

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
Type	Semestral	Semester	1	ECTS credits	6.0
Code	9112-742-3104-00-23				
Workload (hours)	162	Contact hours	T 15	TP 15	PL 30
			TC -	S -	E -
			OT -	O -	

T - Lectures; TP - Lectures and problem-solving; PL - Problem-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:

1. Analyse simple architectures of popular microprocessors and microcontrollers through block diagrams and practical implementation schematics.
2. Program and handle microcontroller based systems.
3. Program embedded systems with low and high level languages, such as C and Python.
4. 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
  - 8 bit microcontroller family AVR
  - Registers, memory and instructions.
2. 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
3. Interruptions (internal and external)
4. Communication protocols
  - UART, SPI, I2C, 1-wire.
  - 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.
3. 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

1. Alternative 1 - (Regular) (Final, Supplementary, Special)
  - Final Written Exam - 40% (Theoretical questions)
  - Practical Work - 60% (Two practical works)
2. 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

José Luís Sousa de Magalhaes Lima	José Augusto de Almeida Pinheiro Carvalho	Orlando Manuel de Castro Ferreira Soares	José Carlos Rufino Amaro
02-10-2023	02-10-2023	10-10-2023	20-10-2023