Universida_{de}Vigo

Subject Guide 2023 / 2024

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	tronics and microcontrollers			
Subject	Digital electronics			
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	microcontrollers			
Code	V12G330V01601			
Study	Grado en			
programme	Ingeniería en			
	Electrónica			
	Industrial y			
	Automática			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Mandatory	3rd	<u>2nd</u>
Teaching	#EnglishFriendly			
language	Spanish			
Department				
	Soto Campos, Enrique			
Lecturers	Costas Pérez, Lucía			
	Rodríguez Andina, Juan José			
	Soto Campos, Enrique			
E-mail	esotoc@uvigo.es			
Web	http://moovi.uvigo.es			
General description	The general objective of this subject is for students to analysis, simulation, debugging, testing and mainten medium-scale integration circuits (MSI), with reconfigure The content of the course emphasizes the following a Study the operating parameters of the logic families. Study of the design methodology for combinational Analysis of the basic functional blocks of combinational Study of the design methodology of sequential digit Analysis of the basic functional blocks of sequential Description and use of hardware description languared Description of the types of Semiconductor Memories Study of the basic structure of a microprocessor and Study of the design methodology of digital systems English Friendly subject: International students may a) resources and bibliographic references in English, exams and assessments in English.	nance of basic digit gurable devices (F aspects: s taking into accou digital circuits. onal digital circuits tal circuits. I digital circuits.	tal electronic cir. PGAs) or with munt the manufaces. ol for the specific parameters and r. ontrollers. eachers:	cuits made with nicrocontrollers. turing technology. cation of digital circuits.

Training and Learning Results

Code

- B3 CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
- B4 CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the scope of industrial engineering in the field of Industrial Electronic and Automation.
- C21 CE21 knowledge of the fundamentals and applications of digital electronics and microprocessors.
- C24 CE24 Ability to design analog, digital and power electronic systems.
- D2 CT2 Problems resolution.
- D9 CT9 Apply knowledge.
- D17 CT17 Working as a team.

Expected results from this subject

Expected results from this subject

Training and Learning Results

Know the technologies of manufacture and parameters of operation of the logical families. C24 D2					
Dominate the technicians of design of digital circuits combinational and sequential. C24 D9 Know the types and applications of semiconductor Memories. B3 C21 C24 Dominate the procedures of a microprocessor and microcontroller. B3 C21 Dominate the procedures of design and realisation of application of microcontrollers. B4 C21 D2 C24 D9 Dominate the procedures of design and realisation of application of microcontrollers. B4 C21 D2 C24 D9 D17 Adquire basic skills of specification of digital electronic circuits with languages of description of digital electronic circuits. Contents Topic Contents Topic Theory 1.1 INTRODUCTION TO DIGITAL Number Codes. Boolean algebra. Basic logic gates. ELECTRONICS Theory 1.2 DIGITAL ELECTRONIC TECHNOLOGIES Digital technologies: electric and timing characteristics, circuits coupling, output circuits. Theory 1.3 BASIC CONCEPTS OF HDLs Methodologies of digital design. Hardware Description Languages. Structures and sentences of VHDL language: Types of descriptions, multivalued logic, examples, simulation. Theory 1.4 ANALYSES AND DESIGN OF Logic functions. Simplification of functions. Incomplete functions. COMBINATIONAL CIRCUITS Theory 1.5 COMBINATIONAL FUNCTION BLOCKS Decoders, coders, multiplexers, demultiplexers, Buffers, tri-state Theory 1.6 BASIC SEQUENTIAL DIGITAL CIRCUITS Theory 1.7 SEMICONDUCTOR DIGITAL MEMORIES Definition and uppear of properties, random and sequential access memories. Active and passive memories. Wolatile memories and nonvolatile. State garalle, shifty, counters. Descriptions in VHDL of feMs. Theory 1.7 SEMICONDUCTION TO CONFIGURABLE CIRCUITS Theory 2.7 PRINTESTATE MACHINES State machine specification of a microcontroller. Memory architecture. Theory 2.7 PRINTESTATE MACHINES State machine specification of a microcontroller of Microcort of the PicL3 structure of the instruct	Know the technologies of manufacture and paran	neters of operation of the logical families.	В3	C21	
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Practice 1 INTRODUCTION To THE LABORATORY OF DIGITAL ELECTRONICS	Introduction to the laboratory of digital electronics, available resources, documentation, methodology of work. Study of the static and dynamic characteristics of a digital circuit. Setting of a combinational circuit with logic gates. Verification by means of the logical probe and the oscilloscope.
DIGITAL CIRCUITS DESCRIBED IN VHDL.	FSimulation environment of circuits described in VHDL. Modelling of combinational circuits in VHDL with concurrent sentences. Modelling of algorithms in VHDL (descriptions of behaviour) with sentences no concurrent. Design of a simulation test-bench. Simulation of the circuit.
Practice 3 STUDY OF THE OPERATION OF THE DIGITAL CIRCUITS SYNCHRONISED BY MEANS OF A CLOCK.	Study of the sequential circuits and of the Logical Analyser. Know the characteristics of the synchronous digital circuits. Analysis of the maximum frequency of work. Analysis of the evolution between states. Elimination of bounces. Analysis of the operation of a synchronous counter. Know the operation of the Logical Analyser.
SEQUENTIAL DIGITAL CIRCUITS DESCRIBED IN VHDL.	FModelling of sequential circuits in VHDL using the sentence process. Modelling in VHDL by means of sentences no concurrent of a circuit counter. Design of a test bench for the circuit. Simulation of the circuit.
Practice 5 INTRODUCTION TO THE IMPLEMENTATION OF DIGITAL CIRCUITS IN FPGAS	Study of the development board with a configurable circuit. Study of the documentation associated to the configurable device used. Study of the available peripherals to make systems based in the device reconfigurable used. Synthesis of a simple example.
Practice 6 SIMULATION AND IMPLEMENTATION OF SYNCHRONOUS SEQUENTIAL SYSTEMS	Design and physical realisation of a synchronous digital circuit described by means of a state graph using a multiplexer and a counter. Structural modelling in VHDL. Design of a teste bench. Simulation of the circuit. Programming of the circuit in the device in the development board.
Practice 7 DESIGN AND IMPLEMENTATION OF A DIGITAL SYSTEMS BASED IN FPGA	Design and simulation of a synchronous sequential system of control of simple peripherals (display, LEDs, switches, keyboard, etc.). Implementation using a FPGA development board.
Practice 8 SIMULATING AND PROGRAMMING APPLICATIONS IN PIC MICROCONTROLLERS	Presentation of the computer tools and of the available hardware for the design, simulation and test of applications based in the Microchip microcontroller.
Practice 9 PARALLEL INPUT/OUTPUT	Program and check the operation of the peripherals of parallel I/O using the PIC microcontroller environment.
Practice 10 TIMERS / COUNTERS	Check the operation of the timer peripherals of the PIC microcontroller.
Practice 11 INTERRUPTIONS.	Check the management of interruptions of peripherals in the PIC microcontroller.
Practice 12 ANALOG INPUT	Program and check the operation of the digital to analog converter of the PIC microcontroller.

Planning					
	Class hours	Hours outside the	Total hours		
		classroom			
Lecturing	48	84	132		
Laboratory practical	24	54	78		
Essay questions exam	4	11	15		
*The information in the planning table	is for guidance only and door no	at take into account the hot	organoity of the students		

^{*}The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

	Description
Lecturing	Explanation by the teaching staff of the relevant aspects of the contents labeled with the epigraph "Theory". For a better understanding of the contents and an active participation in the Session, the students must carry out a previous personal work on the proposed bibliography. In this way, students will be able to ask questions, ask for clarifications or express doubts, which may be resolved in the Session or in personalized tutorials. For a better understanding of certain contents, practical examples planned to increase student participation will be presented. Students must carr out subsequent personal work to assimilate the concepts and acquire the skills corresponding to each Session. They will be developed in the schedules and classrooms indicated by the direction of the center.

Laboratory practical

Activities to apply the theoretical knowledge acquired. They are intended for students to acquire abilities and skills related to the design, simulation, debugging, testing and maintenance of digital electronic circuits. In these sessions, students will use electronic instrumentation for the analysis of digital electronic circuits, design tools, simulation and debugging of digital electronic circuits based on reconfigurable devices (FPGAs), and tools for programming, simulation and debugging of digital electronic circuits based on microcontrollers. Students will face the design and testing of simple digital electronic circuits based on FPGAs and microcontrollers. For each practice there will be a statement indicating the previous personal work that the students must carry out, the tasks that must be carried out in the practical session and the relevant aspects for the evaluation of the practice. They will be held in the Digital Electronics Laboratory of the Department of Electronic Technology, at the times indicated by the center's management. The students will be organized in groups of two people. An attendance check will be carried out.

Personalized assistance		
Methodologies	Description	
Lecturing	The students will have occasion to attend to personalised attendance in the office of the professor in the schedule that the professors will establish to such effect at the beginning of the course and that will publish in the web page of the subject. In it the professors of the subject will resolve the doubts related with the contents given in the sessions and will orient them on as tackle his study.	
Laboratory practica	In addition to the attention of the professor of practicals during their realisation, the students will be able to attend to personalised attendance to pose and resolve the difficulties of the previous works recommended to make the practicals.	

Assessme	''-		
	Description	Qualificati	onTraining and Learning Results
Laboratory practical	As part of the continuous assesment of the subject, each student will be evaluated in each of the practicals. The evaluation will take into account the preparation work prior to carrying out the practical, attendance, punctuality and use. The previous work will have a maximum weight of 30% of the practice grade. The total qualification of the practicals will be obtained as an arithmetic mean of the qualification of each one of them. In order to make the average, it is necessary to obtain in each practical a grade equal to or greater than 30% of the maximum grade of the practical. For justified reasons you can miss doing one of the practicals. The grade corresponding to said practice will be zero (0.0). If the mean criterion cannot be applied, the grade for this part will be calculated by multiplying by 0.42 the grade obtained with the weighted average and it will not be compensable with the theory grade. The grade of individual practicals is not kept for successive academic years.		B4 C21 D2 C24 D9 D17
Essay questions exam	As part of the continuous assesment of the subject, each student will take two face-to-face written tests of two hours each weighting a 30% each one. The first, at the end of the contents related to Digital Electronics, in a master session programmed in the time planning of the subject. The second, of the contents related to Microcontrollers, coinciding with the date set for the final exam. If any of the tests is divided into several parts, to calculate the total mark as a weighted average of the parts, it is necessary to obtain a minimum mark of 30% of the total mark in each part. The final grade will be obtained as the arithmetic mean of the grade of the two tests. In order to make the average, it is necessary to obtain in each test a grade equal to or greater than 40% of the maximum grade of the test. In the case of not being able to apply the criterion of the average, the grade for this part will be calculated by multiplying by 0.56 the grade obtained with the weighted average and it will not be compensable with the practice grade.	-	B3 C21 D2 B4 C24 D9

Other comments on the Evaluation

In order to pass (theoretical contents of digital electronics, theoretical contents of microcontrollers or laboratory practices) between the first and the second call of the academic year, it is necessary to obtain a grade equal to or greater than 50% of the grade corresponding to the evaluation of said subject.

Continuous assessment students who have to take the second call of the academic year must complete:

A final exam whose grade will be 60% of the grade for the subject. It will consist of two parts: Digital Electronics short-answer questions and troubleshooting and Microcontrollers short-answer questions and troubleshooting. To pass the exam, you must achieve at least 40% of the grade for each of the parts. The final grade will be the arithmetic mean of the two grades. In order to compensate the grades of the different parts, at least 40% of the maximum grade must be reached.

If the minimum threshold is not reached somewhere, the final grade for the course will be failed and the numerical value will be calculated by multiplying by 0.62, the grade obtained with the weighted average (clarification on the coefficient: This coefficient is obtained by dividing 4.9 (maximum grade of failure) divided by 7.9 (maximum grade of the weighted average that can be obtained by failing the subject \square 6 in lecture sessions, 1.9 in practices [does not exceed the minimum threshold of 50%]).

The student that renounces the continuous evaluation will be qualified by means of a final exam of theoretical knowledge and problem solving and a Practice exam. The weight and evaluation criteria are the same as in continuous evaluation.

Those students who cannot attend two or more practices for the justified reasons set forth in the Student Statute, will have the right to a single laboratory test to be held in the exam period of the corresponding call established by the school.

Ethical Commitment: The student is expected to exhibit appropriate ethical behavior. In case of detecting unethical behavior (copying, plagiarism, use of unauthorized electronic devices, and others), it will be considered that the student does not meet the necessary requirements to pass the subject. In this case, the overall grade for this academic year will be fail (0.0).

Sources of information

Basic Bibliography

John F. Wakerly, Digital Design: Principles and Practices, 4,

Fernando E. Valdes Pérez, Ramón Pallás Areny, Microcontroladores. Fundamentos y aplicaciones con PIC, 1,

PIC18F27/47Q10 microcontrollers Data Sheet, Microchip Technology Inc., 2020

Enrique Mandado Pérez, **Sistemas Electrónicos Digitales**, 10, Marcombo, 2015

Complementary Bibliography

Recommendations

Subjects that it is recommended to have taken before

Fundamentals of electronics/V12G330V01402