical works)

## Language of instruction

### Portuguese

Electronic validation			
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02-10-2023	02-10-2023	10-10-2023	20-10-2023