COURSE DATA

DATA SUBJECT

Code: 44283
Name: Embedded systems
Cycle: Master's Degree / Doctorate
ECTS Credits: 5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
2199 - Master's Degree in Electronic Engineering	Escola Tècnica Superior d'Enginyeria	1	Annual

SUBJECT-MATTER

Degree	Subject-matter	Character
2199 - Master's Degree in Electronic Engineering	Digital systems and communications	COMPULSORY

COORDINATION

TORRES PAIS JOSE GABRIEL

SUMMARY

This subject teaches to the student all the stages of the codesign hardware / software for the development of embedded systems, focusing specially on the reconfigurable systems based on FPGAs with embedded software microprocessors.

The contents of the subject are the following ones:

- Programmable integrated systems.
- Architecture of the families of programmable systems.
- Embedded Microprocessors.
- Design tools.
- Integrated systems peripherals.
- Applications in information, audio and video.
- Design of commercial solutions.
- Applications in typical components of communications.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

It is convenient that the students have a basic knowledge of the language of hardware description VHDL.
It is necessary that the students have a basic knowledge of the language of programming C.
It is also necessary that the students have solid knowledge of digital programmable systems.

COMPETENCES / LEARNING OUTCOMES

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Capacidad para el modelado matemático, cálculo y simulación en todos los ámbitos relacionados con la Ingeniería Electrónica y campos multidisciplinares afines. En especial los de tratamiento de la señal, sistemas digitales y de comunicaciones y electrónica industrial.

Capacidad para proyectar, calcular y diseñar productos, procesos e instalaciones en todos los ámbitos de la Ingeniería Electrónica y en particular los de tratamiento de la señal, sistemas digitales y de comunicaciones y electrónica industrial.

Conocer las técnicas avanzadas para la propagación de señales y datos mediante soporte físico, haciendo especial hincapié en el estudio de casos prácticos y el diseño de circuitos de microondas mediante líneas de transmisión.

Demostrar una comprensión sistemática de un campo de estudio y el dominio de las habilidades.

Diseñar un sistema, componente o proceso que cumpla unas especificaciones desde diferentes puntos de vista: electrónico, económico, social, ético y medioambiental.

Realizar un análisis crítico, evaluación y síntesis de ideas nuevas y complejas.

Ser capaz de fomentar, en contextos académicos y profesionales, el avance tecnológico, social o cultural dentro de una sociedad basada en el conocimiento.

Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.

Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.

Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.

Students should demonstrate self-directed learning skills for continued academic growth.

Take into account the economic and social context in engineering solutions, be aware of diversity and multiculturalism and ensure sustainability and respect for human rights and equality between men and

women.

DESCRIPTION OF CONTENTS

1. Basic embedded systems design

1. Introduction to Embedded System Design using Zynq and Vivado
2. Lab 1: Simple Hardware Design
3. Zynq Architecture
4. Extending the Embedded System into PL
5. Lab 2: Adding IPs in Programmable Logic
6. Adding Your Own Peripheral
7. Lab 3: Creating and Adding Custom IP
8. Software Development Environment
9. Lab 4: Writing Basic Software Applications
10. Software Development and Debugging
11. Lab 5: Software Debugging Using SDK

2. Advanced embedded systems design

1. Review of Embedded System Design in Zynq using Vivado
2. Lab 1: Create a Complete Embedded System
3. Advanced Zynq Architecture
4. System Debugging using Vivado Logic Analyzer and SDK
5. Lab 2: Debugging using Vivado Logic Analyzer
6. Memory Interfacing
7. Lab 3: Extending Memory Space with BRAM
8. Interrupts
9. Low Latency High Bandwidth
10. Lab 4: Direct Memory Access using CDMA
11. Processor Configuration and Bootloader
12. Lab 5: Configuration and Booting
13. Profiling and Performance Improvement

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	25,00
Laboratory	25,00
Total hours	**50,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	20,00
Preparation of lessons	40,00
Preparation for assessment activities	15,00
Resolution of case studies	0,00
Total hours	**75,00**

TEACHING METHODOLOGY

Training activities will be developed in accordance with the following distribution:

a) Theoretical activities.

Description: Subjects will be developed in theoretical classes by providing a comprehensive perspective, analyzing in greater detail the key aspects and of greater complexity, and encouraging, at all times, the participation of the student.

b) Practical activities.

Description: They will complement the theoretical activities with the objective to apply the basic concepts and extend them with the knowledge and experience that will be acquired during the implementation of the proposed work. In general, practical activities will take place in a group to foster the skills of team work of the students. They include the following type of activities:

- Laboratory work.
- Discussion and problem solving sessions of the students previous work.

c) Home work.

Description: Preparation of both theoretical and practical lessons, and also exams. This task will be individual, in order to improve the self-work capability.

d) Evaluation.

Description: The student performance in the practical sessions will be evaluated continuously, and there will be a final exam at the end of the curse.

e) Scheduled tutoring (Single or in group).

Description: The goal of this activity is to guide and to answer any doubt. The student will expose them, allowing a review of his/her work.

The E-learning platform (Aula Virtual) will be used as communication support tool for the students. Using this application the students will have access to the class materials, and also to the problems and exercises to solve.

EVALUATION

The evaluation of the subject will consist of a written test, with theoretical and practical questions, and laboratory.

REFERENCES

- Pong P. Chu, FPGA prototyping by VHDL Examples: Xilinx Spartan-3 version
- Dennis Silage, Embedded Design using Programmable Gate Arrays
- Uwe Meyer-Baese, Digital Signal Processing with Field Programmable Gate Arrays (Signals and Communication Technology)
- Uwe Meyer-Baese, DSP with FPGAs: VHDL Solution manual
- F. Vahid, T. Givargis, Embedded System Design: A unified HW/SW introduction
- K. Chapman, Creating embedded microcontrollers (Programmable state machines)