COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

**Syllabus**
**2025 - 2026**

## GENERAL INFORMATION

| Data of the subject | |
|---|---|
| **Subject name** | Microprocessors |
| **Subject code** | DEA-GITT-323 |
| **Mainprogram** | Bachelor's Degree in Engineering in Telecommunication Technologies |
| **Involved programs** | Grado en Ingeniería en Tecnologías de Telecomunicación [Third year]<br>Grado en Ingeniería en Tecnologías de Telecom. y Grado en Análisis de Negocios/Business Analytics [Third year] |
| **Level** | Reglada Grado Europeo |
| **Quarter** | Semestral |
| **Credits** | 6,0 ECTS |
| **Type** | Obligatoria (Grado) |
| **Department** | Department of Electronics, Control and Communications |
| **Coordinator** | José Daniel Muñoz Frías |
| **Office hours** | Request an appointment by email |

| Teacher Information | |
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| **Department** | Department of Electronics, Control and Communications |
| **EMail** | mespinosa@icai.comillas.edu |

## DESCRIPTION OF THE SUBJECT

### Contextualization of the subject

#### Prerequisites

Knowledge of C programming and digital electronics.

## Course contents

### Contents

#### Theory

Introduction to microcontrollers

1. Introduction.
2. The microcontroller hardware.
3. The microcontroller software.

Low level programming.in C

1. Integer data types.
2. Type conversions.
3. Bit manipulation.
4. Reading and writing microcontroller configuration registers.
5. Unions.
6. Language extensions.
7. Modular programming.

Digital input/output ports

1. Introduction.
2. Hardware and control registers.
3. Example.

Timers

1. Timer's hardware.
2. Use of timers.
3. Mapping pins to peripherals.

MIPS32® Architecture

1. Introduction.
2. Processor architecture.
3. Memory access.
4. The CPU programmer's model.

### Interrupt support in the PIC32MX family

1. Introduction.
2. Exceptions.
3. Interrupts.
4. Writing interrupt service routines (ISR).
5. Shared data.

### Asynchronous serial communication

1. Introduction.
2. Asynchronous serial transmission.
3. The PIC32MX UART.
4. Queues.

### I2C and SPI buses

1. Introduction.
2. The I2C bus.
3. Example of message on the I2C bus.
4. The SPI Bus.

### Analog to digital converter

1. Introduction.
2. The PIC32 analog to digital converter.

### Pulse width modulation (PWM)

1. Introduction.
2. The output compare unit of the PIC32.
3. PMW on the PIC32.
4. Example: control of a RC servo.

### Organization of a microprocessor-based digital system

1. Introduction.
2. Hardware architecture of a microprocessor-based system.
3. Software architecture of a microprocessor-based system.
4. Example.

## Laboratory

- Lab1: Introduction to the development system.
- Lab 2. Input and output in C.
- Lab 3: Timers.
- Lab 4: Functions in assembler.
- Lab 5: Interrupts.
- Lab 6. Serial communications.
- Lab 7. Serial communications II.
- Lab 8. Final project.

## EVALUATION AND CRITERIA

The use of AI to produce full assignments or substantial parts thereof, without proper citation of the source or tool used, or without explicit permission in the assignment instructions, will be considered plagiarism and therefore subject to the University's General Regulations.

| Evaluation activities | Evaluation criteria | Weight |
|---|---|---|
| • Mid-grade and final exams.<br>• Laboratory exam | • Understanding of concepts.<br>• Application of concepts to the resolution of practical problems.<br>• Analysis and interpretation of the results obtained solving problems.<br>• Presentation and written communication.<br>• Source code quality. | 60 |
| • Short tests.<br>• Final project. | • Understanding of concepts.<br>• Application of concepts to the resolution of practical problems.<br>• Analysis and interpretation of the results obtained in solving problems.<br>• Presentation and written communication.<br>• Group work capacity.<br>• Quality of the computer program developed. | 20 |
| • Laboratory sessions. | • Carrying out the preliminary work.<br>• Lab work.<br>• Quality of the source code.<br>• Clarity of presentations.<br>• Group work capacity.<br>• Presentation and written communication. | 20 |

### Grading

#### Final Grade

Throughout the course, a grade is obtained, called Partial Grade, which is obtained from individual evaluations of each student and is given by the formula:

Partial grade = 0.45 Inter + 0.15 Tests + 0.4 Lab exam

If both the partial grade and the laboratory final project grade are greater than or equal to 7.5, then the student's grade is as follows:

Final grade = 0.2 Inter + 0.05 Tests + 0.15 Lab Exam + 0.2 Practices + 0.4 Project

Otherwise, the student's grade is obtained as follows:

Final grade = 0.5 Theory + 0.5 Laboratory if Theory >= 5 and Laboratory >= 5

Final grade = Min(Theory, Lab) if Theory < 5 or Lab < 5.

Being:

Theory = 0.2 Inter + 0.1 Tests + 0.7 Final Exam

Laboratory = 0.4 Practices + 0.3 Project + 0.3 Lab exam

### Extraordinary evaluation

The extraordinary evaluation is considered a second opportunity in case the student has failed one or both parts of the subject.

If the student has failed the theory, she will take the theory exam and the new theory grade will be obtained according to the formula:

Theory = 0.1 Inter + 0.1 Tests + 0.8 Extraordinary Exam

If the student has failed the lab, she will take the lab exam and the new lab grade will be obtained according to the formula:

Laboratory = 0.4 Practices + 0.3 Project + 0.3 Lab exam extraordinary

As long as the lab exam extraordinary grade is greater than 4.

The final grade for the extraordinary evaluation will be obtained in the same way as for the final grade:

Grade = 0.5 Theory + 0.5 Laboratory if Theory >= 5 and Laboratory >= 5

Grade = Min(Theory, Lab) if Theory < 5 or Lab < 5.

### Attendance Rules

Class attendance is mandatory, according to the Academic Regulations of ICAI. The attendance requirements will be applied independently for the theory and laboratory sessions:

- In the case of theory sessions, failure to comply with this rule may prevent taking the exam in the ordinary call.
- In the case of laboratory sessions, failure to comply with this rule may prevent them from taking the exam in the ordinary and extraordinary calls. In any case, unjustified absences from laboratory sessions will be penalized in the evaluation.

## BIBLIOGRAPHY AND RESOURCES

### Basic References

- José Daniel Muñoz Frías. Sistemas Empotrados. Una introducción basada en el microcontrolador PIC32MX230F064D. (2018)