

## 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
E-mail	javier.azcondo@unican.es
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. Minimum 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. Timers, 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 assignments 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
<b>TOTAL</b>				<b>100,00</b>
<b>Observations</b>				
<p>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.</p> <p>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).</p> <p>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</p>				
<b>Observations for part-time students</b>				
<p>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.</p>				

### 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