Course guides
270072 - VLSI - VLSI

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: 2021  ECTS Credits: 6.0  Languages: Catalan

LECTURER
Coordinating lecturer: RAMON CANAL CORRETGER
Others: Primer quadrimestre: RAMON CANAL CORRETGER - 10

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.

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**

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>84.0</td>
<td>56.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30.0</td>
<td>20.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>15.0</td>
<td>10.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6.0</td>
<td>4.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>15.0</td>
<td>10.00</td>
</tr>
</tbody>
</table>

**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

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**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:** 26h
Theory classes: 6h
Practical classes: 4h
Laboratory classes: 4h
Self study: 12h

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**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:** 37h
Theory classes: 6h
Practical classes: 5h
Laboratory classes: 6h
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:** 10h

- Theory classes: 4h
- Practical classes: 2h
- Self study: 4h

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**Specific tasks, visits and invited talks**

**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

**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:** 4h

- Guided activities: 4h

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**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

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**BIBLIOGRAPHY**

**Basic:**

**Complementary:**