SUBJECT TEACHING GUIDE

G730 - Digital Electronic Systems

Degree in Industrial Technologies Engineering

Academic year 2023-2024

1. IDENTIFYING DATA				
Degree	Degree in Industrial Technologies Engineering		Type and Year	Optional. Year 4
Faculty	School of Industrial Engineering and Telecommunications			
Discipline	Subject Area: Electronics and Automation Optional Module			
Course unit title and code	G730 - Digital Electronic Systems			
Number of ECTS credits allocated	6	Term	Semester based (2)	
Web				
Language of instruction	English		Mode of delivery	Face-to-face

Department	DPTO. TECNOLOGIA ELECTRONICA E INGENIERIA DE SISTEMAS Y AUTOMATICA
Name of lecturer	FRANCISCO JAVIER AZCONDO SANCHEZ
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Office	E.T.S. de Ingenieros Industriales y de Telecomunicación. Planta: - 3. DESPACHO PROFESORES (S3019)
Other lecturers	

3.1 LEARNING OUTCOMES
- Students are able to apply Digital Electronics concepts to solve practical engineering problems on their own.
- Students acquire skills to use the instruments of the Digital Electronics Lab to obtain and assess experimental results

4. OBJECTIVES
Equip the students with competences in middle complexity digital circuits design implemented in programmable devices
Train in a professional computer aided design (CAD) environment using text and graphic interfaces
Identification of the designer tasks to achieve reliable designs
Learn the main elements of the hardware description language VHDL
Describe, simulate, and synthesize combinational and sequential circuits using VHDL
Practice the Digital Electronics concepts, with special emphasis in state machines, using the hardware description language through the design of a Hardware in the Loop + Controller project.
Acquire device selection criteria according to the application needs, identifying the pros and cons of implementing a design in a concurrent vs. a sequential device and adapt the circuit description in consistency with the hardware resources
Analyze, synthesize and simulate synchronous digital circuits, identifying and solving the clock signal distribution.
Define, plan, and carry out a functional verification of synchronous digital circuits.
Acquire design fundamentals of digital systems using low and middle complexity PIC microcontrollers learning their hardware resources

6. COURSE ORGANIZATION	
CONTENTS	
1	Introduction: VHDL. Design flow. Mínimum description. Example. Event oriented simulation. Abstraction levels. Behavioral, data flow and structural descriptions. Basic elements Lexical elements Objects Data type Operators and expressions Design examples
2	Design units Entity. Architecture. Configuration. Package. Design examples Attributes
3	Statements in VHDL Sequential vs. concurrent. Sequential statements. Finite State Machines Concurrent statements. Subprograms. Design examples. Libraries. Design examples.
4	Modulators Variable Pulse Oscillator Pulsewidth Modulator Resolution Sigma-Delta Multiplexed delay Digital Clock Manager Small-signal model of the plant in the digital domain Complete model Approximation Comparison with the model in the continuous domain Implementation of digital controllers Controller design Limit Cycling Anti windup Fixed-point number format Scaling and quantization
5	Introduction, characteristics and general resources of the PIC microcontrollers Architecture of the base line devices. Timmers, I/O gates, reset, sleep mode. Instructions set. Middle range PIC devices. Common resources for interruptions Peripherals of the middle range devices Design examples

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Continuous learning assessment through homework assigments oriented to solve a case study which is the content of the final exam and class exercises	Others	No	No	20,00
Lab exercises	Laboratory evaluation	No	No	30,00
Course project	Laboratory evaluation	Yes	Yes	50,00
TOTAL				100,00

Observations

The continuous evaluation is not recoverable since it consists of follow up questions and exercises to identify the attention, participation and degree of understanding of what is discussed in the classes through exercises, small designs or questions and the interaction of the students during the development of the teaching. The continuous evaluation also allows identifying the points to review in the tutorials.
Students will develop analysis, modeling and design work in specific software and measurements in laboratory practices related to subject topics. The documentation to be evaluated is delivered in writing, in pdf and vhd files (models, analysis, simulation results).
In the event that the health criteria make it necessary, the evaluation tests will be carried out following the mixed teaching format, face-to-face in the classroom and outside of it. In the most extreme case that the attendance of all students and teachers at the center is impossible or inconvenient, the evaluation tests will be developed using telematic means. In these cases, the content of the tests, being similar to the face-to-face case, may be totally or partially individualized for each student

Observations for part-time students

Since 50% of the grading is obtained with activities integrated in the regular and tutorial classes along with the lab and since the final exam consist of the presentation of a practical case study, which is also developed during the classes. The assessment criteria for part time students is the same of for other students.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

D. Perry. VHDL Programming By Example. Mc Graw Hill. 2002

Pong P. Chu FPGA Prototyping by VHDL examples. Wiley Interscience. 2008

Luca Corradini, Dragan Maksimovic, Paolo Mattavelli, Regan Zane. Digital Control of High-Frequency Switched-Mode Power Converters. IEEE Press - Wiley. 2015