

Academic Year: ( 2021 / 2022 )

Review date: 10-06-2021

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: LINDOSO MUÑOZ, ALMUDENA

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

## REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

The lecturers strongly advises students who want to take this course have previously studied both "Digital Electronics" and "Electronic Components and Circuits". "Digital Electronics" covers combinational and sequential digital electronics, acquiring knowledge about the digital building blocks. The second, "Electronic Components and Circuits", it is important to know the basic electronic components and electronic wiring plate or breadboard test and evaluate its operation using basic tools and laboratory equipment.

Other subjects that can help students for this course are "Systems and Circuits", which addresses the differences between discrete-time systems and continuous time systems, and "Systems Architecture", which covers the C programming language the development of a project.

## OBJECTIVES

The main objective is that the student learns about microprocessor technology, and how to analyze and develop solutions based on such technology. The student will learn about microprocessors, their internal architecture, the use of microcontrollers and the most used peripherals. Programming will be done using C-language, using a semi-professional Integrated Development Environment (IDE). The student will also learn about how to debug solutions, in order to be able to detect errors and develop robust solutions.

With all this in mind, the partial objectives are:

- To know the basics of the different microprocessor internal architectures.
- To learn the benefits of using microcontrollers.
- To learn to use an IDE to develop microcontroller-based systems
- To apply medium/high-level programming languages to develop solutions for microprocessors/microcontrollers
- To learn to use the most common microcontroller peripherals.
- To be able to analyze microprocessor-based solutions
- To be able to develop microprocessor-based solutions

## DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to microprocessor based digital systems
2. Architecture of a microprocessor/microcontroller system.
  - 2.1. Central Processing Unit (CPU).
  - 2.2. Memory Structure.
  - 2.3. Interface Modules.
3. Machine level programming: Assembler.
  - 3.1. Machine instructions and addressing modes.
4. Software Development: Integrated Development Environment
  - 4.1. C language integrated development environment.
  - 4.2. Peripherals I/O Libraries
5. General Input/Output Pins
6. Exceptions and Interrupt Systems
7. Timers
8. Analog/Digital and Digital/Analog Conversion
9. Serial Asynchronous Communication
10. Serial Synchronous Communication
11. Additional functionalities: RTC, Watchdog, Power consumption, etc.
12. System design examples and analysis

## LEARNING ACTIVITIES AND METHODOLOGY

The above course competences and skills provide skills within the program outcomes, through different activities. For each program outcome, we briefly describe the activities provided within the course:

- In the course, exercises are held where students have to complete/develop their programs to meet requirements. They are asked to interpret electronic circuit schematics, block diagrams and flowcharts.
- The course includes a laboratory design exercise, with an initial set of specifications that the students must meet by the end of the term. The problem is a manageable version of an electronic system design, where the students must solve using the given resources (Microcontroller Development Board, Debugger, peripherals).
- Design and analysis examples are presented to the students as guidance on good programming practices and electronic design techniques, showing how to apply specific peripherals to solve different problems.
- The students must be able to comment their program code appropriately, develop program flow diagrams, use schematic capture programs for their designs. This will be evaluated comprehensively in laboratory works.
- The students are required to work using engineering tools such as a Microcontroller Integrated Development Environment (IDE) program, use a Development Board, as well as a Debugger.

## ASSESSMENT SYSTEM

The evaluation of the course will be based on the following criteria:

- 1.- Partial evaluation with a total weight of 10% of the final mark
- 2.- Compulsory laboratory exercises, evaluating the progress achieved, with a total weight of 30% of the final mark. Progress will be evaluated by testing performance on the course development board, while knowledge will be evaluated through a laboratory exam to be done after completing all laboratory sessions.
- 3.- Final exam including analysis and design exercises, with a total weight of 60% of the final mark. To pass the subject, a minimum mark of 4 over 10 is requested in the final exam.

<b>% end-of-term-examination:</b>	60
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	40

## BASIC BIBLIOGRAPHY

- Development system manufacturer Development system manual, Development system manufacturer.
- Juan Vázquez, Michael García Lorenz, Juan Pablo García Nieto, Raúl Sánchez Reíllo Sistemas electrónicos digitales basados en microprocesadores ARM7, COPY RED, S.A., 2009
- Lecturers Collection of exercises, UC3M - Electronics Technology Department.
- Lecturers Collection of notes, slides and additional documentation, UC3M - Electronics Technology Department.
- Microcontoller Manufacturer Microcontroller datasheet, Microcontoller Manufacturer.

## ADDITIONAL BIBLIOGRAPHY

- Alan Clements Principles of Computer Hardware, Oxford.