Digital electronic systems

Academic Year: (2023 / 2024) **Review date: 01/02/2024 11:17:01**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: GARCIA VALDERAS, MARIO

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Electronics engineering fundamentals, Digital Electronics, Programming

LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG4. Knowledge and ability to apply current legislation as well as the specifications, regulations and mandatory standards in the field of Industrial Engineering.
CG5. Adequate knowledge of the concept of company, institutional and legal framework of the company. Organisation and management of companies.
CG6. Applied knowledge of company organisation.
CG8. Knowledge and ability to apply quality principles and methods.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA3. Engineering Design: To be able to design industrial products that comply with the required specifications, collaborating with professionals in related technologies within multidisciplinary teams.
RA4. Research and Innovation: To be able to use appropriate methods to carry out research and make innovative contributions in the field of Industrial Engineering.
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.

OBJECTIVES

By the end of this subject, students will be able to have:
1. a systematic understanding of the key aspects and concepts of their branch of engineering in microporcessors and embedded systems;
2. coherent knowledge of their branch of engineering including some at the forefront of the branch in microprocessors and embedded systems;
3. the ability to apply their knowledge and understanding of microprocessors and digital

electronics to identify, formulate and solve engineering problems using established methods;
4. the ability to apply their knowledge and understanding to develop and realise designs based on small embedded sytems to meet defined and specified requirements;
5. an understanding of design methodologies to set and program microcontroller peripherals, and an ability to use them.
6. workshop and laboratory skills.
7. the ability to select and use appropriate equipment, tools and methods for the development of embedded systems;
8. the ability to combine theory and practice to solve problems of microprocessor based digital systems;

In summary, the teaching objectives are:
- Knowing in detail the basic architecture of a reference CPU for embedded systems
- Knowing the different levels of abstraction in the definition of functions and specifications of an embedded system
- Knowing the interrupts subsystem, the timing subsystem, and the input/output subsystems of a reference microcontroller.
- Being able to program libraries for the use of specific peripherals, sensors and actuators, according to a technical user manual
- Being able to analyze the hardware-software set of a simple embedded system
- Being able to allocate resources and conceive at system level the hardware-software set of a simple embedded system
- Being able to implement signal processing functions and sequencers in embedded systems
- Knowing the principles of real-time operation of an embedded system

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to Digital Systems and Embedded systems. Basic concepts.
2. Fundamentals of Computer Architecture
3. Microprocessors:
 - Memory organization, addressing modes and instruction set
 - Input / output subsystems. Structure, Control and Addressing
 - Event management and Interruption System
4. Microcontrollers:
 - Real-time programming
 - Parallel Input / Output Subsystems and External Interruptions
 - Timing subsystems:
  - time control
  - generation and capture of binary signals
 - Analog inputs / outputs
 - Serial communication subsystems (USART, I2C, SPI)
5. Design of embedded systems:
 - Development environment
 - Practical cases

LEARNING ACTIVITIES AND METHODOLOGY

The teaching methodology will include:
 - Magisterial Classes, where the students will be presented with the basic knowledge they must acquire. Students will be supplied with lecture notes and key reference texts which will enable them to complete and acquire a more in depth knowledge of the subject.
- Problems Classes, these are aimed at the solving of exercises and examples within the context of real case studies. These classes will be complimented with the resolution of practical exercises on behalf of the student.
- Laboratory Practical Sessions
- Group tutorials

ASSESSMENT SYSTEM

% end-of-term-examination/test:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

A mixed system has been chosen between continuous evaluation and finalist evaluation. The continuous evaluation consists of:
- Six practical laboratory sessions where students will design, build and evaluate a simple embedded system based on a set of specifications. The assessment will be carried out by checking a series of

% end-of-term-examination/test:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

practical milestones and an individual practical exam (30%)

- A midterm exam on microprocessor systems (20%)

The final exam will consist of an analysis exercise and an embedded system design exercise with a weight of 50%, and a minimum mark of 3.5 out of 10

BASIC BIBLIOGRAPHY

- Donald Norris Programming with STM32: Getting Started with the Nucleo Board and C/C++, McGraw Hill Professional, , Mar 21, 2018

- Hennessy, John L ; Patterson, David A Computer Architecture: A Quantitative Approach, San Francisco: Elsevier Science & Technology 2011, 2011

- Sarmad Naimi, Muhammad Ali Mazidi, Sepehr Naimi The STM32F103 Arm Microcontroller and Embedded Systems: Using Assembly and C, MicroDigital Ed, 2020

ADDITIONAL BIBLIOGRAPHY

- Dogam Ibrahim ARM-based Microcontroller Projects Using mbed, Newnes Elsevier, 2019