COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2022 - 2023

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] Grado en Ingeniería en Tecnologías de Telecom. y Grado en Análisis de Negocios/Business Analytics [Third year] Grado en Ingeniería en Tecnologías de Telecom. y Grado en Análisis de Negocios/Business Analytics [Third year] Grado en Ingeniería en Tecnologías de Telecomunicación [Third year]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	6,0 ECTS
Type	Compulsory
Department	Department of Electronics, Control and Communications
Coordinator	José Daniel Muñoz Frías
Office hours	Request an appointment by email

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Teacher	
Name	Miguel Ángel Espinosa Bustillo
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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

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

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In compliance with current regulations on the **protection of personal data**, we would like to inform you that you may consult the aspects related to privacy and data that you have accepted on your registration form by entering this website and clicking on "download"
https://servicios.upcomillas.es/sedeelectronica/inicio.aspx?csv=02E4557CAA66F4A81663AD10CED66792

CRONOGRAMA orientativo Microprocesadores. 3º GITT

PROGRAMA DE TEORIA	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S.S.	S14	S15
Tema 1. Introducción a los microcontroladores																
Tema 2. Lenguaje C para programación en bajo nivel																
Tema 3. Puertos de entrada y salida digital																
Tema 4. Temporizadores																
Tema 5. Arquitectura del MIPS32®																
Tema 6. Soporte de interrupciones en la familia PIC32MX																
Tema 7. Comunicación serie asíncrona																
Tema 8. Buses I2C y SPI																
Tema 9. Conversor Analógico Digital																
Tema 10. Modulación por ancho de pulso (PWM)																
Tema 11. Organización de un sistema digital basado en microprocesador																

Nota. El cronograma se da por semanas de clase. Cada semana se identifica por la fecha del lunes de dicha semana

Fechas clave

En amarillo	Controles de clase
En Naranja	Intercuatrimestrales
En Gris	Festivos

PROGRAMA DE LABORATORIO 3º B	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S.S.	S14	S15
P1. Introducción al sistema de desarrollo																
P2. Entrada y salida en C																
P3. Temporizadores																
P4. Funciones en Ensamblador																
P5. Interrupciones																
P6. Comunicaciones Serie																
P7. Comuniaciones Serie II																
Examen Laboratorio																
P8. Proyecto final																

Fechas clave laboratorio

En Gris	Festivos
En Naranja	Intercuatrimestrales
Examen de laboratorio	Semana 11
Entrega de la propuesta de diseño final	Semana 11
Entrega del proyecto final	Semana 15
Entrega del informe del diseño final	Último día del periodo de exámenes