

Course guide

330215 - ISD - Introduction to the Digital Design

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Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN ICT SYSTEMS ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: JORDI BONET DALMAU

Others: Martínez Domene, Juan

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. (ENG) L'assignatura contribueix a desenvolupar:
 - La capacitat d'especificar, analitzar, dissenyar, avaluar i documentar circuits digitals, tant seqüencials com combinacionals, així com les seves alternatives d'implementació, incloent dispositius CPLD i FPGA.
 - La capacitat d'emprar les eines i els llenguatges d'especificació, síntesi i verificació de circuits digitals.
 - El coneixement i la capacitat d'emprar les eines i la instrumentació existents per a l'anàlisi, el disseny, el desenvolupament i la verificació de sistemes electrònics, informàtics i de comunicacions.
2. The ability to use tools and languages specification, synthesis and verification of digital circuits.
3. Knowledge and ability to use existing tools and instrumentation for the analysis, design, development and verification of electronic, computer and communications systems.

Transversal:

4. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
5. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
6. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

TEACHING METHODOLOGY

The subject consists of face-to-face activities consisting of 3 hours per week of class and 2 hours per fortnight of laboratory practices. The student carries out learning through various mechanisms. In the lectures and participative classes the contents of the subject are presented and the interaction between students and teacher is facilitated. Individual / group personal work activities are also proposed to contribute to the understanding of the subject.

In laboratory classes, students carry out preliminary work that helps to put into context the work that is intended to be carried out in the laboratory. The laboratory activity itself is developed in groups of two students and allows experimentation with certain aspects developed in the subject. The writing of the memory and the interaction with the teacher in the laboratory allows working on the oral and written communication skills. In a timely manner, nomenclature is introduced in English to progressively initiate the student in learning this language.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course of Introduction to Digital Systems, the student:

- Understand the foundations of combinational and sequential logic and analyze and design simple combinational and sequential circuits.
- Write simple technical reports and present them orally.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Hours large group	45,0	30.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1. INTRODUCTION

Description:

This topic presents the principles of digital design, as well as an overview of the history and applications of the subject.

Related activities:

All.

Full-or-part-time: 20h

Theory classes: 6h

Laboratory classes: 2h

Self study : 12h

2. COMBINATIONAL LOGIC

Description:

In this topic, the aim is for students to:

- Identify and remember the main combinational elements and understand the logical functions they perform.
- Combine combinational elements to create more complex functions.
- Recognize equivalences between combinational circuits and identify the principles for designing minimally complex combinational circuits.
- Understand the foundations of describing combinational circuits with a hardware description language.

Related activities:

All.

Full-or-part-time: 60h

Theory classes: 18h

Laboratory classes: 6h

Self study : 36h

3. SEQUENTIAL LOGIC

Description:

In this topic, the aim is for students to:

- Identify and remember the main memory elements and the functions they perform.
- Understand and use standard sequential building blocks, such as counters and shift registers.
- Understand the foundations of describing sequential circuits with a hardware description language.
- Use a programmable logic device to create moderately complex digital systems.

Full-or-part-time: 70h

Theory classes: 21h

Laboratory classes: 7h

Self study : 42h

ACTIVITIES

1. LECTURES WITH EXERCISES

Description:

Theoretical content will be presented during these sessions. Students will have the opportunity to participate and interact with the professor.

Specific objectives:

- Know and remember the main combinational elements and know the logical functions they perform.
- Combine combinational elements to achieve higher complexity functions.
- Recognize equivalences between combinational circuits and know the principles for designing combination circuits with minimal complexity.
- Know and remember the main elements of memory and the functions they perform.
- Know and know how to use standard sequential blocks, such as counters, shift registers.
- Know the fundamentals of the description of combinational and sequential circuits through a language or hardware description.
- Know and use a programmable logic device to create digital systems of moderate complexity.

Material:

Published teaching material.

Recommended bibliography.

Delivery:

Occasionally some evaluable activity is performed, which contributes a proportional part to the EXE variable.

Full-or-part-time: 40h

Theory classes: 40h

2. LABORATORY CLASS

Description:

Practicals lasting two hours will be held at the laboratory every two weeks and will be completed in pairs. The practical worksheet will be available on Atenea. If the practical worksheet includes a preliminary study, it must be delivered by the corresponding deadline before doing the laboratory practical. A computer with the software needed to simulate digital components will be available at the lab. The equipment required to experiment with commercial digital devices will also be available. The professor will give students individual feedback on their progress. At the end of each practical, the groups will upload a file in which they comment on the work they have completed and knowledge they have gained.

Specific objectives:

- Implement simple combinational and sequential circuits in the laboratory.
- Validate the operation of digital circuits of moderate complexity.
- Write and present documents reflecting the process of design and validation of digital circuits of moderate complexity.

Material:

Electronic equipment, breadboard, digital devices, computer with adequate software.
Statement of the practice and support information to carry out the work.

Delivery:

Before carrying out the practice, the students will deliver the previous individual study corresponding to the practice to be carried out.

During the session, the achievement of the objectives of each laboratory session will be assessed, taking into account the degree of understanding of the work demonstrated for each student.

At the end of the session, each working group will prepare a final report that will reflect the main points of the work carried out. The grade obtained in these activities configures the LAB variable.

Full-or-part-time: 25h

Laboratory classes: 15h

Self study: 10h

3. INDEPENDENT STUDY AND EXERCISES

Description:

Students must complete certain activities on their own time in order to achieve the objectives of the subject.

Specific objectives:

All of the subject.

Material:

Published teaching material.
Recommended bibliography.

Delivery:

Individual / group personal work will be translated, in part, into exercises during the course. The grading of these exercises will contribute to the EXE variable.

Full-or-part-time: 50h

Self study: 50h

4. EXAM

Description:

There will be a midterm that students must take individually. The midterm mark will weigh into the continuous assessment (CON) variable. At the end of the class, there will be a final exam on the overall knowledge acquired. The final exam mark will weigh into the CON variable.

Specific objectives:

The control test score sets the variable CON.

The final test grade sets the FIN variable.

Material:

Test statements.

Full-or-part-time: 35h

Theory classes: 5h

Self study: 30h

GRADING SYSTEM

The final grade for the class will be calculated using the following equation:

$$\text{Final grade} = 0.15 * \text{EXE} + 0.25 * \text{LAB} + 0.20 * \text{CON} + 0.40 * \text{FIN}$$

Note 1. If the final exam mark is greater (in part or in total) than other aspects assessed, it will substitute the results obtained on other activities during the class.

Note 2. If the marks obtained on individual activities are substantially lower than those obtained on group activities, students may be requested to complete individual activities similar to those completed in group. The marks on these individual activities will replace the group ones.

EXAMINATION RULES.

In the case of laboratory activities for which a previous study has been established, it will be mandatory to submit it before accessing the laboratory.

Those activities that are explicitly declared as individual, whether in person or not, will be carried out without any collaboration from other people.

The dates, formats and other delivery conditions established will be mandatory.

BIBLIOGRAPHY

Basic:

- Katz, Randy H.; Borriello, Gaetano. Contemporary logic design. 2nd ed. Upper Saddle River: Pearson, 2005. ISBN 0131278304.

Complementary:

- Ashenden, Peter J. Digital design : an embedded systems approach using VHDL [on line]. Burlington, MA: Morgan Kaufmann Publishers, 2007 [Consultation: 31/05/2022]. Available on : <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=858615>. ISBN 9780123695284.

RESOURCES

Other resources:

Documentation published in the OpenCourseWare (ocw.itic.cat), which includes statements of the practices, exercises and statements of exams from previous courses.