



Teaching Guide				
Identifying Data				2022/23
Subject (*)	Digital Systems I	Code	770G01026	
Study programme	Grao en Enxeñaría Electrónica Industrial e Automática			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Third	Obligatory	6
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría Industrial			
Coordinador	Díaz Longueira, Antonio Javier	E-mail	a.diazl@udc.es	
Lecturers	Díaz Longueira, Antonio Javier Jove Pérez, Esteban Meizoso López, Maria del Carmen Timiraos Díaz, Miriam	E-mail	a.diazl@udc.es esteban.jove@udc.es carmen.meizoso@udc.es miriam.timiraos.diaz@udc.es	
Web				
General description	O obxectivo desta materia é que o alumno coñeza as memorias e os dispositivos lóxicos programables, así como os métodos e ferramentas de deseño de circuitos sobre dispositivos lóxicos programables.			

Study programme competences / results	
Code	Study programme competences / results
A26	Coñecer os fundamentos e aplicacións da electrónica dixital e microprocesadores.
A30	Coñecer e ser capaz de modelar e simular sistemas.
A31	Coñecementos de regulación automática e técnicas de control e a súa aplicación á automatización industrial.
B1	Capacidade de resolver problemas con iniciativa, toma de decisións, creatividade e razoamento crítico.
B2	Capacidade de comunicar e transmitir coñecementos, habilidades e destrezas no campo da enxeñaría industrial.
B3	Capacidade de traballar nun contorno multilingüe e multidisciplinar.
B4	Capacidade de traballar e aprender de forma autónoma e con iniciativa.
B5	Capacidade para empregar as técnicas, habilidades e ferramentas da enxeñaría necesarias para a práctica desta.
B6	Capacidade de usar adecuadamente os recursos de información e aplicar as tecnoloxías da información e as comunicacións na enxeñaría.
B7	Capacidade para traballar de forma colaborativa e de motivar un grupo de traballo.
B11	CB4 - Que los estudiantes puedan transmitir información, ideas, problemas y soluciones a un público tanto especializado como no especializado.
C2	Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.
C5	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.

Learning outcomes			
Learning outcomes			Study programme competences / results
Programa dispositivos lóxicos programables e configurables e utiliza con soltura a suas ferramentas de desenvolvemento.	A26	B1	C2
	A30	B3	
Coñece a realización electrónica dos circuitos convertidores A/D e D/A e sabe elegir o máis adecuado en cada aplicación.	A26	B1	C2
	A30	B2	C5
		B5	
		B6	



Distingue os tipos de circuitos lóxicos programables e dispositivos de memoria.	A26 A30 A31	B1 B5	C2 C5
Coñece as técnicas de conexión de periféricos básicos, deseña o seus circuitos.	A26 A30	B2 B4 B7 B11	C2 C5

Contents	
Topic	Sub-topic
Contidos da memoria de verificación relacionados cos temas da asignatura	<ul style="list-style-type: none"> <li>· Programación básica en VHDL: Temas 1 e 2.</li> <li>· Deseño con dispositivos electrónicos configurables CPLD e FPGA: Temas 3, 4 e 6.</li> <li>· Circuitos de memoria. Temas 5, 6 y 7.</li> <li>· Conversión A/D y D/A. Tema 6 e 9.</li> <li>· Ferramentas de deseño e desenvolvemento de sistemas lóxicos programables: Temas 4, 6, 8, 9 e 10.</li> <li>· Transmisión de datos. Temas 8 y 10.</li> </ul>
Subject 1. Sequential synchronous systems design	Finite state machines. Analysis and synthesis . VHDL description.
Subject 2. Introduction to Programmable Logic	Programmable circuits features. Steps of design. Applications.
Subject 3. PLD CoolRunner II architecture	Function Blocks. Macrocells. I/O Blocks. Timing model.
Subject 4. Digital systems design with CPLDs.	Synthesis: Examples of macros codes. Synthesis Report. Options. Translate. Fit:Options. Timing report Secuencial systems design: Clock signals. Synchronous circuits design:counters, control circuits, asynchornous inputs, metaestability. Interface between synchronous systems and other circuits.  Design of complex systems: Method and practical application.
Subject 5. Architecture of the FPGAs of the family Spartan 3 E of Xilinx	Logic resources.CLB. Internal memories. Clock Circuits. Multipliers. E/S technologies.
Subject 6. Synchronous design with FPGAs	Synchronous design methodology.
Subject 7: Working with files	File declaration. Reading and writing files. Open and close files. Package std_logic_textio. Examples.
Tema 8. Deseño de un controlador VGA	DA converter for VGA into the Nexys 2. Standard VGA. Controller design.
Subject 8. Design of arithmetic systems with programmable logic	Adders. Subtracters. Multipliers. Dividers
Subject 9. Techniques for improving the performance of synchronous systems.	Duplicating states. Pipelining.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A26	30	0	30
Laboratory practice	B7 B11 C2 C5	30	0	30
Supervised projects	A26 A30 A31 B1 B2 B3 B4 B5 B6	0	76	76
Mixed objective/subjective test	A26 A30 B1	4	0	4
Personalized attention		10	0	10



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

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Exposición oral e mediante o uso de medios audiovisuais.
Laboratory practice	Desenrolo de prácticas de aplicación dos coñecementos teóricos adquiridos. Manexo do software de simulación e deseño de circuitos dixitais.
Supervised projects	Traballos de realización individual ou en grupo para o deseño dun circuito de complexidade media.
Mixed objective/subjective test	Probas de avaliación que poderán incluír preguntas sobre dos contidos teóricos da asignatura, así como exercicios ou problemas relacionados cos seus contidos.

Personalized attention	
Methodologies	Description
Supervised projects	Os profesores atenderán persoalmente as dúbidas sobre calquera das actividades desenvolvidas ao longo do curso. O horario de tutorías será publicado ao comezo do cuadrimestre na páxina web do centro.
Guest lecture / keynote speech	
Laboratory practice	O alumnado con recoñecemento de dedicación a tempo parcial e dispensa académica de exención de asistencia, poderá realizar sesión periódicas co coordinador da materia a través de Microsoft Teams ou correo electrónico.

Assessment			
Methodologies	Competencies / Results	Description	Qualification
Supervised projects	A26 A30 A31 B1 B2 B3 B4 B5 B6	Work designing a digital system of medium complexity. The correct application of theoretical concepts to the work performed will be evaluated. It is necessary to submit an explanatory report, make an oral presentation and answer correctly the questions made by the teachers.	40
Mixed objective/subjective test	A26 A30 B1	There will be 2 objective tests to be performed individually for each student.  The first will take place once explained the first 5 issues. It will mean the 30% of the final grade.  The second test will be the final exam 1st opportunity and can have the following weights: - 30% for those students who decide to do the test of the second part. - 60% for those students who decide to do the test of the first and second parts. In that case, the grade obtained in the first objective test is discarded.	60
Others			

Assessment comments



The scores for the evaluable tasks are only valid for the academic year in which they are made.

Objective tests may include short-answer questions and / or test, problem solving on paper or circuit design with the ISE software.

To achieve maximum grade at project, the following issues will be considered:

- The designed circuits must work perfectly in all its aspects (functional and temporal simulation).
- The documentation and presentation must be clear.
- The students must explain the reasons to make the design and answer correctly the questions made by the teacher regarding the project.

#### Final grade

The final grade is usually calculated as:

$$\text{Final grade} = 0.4 \times \text{project grade} + 0.6 \times \text{objective test 2 grade}$$

#### Second opportunity

The second time, an objective test that can consist of theoretical and practical questions, written exercises, issues and implementation of a circuit in one of the Laboratory boards will be performed.

The final grade is usually calculated as:

$$\text{Final grade} = 0.4 \times \text{project grade} + 0.6 \times \text{objective test 2 grade}$$

#### Sources of information

<b>Basic</b>	<ul style="list-style-type: none"> <li>- Jacobo Álvarez Ruiz de Ojeda (2004). Diseño Digital con Lógica Programable. Santiago de Compostela. Tórculo</li> <li>- Jacobo Álvarez Ruiz de Ojeda (2012). Diseño digital con FPGAs. Madrid : Vision Ebooks</li> </ul>
<b>Complementary</b>	<ul style="list-style-type: none"> <li>- Roy W. Goody (2001). OrCAD PSpice for Windows. Prentice Hall</li> <li>- Tocci. Ronald J. (1996). Sistemas Digitales. Prentice Hall</li> </ul>

#### Recommendations

##### Subjects that it is recommended to have taken before

Fundamentals of Electricity/770G01013  
 Fundamentals of Electronic Circuits/770G01018  
 Analog Electronics/770G01022  
 Digital Electronics/770G01023

##### Subjects that are recommended to be taken simultaneously

##### Subjects that continue the syllabus

Digital Systems II/770G01034

#### Other comments

Nesta asignatura dase por suposto que o alumno sabe programar en linguaxe VHDL, e manexa o entorno de deseño ISE Web Pack de Xilinx, polo que para matricularse con posibilidades de éxito é preciso haber cursado con aproveitamento Electrónica Dixital, ou ben haber adquirido esos coñecementos previamente.

(\*The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.