VNIVERSITAT Ö ID VALÈNCIA

COURSE DATA

Data Subject

Code	34883
Name	Digital systems II
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1403 - Degree in Telematics Engineering	School of Engineering	2	Second term

Subject-matter

Degree	Subject-matter	Character
1403 - Degree in Telematics Engineering	9 - Digital electronic systems	Obligatory

Coordination

Name	Department
PEREZ SOLANO, JUAN JOSE	240 - Computer Science

SUMMARY

The course *"Digital Electronic Systems II"* is a core course of the second year of Bachelor's Degree in Telematics Engineering. The course workload is 6 ECTS and it is given in the first four-month period of the second year. This course is a part of the subject *"Digital Electronic Systems"* of the Telematics Engineering Degree curriculum.

The main goal of *"Digital Electronic Systems II"* is to provide students with the understanding of the basic structure of a computer and how to design digital electronic systems based on microprocessors. The first section of this course introduces the computer language, i.e. machine language, presenting the computer instruction set, the formats of the instructions and the operands addressing modes. Once the generic concepts about machine language are provided, the study is focused on the presentation of the MIPS32 microprocessor instruction set.

The next goal is the understanding of the basic computer components and their role in the development of the computer architecture. In this section, the student will be able to design the data paths inside the computer and the control unit that manages the overall operation. The arithmetic-logic unit (ALU) is studied with the aim that students can understand how basic operations are performed in the computer and how to design it correctly.

The following section treats the hierarchical computer memory system. First of all, various memory technologies that can be used to build the computer's memory system are introduced. It is intended that students know their capabilities in terms of performance, capacity and cost. Then, the concept of main memory and its internal organization is introduced. Students will learn how to design a small memory system and specify the memory map of a computer. Finally, the student is faced with the problem of optimizing the memory design under capacity, performance and cost constraints, and its solution based on a hierarchical design with three different levels: cache, main memory and virtual memory.

In the next section of the course the student will gain understanding of how the exchange of information between the computer and peripherals is performed. The input/output system structure and the transfer of information will be presented. The student should be able to determine the best method to carry out a data transfer between a computer and a peripheral, whether based on polling or interrupts. The presentation of the internal structure of the computer finishes dealing with the internal bus that interconnects all the computer components and performs the exchange of information between them.

The last section of the course is focused on the design of microcontroller-based systems. In this section the microcontroller structure and the most popular families of this type of devices are introduced. After that, the PIC32 microcontroller, based on the MIPS32 architecture, will be presented in detail. Finally, most common integrated peripherals are showed: timers, analogue to digital converters and communications modules, jointly with the development of applications using high level programming languages

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is advisable to have attended the courses corresponding to the subject "Circuitos y componentes electrónicos y fotónicos".

OUTCOMES

1403 - Degree in Telematics Engineering

- R9 - Ability to analyze and design combinational and sequential circuits, synchronous and asynchronous, and use microprocessors and integrated circuits.

- G3 - Acquisition of the knowledge of the basic and technological subjects that allows students to learn new methods and theories and endows them with the versatility to adapt to new situations.

- G4 - Ability to solve problems with initiative, decision-making and creativity, and to communicate and transmit knowledge, abilities and skills, understanding the ethical and professional responsibility of the activity of a telecommunications technical engineer.

LEARNING OUTCOMES

Learning goals of the course:

1. Ability to analyse and design digital circuits using microcontrollers and other integrated circuits. (R9)
2. Ability to design digital electronic systems. (R9)
3. Apply digital technologies to work out problems in various application areas. (R9)
4. Design correctly the global structure of a digital system and the interrelationship between its different components. (R9)
5. Ability to use design and programming tools needed for a proper development of a digital system. (R9)

DESCRIPTION OF CONTENTS

1. Machine language.

Introduction to computer architecture.
Types and formats of instructions.
Operands addressing modes.
MIPS32 particular case.

2. Processor internal structure.

Datapath and control signals.
Control unit design.
Pipelining.

3. Memory hierarchy.

Main memory system design.
Memory maps.
Hierarchical memory system design.

4. Input /output system.

I/O modules and controllers.
Interruptions

5. Microcontroller based systems

Microcontroller structure and most common families
PIC32 structure with MIPS32 core.
Peripherals:
o   Timers.
o   A/D converters.
o   Communications ports.
System design methodology.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Study and independent work	15,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	20,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	15,00	0
Resolution of case studies	20,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

All the teaching activities of the course are focused on the achievement of the R9 competence.

The teaching activities will be developed according to the following distribution:

The 40% of workload of the course in ECTS (1 credit corresponds to 25 hours) will be spent in the following in class activities:

Theoretical activities.

Description: The lectures will present the course contents providing a global vision, with a more detailed analysis of the key aspects and the more complicated concepts and encouraging the student participation.

Practical activities.

Description: The practical activities complement the theoretical classes and allow the students to put into practice the course contents and improve its understanding through the knowledge and experience gained during the achievement of the proposed work. They include the following types of classroom activities:

• Solving problems in class.
• Regular discussion of exercises and problems that the students have previously tried to work out.

• Laboratory sessions.

• Oral presentations.

• Support tutorial sessions (individualized or in group).

• Individual evaluation of questionnaires to be done in class with the help of professors.

Assessment:

Description: Students will carry out individual examinations in class and in the presence of professors.

The 60% of workload of the course in ECTS (1 credit corresponds to 25 hours) will be spent in the following out of class activities:

Personal work.

Description: It is the work that the student must carry out individually out of the classroom timetable. It tries to promote the autonomous work. Activities in this group are: monographs, guided literature search, exercises and problems as well as preparation of classes and exams.

Teamwork in small groups.

Description: It will be carried out by small groups of students (2-4). It consists of work to be done out of the class timetable in form of exercises and problems. This work complements the individual work and tries to improve the teamwork and leadership skills.

During the course the e-learning (pizarra virtual) platform of the University of Valencia will be used to support the teaching activities. This platform allows the access to the course materials used in the classes as well as additional documents, solved problems and exercises.

EVALUATION

The course evaluation will be performed preferably by the continuous assessment mark (C) and the laboratory mark (L).

The continuous assessment mark (C) is calculated as the weighted average of 2 continuous assessment tests, taken during the course, at the end of each group of course sections: P1 and P2. The following expression will be used, which reflects the relative weight of each part:

$$C = 0,6 * P1 + 0,4 * P2$$

If the continuous assessment mark (C) is greater or equal than 5 the student may not take the official first examination of the course, calculating the grade of the course as:

$$N1a = 0,8 * C + 0,2 * L$$

Where the laboratory mark (L) is calculated as the average of the laboratory sessions marks.

The continuous assessment mark (C) and laboratory mark (L) can not be retaken and these marks will be maintained at the first and the second exam sittings.

If C is lower than 5 the student must take the official first examination (Ex1), calculating the grade of the course as:

$$N1b = 0,8 * maximum\{C , Ex1\} + 0,2 * L$$

If a student, who has passed the continuous assessment with a mark higher or equal to 5 (C is higher tahn 5), wants to improve its final grade N1a, he/she may take the examination Ex1.

At the second exam sittings, the grade (N2) is calculated using the official second examination mark (Ex2), the laboratory marks (L) and continuous assessment mark (C). The final grade of the course in this case is calculated as:

$$N2 = 0{,}8 * maximum\{C, Ex2\} + 0{,}2 * L$$

In any case, the assessment shall conform to the "**Reglament d'avaluació i qualificació de la Universitat de València per a títols de grau i de màster"** approved by the Governing Council of the UVEG on May 30, 2017. It states basically that the final grade will be numbered from 0 to 10 with a decimal expression and a qualitative rating scale will be added following this guideline:

• From 0 to 4.9: "Failed"
• From 5 to 6.9 "Approved"
• From 7 to 8.9, "Notable"
• From 9 to 10: "Excellent" or "Honors with Distinction"

REFERENCES

Basic

- - Estructura y diseño de computadores: La Interfaz Hardware/Software. Patterson, D.A. y Hennesy, J.. Reverté, 4ª Ed.
https://www.vlebooks.com/Vleweb/Product/Index/39387?page=0

- Organizacion y arquitectura de computadores. William Stallings. 7ª ed. Pearson,
http://www.ingebook.com/ib/NPcd/IB_Escritorio_Visualizar?cod_primaria=1000193&libro=1266.

- Programming 32-bit Microcontrollers in C: Exploring the PIC32. Lucio Di Jasio. Newnes. 2008
https://www.vlebooks.com/Vleweb/Product/Index/37244?page=0

Additional

- Estructura de computadores y periféricos Rafael Martínez Durá, José A. Boluda Grau, Juan José Pérez Solano. Rama. 2002.
- Embedded Systems Design: An Introduction to Processes, Tools and Techniques. Arnold S. Berger. 2001.