270072 - VLSI - VLSI

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 701 - AC - Department of Computer Architecture
Academic year: 2017
Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan

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

Requirements
- Prerequisite AC2

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.

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

| Total learning time: 150h | Hours large group: 30h 20.00% | Hours medium group: 15h 10.00% | Hours small group: 15h 10.00% | Guided activities: 6h 4.00% | Self study: 84h 56.00% |
# 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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Description</th>
<th>Specific objectives</th>
</tr>
</thead>
</table>
| **Final Exam**            | 10h       | Guided activities: 2h  
Self study: 8h                                                                                                                                     | 1, 2, 3, 4, 5, 6    |
| **2nd Mid-term Exam**     | 12h       | Guided activities: 2h  
Self study: 10h                                                                                                                                   | 1, 2, 3, 4, 5, 6    |
| **1st Mid-term Exam**     | 12h       | Guided activities: 2h  
Self study: 10h                                                                                                                                   | 1, 2, 3, 4          |
| **Introduction to VLSI technology** | 6h        | Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 0h  
Guided activities: 0h  
Self study: 4h                                                                                       | 7                   |
### Steps of VLSI design

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

**Specific objectives:**
1, 7

**Hours:** 6h  
Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 0h  
Guided activities: 0h  
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

**Hours:** 8h  
Theory classes: 2h  
Practical classes: 2h  
Laboratory classes: 0h  
Guided activities: 0h  
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

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

### 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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<td></td>
<td>Guided activities: 0h</td>
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<tr>
<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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
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<tr>
<td></td>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 0h</td>
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<tr>
<td></td>
<td>Guided activities: 0h</td>
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<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>
</tr>
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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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<td>Guided activities: 4h</td>
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<td>Self study: 0h</td>
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**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: