

**270072 - VLSI - VLSI**

**Coordinating unit:** 270 - FIB - Barcelona School of Informatics  
**Teaching unit:** 701 - AC - Department of Computer Architecture  
**Academic year:** 2018  
**Degree:** BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Teaching unit Optional)  
**ECTS credits:** 6  
**Teaching languages:** Catalan

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### Teaching staff

**Coordinator:** - Ramon Canal Corretger (rcanal@ac.upc.edu)

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### Requirements

- Prerequisite AC2

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### 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.

**General:**

- 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.

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### 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.

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### 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

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group:</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>6h</td>
<td>4.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>84h</td>
<td>56.00%</td>
</tr>
</tbody>
</table>
## Content

### 1. Introduction to VLSI technology

**Degree competences to which the content contributes:**

**Description:**

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

### 2. Steps of VLSI Design

**Degree competences to which the content contributes:**

**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

**Degree competences to which the content contributes:**

**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

**Degree competences to which the content contributes:**

**Description:**

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

### 5. Microprocessor structures: Memories

**Degree competences to which the content contributes:**

**Description:**

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

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

**Degree competences to which the content contributes:**

**Description:**

Description of existing combinational structures in microprocessors. HDLs description and evaluation.
7. Layout and full-custom design

Degree competences to which the content contributes:

Description:
Introduction to full-custom design and layout.
# Planning of activities

| Final Exam | Hours: 10h  
Guided activities: 2h  
Self study: 8h |
|---|---|
| **Description:**  
Final Exam in case the student fails the mid-term exams |
| **Specific objectives:**  
1, 2, 3, 4, 5, 6 |

| 2nd Mid-term Exam | Hours: 12h  
Guided activities: 2h  
Self study: 10h |
|---|---|
| **Description:**  
2nd Midterm Exam |
| **Specific objectives:**  
1, 2, 3, 4, 5, 6 |

| 1st Mid-term exam | Hours: 12h  
Guided activities: 2h  
Self study: 10h |
|---|---|
| **Description:**  
1st mid-term exam |
| **Specific objectives:**  
1, 2, 3, 4 |

| Introduction to VLSI technology | Hours: 6h  
Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 0h  
Guided activities: 0h  
Self study: 4h |
|---|---|
| **Description:**  
Introduction of the history of circuit fabrication technology, circuit design; as well as, state-of-the art and future projections. |
| **Specific objectives:**  
7 |
### Steps of VLSI design

**Hours:** 6h  
- Theory classes: 2h  
- Practical classes: 0h  
- Laboratory classes: 0h  
- Guided activities: 0h  
- Self study: 4h  

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

**Specific objectives:**  
1, 7

### Figures of Merit

**Hours:** 8h  
- Theory classes: 2h  
- Practical classes: 2h  
- Laboratory classes: 0h  
- Guided activities: 0h  
- Self study: 4h  

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

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

### Introduction to HDLs

**Hours:** 19h  
- Theory classes: 4h  
- Practical classes: 2h  
- Laboratory classes: 5h  
- Guided activities: 0h  
- Self study: 8h  

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

**Specific objectives:**  
2, 3

### Microprocessor structures: Memories

**Hours:** 26h  
- Theory classes: 6h  
- Practical classes: 4h  
- Laboratory classes: 4h  
- Guided activities: 0h  
- Self study: 12h
### Description:
Study the theoretical concepts of the chapter and solve exercises and the problem set.

### Specific objectives:
3, 4

<table>
<thead>
<tr>
<th>Microprocessor structures: ALUs and combinational elements</th>
<th>Hours: 37h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 6h</td>
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<tr>
<td></td>
<td>Practical classes: 5h</td>
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<tr>
<td></td>
<td>Laboratory classes: 6h</td>
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<tr>
<td></td>
<td>Guided activities: 0h</td>
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<td></td>
<td>Self study: 20h</td>
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</tbody>
</table>

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

### Specific objectives:
2, 3, 5

<table>
<thead>
<tr>
<th>Layout and full-custom design</th>
<th>Hours: 10h</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
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<tr>
<td></td>
<td>Practical classes: 2h</td>
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<tr>
<td></td>
<td>Laboratory classes: 0h</td>
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<tr>
<td></td>
<td>Guided activities: 0h</td>
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<tr>
<td></td>
<td>Self study: 4h</td>
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</tbody>
</table>

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

### Specific objectives:
1, 2, 6

<table>
<thead>
<tr>
<th>Specific tasks, visits and invited talks</th>
<th>Hours: 4h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 0h</td>
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<tr>
<td></td>
<td>Practical classes: 0h</td>
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<tr>
<td></td>
<td>Laboratory classes: 0h</td>
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<tr>
<td></td>
<td>Guided activities: 4h</td>
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<tr>
<td></td>
<td>Self study: 0h</td>
</tr>
</tbody>
</table>

### Description:
Settlement of the concepts learnt during the course, approximation to the professional career of an engineer.

### Specific objectives:
1, 2, 3, 4, 5, 6, 7
Qualification 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:


Complementary: