# Course guide
# 270072 - VLSI - VLSI

**Last modified:** 13/07/2023

**Unit in charge:** Barcelona School of Informatics
**Teaching unit:** 701 - DAC - Department of Computer Architecture.

**Degree:** BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Optional subject).

**Academic year:** 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

## LECTURER

**Coordinating lecturer:** RAMON CANAL CORRETGER

**Others:** Primer quadrimestre:
RAMON CANAL CORRETGER - 10

## PRIOR SKILLS

Those listed in IC, EC, PE and AC.

## REQUIREMENTS

- Prerequisite AC

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Specific:**
CEC1.2. To design/configure an integrated circuit using the adequate software tools.
CEC3.2. To develop specific processors and embedded systems; to develop and optimize the software of these systems.

**Generical:**
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

## TEACHING METHODOLOGY

Lectures will cover the fundamentals, the participation of the student is scarce.
Problem classes will develop the concepts learnt in the lectures. The student is actively participating.
Lab sessions will give a hands-on experience on the concepts developed in the problem sessions and explained in the lectures. The student is actively participating and working in a group.
The course is based on the previous courses taught in this specialization. At each point the course, the student will build on top of his previous knowledge.

## LEARNING OBJECTIVES OF THE SUBJECT

1.Understand the steps of VLSI circuit design. Get to know the tools available at each point.
2.Evaluate the VLSI circuits according to a set of figures of merit which include the economic and environmental evaluation
3.Get to know Hardware Description Languages. Be able to program simple structures in one of them
4.Describe the operation and programming simple memory structures.
5.Describe the operation and programming simple combinational structures.
6.Implement at the physical level an optimization of certain memory blocks and combinational structures.
7.Understand the evolution of circuit manufacturing technology, be able to understand the economic and social impact.

## STUDY LOAD

| Type | Hours | Percentage |
|---|---|---|
| Self study | 84,0 | 56.00 |
| Hours medium group | 15,0 | 10.00 |
| Hours small group | 15,0 | 10.00 |
| Guided activities | 6,0 | 4.00 |
| Hours large group | 30,0 | 20.00 |

**Total learning time:** 150 h

## CONTENTS

### 1. Introduction to VLSI technology

**Description:**
Historical perspective of VLSI manufacturing technologies and IC design. Current situation and forecast.

### 2. Steps of VLSI Design

**Description:**
Description of the steps and tools used in VLSI design, from system specification to the implementation in an integrated circuit

### 3. Figures of merit

**Description:**
Description of the figures of merit (area, delay and consumption) of integrated circuits and how to get an estimate before having made □□the circuit.

### 4. Introduction to HDLs

**Description:**
Description of existing hardware description languages□□, comparative advantages and disadvantages. Programming of small structures.

### 5. Microprocessor structures: Memories

**Description:**
Description of existing memory structures for microprocessors. HDLs description and evaluation in the figures of merit.

### 6. Microprocessor structures: ALUs and combinational elements

**Description:**
Description of existing combinational structures in microprocessors. HDLs description and evaluation.

### 7. Layout and full-custom design

**Description:**
Introduction to full-custom design and layout.

## ACTIVITIES

### Final Exam

**Description:**
Final Exam in case the student fails the mid-term exams

**Specific objectives:**
1, 2, 3, 4, 5, 6

**Related competencies :**
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

**Full-or-part-time:** 10h
Guided activities: 2h
Self study: 8h

### 2nd Mid-term Exam

**Description:**
2nd Midterm Exam

**Specific objectives:**
1, 2, 3, 4, 5, 6

**Related competencies :**
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

**Full-or-part-time:** 12h
Guided activities: 2h
Self study: 10h

### 1st Mid-term exam

**Description:**
1st mid-term exam

**Specific objectives:**
1, 2, 3, 4

**Related competencies :**
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

**Full-or-part-time:** 12h
Guided activities: 2h
Self study: 10h

### Introduction to VLSI technology

**Description:**
Introduction of the history of circuit fabrication technology, circuit design; as well as, state-of-the art and future projections.

**Specific objectives:**
7

**Related competencies :**
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

**Full-or-part-time:** 6h
Theory classes: 2h
Self study: 4h

### Steps of VLSI design

**Description:**
Study the theoretical concepts of the chapter and solve exercises and the problem set.

**Specific objectives:**
1, 7

**Related competencies :**
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

**Full-or-part-time:** 6h
Theory classes: 2h
Self study: 4h

### Figures of Merit

**Description:**
Study the theoretical concepts of the chapter and solve exercises and the problem set.

**Specific objectives:**
1, 2, 7

**Related competencies :**
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

**Full-or-part-time:** 8h
Theory classes: 2h
Practical classes: 2h
Self study: 4h

### Introduction to HDLs

**Description:**
Study the theoretical concepts of the chapter and solve exercises and the problem set.

**Specific objectives:**
2, 3

**Related competencies :**
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

**Full-or-part-time:** 19h
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 5h
Self study: 8h

### Microprocessor structures: Memories

**Description:**
Study the theoretical concepts of the chapter and solve exercises and the problem set.

**Specific objectives:**
3, 4

**Full-or-part-time:** 24h
Theory classes: 4h
Practical classes: 4h
Laboratory classes: 4h
Self study: 12h

### Microprocessor structures: ALUs and combinational elements

**Description:**
Study the theoretical concepts of the chapter and solve exercises and the problem set.

**Specific objectives:**
2, 3, 5

**Related competencies :**
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

**Full-or-part-time:** 35h
Theory classes: 6h
Practical classes: 5h
Laboratory classes: 4h
Self study: 20h

**Layout and full-custom design**

**Description:**
Study the theoretical concepts of the chapter and solve exercises and the problem set.

**Specific objectives:**
1, 2, 6

**Related competencies :**
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

**Full-or-part-time:** 18h
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study: 10h

## GRADING SYSTEM

Mid-term1: Review of first 5 chapters
Mid-term2: Review of last 3 chapters
Final: final exam
Lab Review: evaluated on the basis of reports submitted in each of the sessions and, if appropriate, a personal interview

Final mark (NF) = 0.8 x max (final, 0.5 x Mid-term1 + 0.5 x Mid-term2) 0.2 x Lab

The level of achievement of the generic competence is assessed indirectly from the final mark as follows:
A if (NF>8.5), B if (NF>7), C if (NF>5), D otherwise

## BIBLIOGRAPHY

**Basic:**
- Weste, N. H.E.; Harris, D.M. CMOS VLSI design: a circuits and systems perspective. 4th ed. Addison Wesley, 2011. ISBN 9780321547743.

**Complementary:**
- Rabaey, J.M.; Chandrakasan, A.P.; Nikolic, B. Digital integrated circuits: a design perspective. 2nd ed. Pearson Education, 2003. ISBN 0130909963.