

| Degree                                 | Type | Year | Semester |
|--|------|------|----------|
| 4313797 Telecommunications Engineering | OB   | 1    | 2        |

## Contact

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## Teachers

Lluís Antoni Teres Teres  
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## Use of languages

Principal working language: english (eng)

## Prerequisites

Knowledge on the following subjects is recommended:

Electronic Systems Design  
Digital Sistemes and Hardware Description Languages  
Electronic Systems and Applications

## Objectives and Contextualisation

The main objective of this course is to learn, understand and be able to design electronic systems with the focus on embedded systems. These Systems are composed of integrated circuits that manage their capacity of computation and communication through wired or wireless protocols. The study of these integrated systems will be oriented to the usual digital processing architectures in modern electronics: single-core (i.e. wireless sensor networks), multi-core (i.e. multimedia devices) and many core (high performance computing), and the different types of computation: data-flow and reactive. Digital systems are integrating also non digital components such as sensors, actuators, analog, RF and power components. We will review the different fabrication technologies available in the market, from silicon technologies to new processes for organic and flexible electronics, and we will use FPGA platforms to implement such systems in the labs.

## Skills

- Be capable of using programmable logic as well as designing advanced electronic systems, both analogue and digital.
- Capacity for critical reasoning and thought as means for originality in the generation, development and/or application of ideas in a research or professional context.
- Capacity for working in interdisciplinary teams
- Knowledge of the hardware description languages for highly complex circuits
- Maintain proactive and dynamic activity for continual improvement

- Students should be capable of integrating knowledge and facing the complexity of making judgements using information that may be incomplete or limited, including reflections on the social and ethical responsibilities linked to that knowledge and those judgements
- Students should know how to apply the knowledge they have acquired and their capacity for problem solving in new or little known fields within wider (or multidisciplinary) contexts related to the area of study
- Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously

## Learning outcomes

1. Capacity for critical reasoning and thought as means for originality in the generation, development and/or application of ideas in a research or professional context.
2. Capacity for working in interdisciplinary teams
3. Design ASICs
4. Design integrated circuits using hardware description languages through ASICs and/or FPGAs
5. Knowledge of the hardware description languages for highly complex circuits
6. Maintain proactive and dynamic activity for continual improvement
7. Students should be capable of integrating knowledge and facing the complexity of making judgements using information that may be incomplete or limited, including reflections on the social and ethical responsibilities linked to that knowledge and those judgements
8. Students should know how to apply the knowledge they have acquired and their capacity for problem solving in new or little known fields within wider (or multidisciplinary) contexts related to the area of study
9. Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
10. Use programmable digital logic.

## Content

### 1. Introduction to the Design of Integrated Systems for Digital Processing

Main concepts on Integrated and Embedded Systems

Models of Computation

Design and Technology Evolution

Electronic Design Automation Tools

Platform-based and Model-based Design

### 2. Implementation Technologies for Integrated Systems

Silicon technology and Physical design

From transistors to Cell libraries and design kits

(Seminar on logic synthesis)

Introduction to printed electronics

(Seminar on printed electronics circuit design)

High performance printed circuit boards

### 3. Design Methodologies for Integrated Circuits

Introduction to VHDL

VHDL Modeling, simulation and synthesis

ASIC and FPGA Implementation

#### **4. Systems-on-a-Chip Design**

IPs, Virtual Components and cores

Power and performance

SoC Architectures

Physical and virtual Platforms

Introduction to NoCs and MPSoCs

#### **Laboratory: Integrated Digital Processing on FPGA**

#### **Methodology**

The course will be mainly driven by the lectures, that will use adhoc material (presentations and documents) available in the virtual campus of the UAB.

Two seminars are scheduled and others can also be added, according to the parallel activity at UAB, in order to analyse in depth specific topics.

Laboratory work will let the students to apply and experiment the concepts acquired on FPGA platforms widely used in industry.

According to the personal interests of every student, a scientific and/or technologic paper will be selected in order to get familiar and evaluate the knowledge that is available through specialized journals and publications.

#### **Activities**

| Title  | Hours | ECTS | Learning outcomes          |
|--|-------|------|----------------------------|
| <b>Type: Directed</b>  |       |      |                            |
| Laboratory Sessions  | 15    | 0.6  | 1, 2, 5, 4, 6, 8, 9, 7, 10 |
| Lectures   | 22    | 0.88 | 1, 5, 3, 4, 6, 8, 7, 10    |
| Thematic Seminars  | 4     | 0.16 | 1, 3, 6, 8, 9, 7           |
| <b>Type: Supervised</b>  |       |      |                            |
| Selection and follow-up of a personalized scientific-technologic journal paper | 14    | 0.56 | 1, 6, 8, 9, 7              |
| <b>Type: Autonomous</b>  |       |      |                            |
| Laboratory activities preparation and evaluation                               | 20    | 0.8  | 1, 2, 5, 4, 8, 7, 10       |
| Study  | 69    | 2.76 | 1, 5, 3, 4, 6, 8, 7, 10    |

#### **Evaluation**

Evaluation is based on:

- 2 parcial exams containing both theoretical concepts and exercises. Minimum mark on those exams is 3 (over 10)
- Team work at lab scheduled in 5 sessions with the need to deliver the corresponding reports (delivered individually). This is mandatory to pass the course evaluation.
- Individual work on the critical review of a specific scientific and/or technological paper

A method to recover failed parcial exams will be provided.

Any change on the above evaluation method will be communicated in advance

A student will be considered as NON PRESENTED if he/she did not participate in the following evaluation activities (defined in the guide): 2nd Parcial Test and Laboratory work reports.

## Evaluation activities

| Title  | Weighting | Hours | ECTS | Learning outcomes       |
|--|-----------|-------|------|-------------------------|
| Critical review of a personalized scientific-Technologic paper | 15%       | 1     | 0.04 | 1, 6, 8, 9, 7           |
| Laboratory work reports  | 35%       | 1     | 0.04 | 2, 5, 4, 6, 8, 9, 7, 10 |
| 1st Parcial Test   | 25%       | 2     | 0.08 | 5, 3, 4, 8, 7, 10       |
| 2nd Parcial Test   | 25%       | 2     | 0.08 | 5, 3, 4, 8, 7, 10       |

## Bibliography

L. Terés, Y. Torroja, S. Olcoz, E. Villar: "VHDL: Lenguaje estándar de diseño electrónico".

P. Bricaud, M. Keating "Reuse Methodology Manual for System-On-A-Chip Designs".

R. Rajsuman "System-on-a-Chip: Design and Test".

I. Grout "Digital Systems Design with FPGAs and CPLDs"

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