

**COURSE DATA****Data Subject**

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|----------------------|--------------------|
| Code | 34883 |
| Name | Digital Systems II |
| Cycle | Grade |
| ECTS Credits | 6.0 |
| Academic year | 2020 - 2021 |

Study (s)

| Degree | Center | Acad. 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.
Arithmetic and logical instructions and the ALU design.

**3. Memory hierarchy.**

Main memory system design.

Memory maps.

Hierarchical memory system design.

4. Input /output system and buses.

I/O modules and controllers.

Interruptions

Buses.

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.

In the case that $C < 5$ the student must take the official first examination (Ex1), calculating the grade of the course as:

$$N1b = 0,7 * Ex1 + 0,2 * L + 0,1 * C$$

If a student, who has passed the continuous assessment with a mark higher or equal to 5 ($C \geq 5$), wants to improve its final grade N1a, he/she may take the examination Ex1, calculating the grade with both methodologies, N1a and N1b, and keeping the higher one.

At the second exam sittings, the grade (N2) is calculated in only one way, 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:

$$N2 = 0,7 * Ex2 + 0,2 * L + 0,1 * C$$

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.dawsonera.com/abstract/9780080886138>
- Organización 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.dawsonera.com/readonline/9780080560106>

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.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contents

The contents initially included in the teaching guide are maintained.

Workload and temporary teaching planning

The different activities described in the teaching guide are maintained with the planned dedication.

The material for the follow-up of the classes of theory/practices allows to continue with the professor of temporary planning so much in days as in schedule, so much if the teaching is face-to-face in the classroom or if it is not.

Teaching methodology

In classroom theory and practices, students will tend to have the maximum physical attendance possible, always respecting the sanitary restrictions that limit the capacity of the classrooms as indicated by the competent public health authorities to the estimated percentage of their usual occupation.



Depending on the capacity of the classroom and the number of students enrolled, it may be necessary to distribute the students into two groups. If this situation arises, each group will attend classroom theory and practical sessions with physical presence in the classroom by rotating shifts, thus ensuring compliance with the criteria for occupying spaces.

The rotation system will be established once the actual enrollment data is known, guaranteeing, in any case, that the attendance percentage of all the students enrolled in the subject is the same.

With respect to laboratory practices, attendance at sessions scheduled in the schedule will be totally face-to-face.

Once the actual enrollment data is available and the availability of spaces is known, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaptation to each subject, establishing in said model the specific conditions in which it will be developed teaching the subject.

If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes of the subject, these will be replaced by non-contact sessions following the established schedules.

Evaluation

The evaluation system described in the teaching guide of the subject in which the different evaluable activities have been specified as well as their contribution to the final grade of the subject is maintained.

If there is a closure of the facilities for health reasons that affect the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the Universitat de València.

The contribution of each evaluable activity to the final grade for the course will remain unchanged, as established in this guide.



Bibliography

The bibliography recommended in the teaching guide.

