COURSE DATA

DATA SUBJECT

Code: 46802
Name: Embedded Systems
Cycle: Master's Degree / Doctorate
ECTS Credits: 4.5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
2269 - Master's Degree in Electronic Engineering	Escola Tècnica Superior d'Enginyeria	1	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2269 - Master's Degree in Electronic Engineering	Sistemas Digitales	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 hardware microprocessors (SoC).

The contents of the subject are the following ones:

- Programmable embedded systems.
- Architecture of the families of programmable systems.
- Embedded Microprocessors.
- Design tools.
- Embedded 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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Conduct a critical analysis, evaluation and synthesis of new ideas to solve problems in complex or unfamiliar environments within broader contexts in the field of electronic engineering and related multidisciplinary fields.

Create mathematical models and simulations in the field of electronic engineering and related multidisciplinary fields.

Demonstrate a systematic knowledge and a mastery of technical, personal, social and methodological skills in the field of electronic engineering and related multidisciplinary fields.

Design systems and processes that meet electronic, regulatory, economic, social, ethical and environmental specifications.

Gain the professional skills and cooperation abilities that are suitable for practising in the field of electronic engineering and related multidisciplinary fields.

Handle specialised software and hardware, as well as design, simulation and programming environments in the field of electronic engineering and related multidisciplinary fields.

Identify, formulate and solve problems in the field of electronic engineering and related multidisciplinary fields.

Interpret technical documentation and regulatory standards for equipment and systems in the field of electronic engineering and related multidisciplinary fields.

Know advanced techniques of signal and data propagation through hardware to ensure signal integrity, with an emphasis on case studies.

Project, calculate and design products, processes and installations in the field of electronic engineering and related multidisciplinary fields.

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
14. Lab 6: Profiling and Performance Tuning

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	20,00
Laboratory	25,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	15,00
Preparation of lessons	35,00

Preparation for assessment activities	10,00
Resolution of case studies	7,50
Total hours	**67,50**

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 student's 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

At the **first call for evaluation**, the subject will be evaluated continuously, according to the following instructions:

- SE3 - Continuous evaluation: Continuous assessment of the activities done from the questions proposed in the theoretical/practical sessions (50%). This activity is not recoverable.
- SE1 - Objective test: Exam that includes the realization of a Project based on the learning and development of the subject, and it also includes theoretical/practical questions to be answered (50%).
- In order to pass the subject, a minimum mark of 4 (over 10) is required in both, the activities and the exam.

At the **second call for evaluation**, it just be proposed another exam theoretical/practical, while the continuous activities mark will be kept from the first call.

Copying or plagiarism of any activity that is part of the evaluation will result in the impossibility of passing the course, and the student will then be subject to the appropriate disciplinary procedures indicated in the ACTION PROTOCOL FOR FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA (ACGUV 123/2020).

In any case, the system of evaluation will be ruled by the established in the Regulation of Evaluation and Qualification of the University of Valencia for Degrees and Masters.

(https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639).

REFERENCES

- Pong P. Chu, FPGA prototyping by VHDL Examples: Xilinx Spartan-3 version
- Dennis Silage, Embedded Design using Programmable Gate Arrays
- Louise H. Crockett, The Zynq Book
- 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)

- Louise H. Crockett, Exploring Zynq MPSoC