Universidad Europea

1. BASIC DATA

Course	Digital Electronics and Microprocessors
Degree	Biomedical Engineering
School/ Faculty	Architecture, Engineering and Design
Course	Third Course
ECTS	6 ECTS
Type	Mandatory
Language/s	English / Spanish
Delivery mode	Face to face
Semester	First Semester
Academic Course	2019/2020
Coordinating professor	Víctor Manuel Padrón Nápoles

2. PRESENTATION

At present, digital electronics and microprocessors are present in almost all branches of Humans' activity. While the use of these technologies is evident when using a computer or a mobile device, in many other cases its use is transparent to us. This is the case of embedded systems, digital electronic circuits, which use microcontrollers, microprocessors, specific processors as GPUs and hardware programmable devices as FPGAs to control electrical and mechanical systems, from the simple remote controls with which we control the television receiver to sophisticated systems such as robots, control systems of airplanes, trains, medical equipment, etc.

In this subject, the basic concepts and skills necessary to design and implement digital electronic systems and understand their application are taught.

Content of the subject:
1. Fundamentals of Programmable Logic Devices (FPGA) and its description (VHDL).
2. Description of combinational circuits
3. Description of sequential circuits
4. Introduction to semiconductor memories
5. Introduction to Microprocessors and Microcontrollers
6. Introduction to Analog-to-Digital and Digital-to-Analog converters
7. Development of application with microcontrollers

The course includes next topics: FPGA, VHDL, microprocessors and microcontrollers.

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3. COMPETENCIES AND LEARNING OUTCOMES

Core competencies:

- CB1: That students have demonstrated to possess and understand knowledge in an area of study that is based on general secondary education, and it is usually found at a level that, although it is supported by advanced textbooks, also includes some aspects that imply knowledge coming from the vanguard of their field of study.
- CB2: That the students know how to apply their knowledge to their work or vocation in a professional manner and possess the skills that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.
- CB3: That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.
- CB4: That students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.
- CB5: That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

Cross-curricular competencies:

- CT4. Capacity for analysis and synthesis: being able to decompose complex situations in their constituent parts; also evaluate other alternatives and perspectives to find optimal solutions. The synthesis seeks to reduce complexity in order to understand it better and / or solve problems.
- CT5. Ability to apply knowledge to practice, to use knowledge acquired in academic settings in situations as similar as possible to the reality of the profession for which they are being trained.CT2. Autonomous learning: A set of skills to select search strategies, analysis, evaluation and management of information from diverse sources, as well as to learn and put into practice independently what has been learned.
- CT12. Critical reasoning: Ability to analyze an idea, phenomenon or situation from different perspectives and assume before him / her a personal and personal approach, built from rigor and objectivity argued, and not from intuition.
- CT16. Decision making: Ability to make a choice between existing alternatives or ways to effectively solve different situations or problems.

Specific competencies:

- CoEs.5 Knowledge of the fundamentals and applications of digital electronics and microprocessors.

Learning outcomes:

- LO1: Resolution of exercises and problems applying the knowledge acquired.
- LO2: Carrying out cooperative work where the student will demonstrate their ability to work in teams, communicate orally and in writing and apply the contents of the subject to make critical judgments.
- LO3: Realization of laboratory practices and delivery of structured and rigorous reports thereof

The table below shows the relation between the competencies developed during the course and the envisaged learning outcomes:

Competencies	Learning outcomes
CB1, CB3, CB4, CB5, CT4, CT12, CT16, CoEs.5	**LO1:** Resolution of exercises and problems applying the knowledge acquired.
CB1, CB2, CB3, CB4, CB5, CT4, CT5, CT12, CT16, CoEs.5	**LO2:** Carrying out cooperative work where the student will demonstrate their ability to work in teams, communicate orally and in writing and apply the contents of the subject to make critical judgments
CB1, CB2, CB3, CB4, CB5, CT4, CT5, CT12, CT16, CoEs.5	**LO3:** Realization of laboratory practices and delivery of structured and rigorous reports thereof

4. CONTENT

The course covers the content stated in the official description of the Degree:

- Combinational and sequential circuits
- Integrated circuits (A/D and D/A converters, memories, etc.)
- Fundamentals of Programmable Logic Devices (PLD) and Hardware Description Languages (HDL).
- Microprocessor and their programming

In order to do that, the course material is organized in seven learning units as shown below:

- Unit 1. Fundamentals of Programmable Logic Devices (FPGA) and circuits' description (VHDL).
- Unit 2. Description of combinational circuits
- Unit 3. Description of sequential circuits
- Unit 4. Introduction to semiconductor memories
- Unit 5. Introduction to Microprocessors and Microcontrollers
- Unit 6. Introduction to Analog-to-Digital and Digital-to-Analog converters
- Unit 7. Development of application with microcontrollers

5. TYPES OF EDUCATIONAL ACTIVITIES

In this course, next types of educational activities will be applied.

- Lectures, reading of main topics and complementary materials, implementation of individual and collaborative application activities (classroom mode)
- Group work of an integrative nature, which consists of participation in debates and seminars, and the group implementation of application activities of an inclusive nature (face-to-face mode)
- Autonomous work (classroom mode)
- Tutoring, academic monitoring and evaluation (classroom mode)
- Laboratory practices (classroom mode)

6. EDUCATIONAL ACTIVITIES

Relationship between the different educational activities and student work related to them in hours.

Educational activities	Number of hours
Lectures, reading of main topics and complementary materials, implementation of individual and collaborative application activities (classroom mode)	30
Group work of an integrative nature, which consists of participation in debates and seminars, and the group implementation of application activities of an inclusive nature (face-to-face mode)	20
Autonomous work (classroom mode)	50
Tutoring, academic monitoring and evaluation (classroom mode)	25
Laboratory practices (classroom mode)	25
TOTAL	**150**

7. ASSESSMENT

Next, the evaluation systems are related, as well as their weight on the total grade of the subject:

Assessment system	Weight
Exams	30-50%
Reports, case studies, exercises and problems	15-30%
Alternative techniques	15-30%
Conferences	0-10%
Basic and general skills	15%

In the Virtual Campus, when you access the subject, you will be able to consult in detail the evaluation activities that you must carry out, as well as the delivery dates and the evaluation procedures of each one of them.

7.1. Ordinary exam call

To pass the subject in ordinary call you must obtain a grade greater than or equal to 5.0 out of 10.0 in the final grade (weighted average) of the subject.

In addition to that, it will be necessary for you to obtain a grade greater than or equal to 5.0 in both, the final exam and in the project's grade.

7.2. Extraordinary exam call

To pass the subject in ordinary call you must obtain a grade greater than or equal to 5.0 out of 10.0 in the final grade (weighted average) of the subject.

In addition to that, it will be necessary for you to obtain a grade greater than or equal to 5.0 in both, the final exam and in the project's grade.

The failed activities in ordinary call must be delivered, after having received the corresponding corrections to them by the teacher. Also, undelivered or unrealized activities, should be realized/delivered.

The grade in extraordinary call will be considered as NP (Not Submitted/No Attendance/Not show up) when the student has not delivered or done any new activity with respect to what was presented in the ordinary call.

8. SCHEDULE

This section indicates the schedule with delivery dates of evaluable activities of the subject:

Assessed activities	Approximated dates
Digital circuits. Exercises	Weeks 1-3
Lab Exercise 1. Introduction to PLD	Weeks 2-4
Lab Exercise 2. Description of standard combinational circuits	Weeks 4-6
Lab Exercise 3. Description of standard sequential circuits	Weeks 7-8
Lab Exercise 4. Description of Finite State Machines	Weeks 8-9
Lab Exercise 5. Microcontrollers and Digital I/O	Weeks 9-10
Lab Exercise 6. Microcontrollers. Sensors and actuators	Weeks 10-11
Integrating Project	Weeks 10-15
First Exam	Weeks 8-11
Final Exam	Weeks 16-18

This schedule may undergo modifications for logistical reasons of the activities. Any modification will be notified to the student in a timely manner.

9. BIBLIOGRAPHY

Here is the basic recommended bibliography:

1. T. L. FLOYD. “Digital Fundamentals”, 11th edition. Ed. Pearson, 2014.
2. T. L. FLOYD. “Digital Fundamentals”, 9th Edition. Prentice Hall, 2010.
3. J. F. WAKERLY. “Digital Design. Principles and Practices”. 3th Edition. Prentice Hall, 2001.
4. F. PARDO CARPIO and J. A. BOLUDA GRAU. “VHDL. Lenguaje para síntesis y modelado de circuitos”, 3ª edición. Ed. RA-MA, 2011
5. ANDREW S. TANENBAUM. “Structured computer organization”, 6th Edition. Pearson, 2012.
6. WILLIAM STALLINGS. “Computer Organization and Architecture”, 7th Edition. Pearson, 2011
7. Tools manuals and chip datasheets used in the course

10. DIVERSITY CARE UNIT

Students with specific educational support needs:

Adaptations or curricular adjustments for students with specific educational support needs, in order to guarantee equal opportunities, will be guided by the Diversity Attention Unit (UAD).

The issuance of a report of curricular adaptations / adjustments by said Unit will be essential, so that students with specific educational support needs should contact through: unidad.diversidad@universidadeuropea.es at the beginning of each semester.

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INSTITUTIONAL ASSESSMENT OF LEARNING OUTCOMES PLAN Covid-19
TEMPLATE TO ADAPT TEACHING AND EVALUATION ACTIVITIES

Course: Digital Electronics and Microprocessors

Degree: Telecommunication Systems Engineering / Biomedical Engineering

Year: 2º

Group: M22-9953 M23-9971 M22-MSTA M32-9972

Professor: Víctor Manuel Padrón Nápoles

Coordinating professor: Borja Rodríguez Vila

Teaching Activity described in the syllabus	Adapated activity in distance learning
Lectures	Lectures online using BB Collaborate
Problem resolution	Problem resolution online using BB Collaborate
Oral presentation	Oral presentation online using BB Collaborate
Reporting and writing	Reporting and writing
Tutorials	Tutorials online using BB Collaborate
Autonomous work	Autonomous work
Activities in workshops / labs	Labs exercises are partially converted into simulations using the same designing tool (Quartus II). Other lab exercises are realized online, buying Arduino kits and using BB Collaborate
Exams	Exams using proctoring and BB Collaborate.

Lab exercises		Lab exercises (adapted)	
Description of original face to face evaluation activity	Lab exercises	**Description of new activity**	Simulations using the same designing tool (Quartus II). lab exercises online, using Arduino kits and BB Collaborate
Content to be assessed	The same content is to be assessed. Some lab exercises were realized before being confined. Students got some practical skills using software (Quartus II) and board. We get deeper in the use of VHDL and description of circuits using simulations instead of using the boards. Also, we bought some Arduino kits to perform the rest of lab exercises online.		
Learning Outcomes to be assessed ***(Please check Syllabus of the course/module)***	The Learning Outcomes that are addressed are the same: specify: LO1: Know, analyze and design basic combinational and sequential circuits. LO2: Analyze and design basic circuits using programmable logic devices and hardware description languages. LO3: Understand the operation of converters, memories, microprocessors and microcontrollers. LO4: Gather and interpret the relevant data to perform the basic programming of microprocessors and microcontrollers. LO5: Transmit the information related to the designed circuits and the solutions found both to a specialized and non-specialized public, including the ethical and professional responsibility of the work performed.		
Duration	22,5	**Approximate duration**	22,5
Weight in evaluation	50%	**Weight in evaluation**	50%
Please note:	Already performed: 10% Simulations: 20% Arduino: 20%		

Exams / project		Exams / Project (adapted)	
Description of original face to face evaluation activity	Exams Project	**Description of new activity**	Not defined in detail yet. Potentially using proctoring and BB Collaborate. The **oral assessment** of the Project will be used to complement online exam evaluation.
Content to be assessed	The same content is to be assessed. Description of digital circuits using VHDL and Quartus-II. Development of project using microcontrollers.		
Learning Outcomes to be assessed ***(Please check Syllabus of the course/module)***	The Learning Outcomes that are addressed are the same: specify: LO1: Know, analyze and design basic combinational and sequential circuits. LO2: Analyze and design basic circuits using programmable logic devices and hardware description languages. LO3: Understand the operation of converters, memories, microprocessors and microcontrollers. LO4: Gather and interpret the relevant data to perform the basic programming of microprocessors and microcontrollers. LO5: Transmit the information related to the designed circuits and the solutions found both to a specialized and non-specialized public, including the ethical and professional responsibility of the work performed.		
Duration	37,5	**Approximate duration**	37,3
Weight in evaluation	50% (50% Exams)	**Weight in evaluation**	50%
Please note:	Final exam: 40% 10% Oral assessment of Project		