Microprocessor based digital systems

Academic Year: (2022 / 2023) **Review date: 13-01-2023**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: BELLOCH RODRIGUEZ, JOSE ANTONIO

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

The lecturers strongly advise 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.
It is also very important that the student is able to program a computer application. Therefore, the Faculty strongly recommends the students to have passed subjects like "Programming", "Systems Programming" and "Systems Architecture".
Another subject that can help students for this course is "Systems and Circuits", with allows the analysis of electronic circuits.

OBJECTIVES

The main objective is that the student learns about microprocessor technology, and how to analyse 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 analyse microprocessor-based solutions
- To be able to develop microprocessor-based solutions

DESCRIPTION OF CONTENTS: PROGRAMME

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

LEARNING ACTIVITIES AND METHODOLOGY

The course competences provide certain skills as a result of the program, 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 certain requirements. They are asked to interpret and develop electronic circuits, 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, that 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 use 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, a development board, as well as a debugger.

ASSESSMENT SYSTEM

The evaluation of the course will be based on the following criteria:
1.- Mandatory laboratory exercises, evaluating the progress achieved, with a total weight of 40% of the final mark. Progress will be evaluated by testing performance on the course development board, while knowledge will be evaluated through an individual laboratory exam to be done after completing all laboratory sessions. A minimum mark of 4 out of 10 is needed for the individual lab exam in order to achieve the complete lab mark. If the lab exam mark is below 4 out of 10, then the lab mark will be multiplied by 0.45.
2.- 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.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Development system manufacturer Development system manual, Development system manufacturer.
- 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

- [Clements] Alan Clements Principles of Computer Hardware, Oxford University Press.

BASIC ELECTRONIC RESOURCES

- Raul Sánchez Reíllo, et. al. . Curso OCW "Sistemas Digitales Basados en Microprocesadores": https://ocw.uc3m.es/course/view.php?id=260