



Course guides

230120 - DSED - Design of Digital Electronic Systems

Last modified: 29/04/2020

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2020 **ECTS Credits:** 5.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Chavez Dominguez, Juan Antonio
Rubio Sola, Jose Antonio

Others: Pons Nin, Joan
Moll Echeto, Francesc De Borja

PRIOR SKILLS

Basic knowledge of CMOS technology.
Basic knowledge of combinational and sequential digital design.
Basic knowledge of microprocessor architectures.

REQUIREMENTS

DISSENY DIGITAL - Precorequisit

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:

07 AAT N3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

TEACHING METHODOLOGY

Lectures: presentations on each specific topic and collective analysis of cases of electronic digital design.
Classes of problems: Study of digital design problems related to exposed theory.
Laboratory classes: Design, analysis and development of digital circuitry associated with the exposed theory and telecommunications. These laboratory activities will be implemented in Terasic development boards using ALTERA programmable devices.
Short-answer tests (controls) and extended-response (final exam)

LEARNING OBJECTIVES OF THE SUBJECT

The main objective will be the design of synchronous circuits of medium and high complexity for applications preferably communications and signal processing in real time.

Rapid prototyping is the focus of the subject. Implement efficient designs require good training in the hardware description language VHDL, knowledge and use of design tools, architectures of FPGAs, as well as advanced digital design concepts.

The study and characterization of features, especially the temporal behavior of designs will also be important. Knowing the physical limitations of the devices is a priority to calculate the basic parameters of the circuits: maximum operating frequency, power dissipation, cost and occupied area.

Assimilation and consolidation of knowledge will be achieved implementing the designs in the laboratory with design tools and commercial devices.

List of specific objectives of the course:

- * The use of methodologies and design tools for complex sequential digital systems.
- * To analyze some of the issues of greatest impact in the digital design.
- * Identify and evaluate alternative implementation of digital systems, including programmable logic devices.
- * Understanding and using hardware description languages, including VHDL.

STUDY LOAD

Type	Hours	Percentage
Self study	97,0	65.10
Hours large group	26,0	17.45
Hours small group	26,0	17.45

Total learning time: 149 h

CONTENTS

1. Design of digital electronic systems

Description:

- 1.1. Design strategies.
- 1.2. Programmable logic devices: CPLDs, FPGAs.
- 1.3. Rapid prototyping tools.
 - 1.3.1. Hardware description languages, types and levels of description.
 - 1.3.2. Synthesis.
 - 1.3.3. Simulation. Timing constraints and performance verification.
 - 1.3.4. Guidelines for manufacturing test.

Full-or-part-time: 37h

Theory classes: 6h 30m

Laboratory classes: 6h 30m

Self study : 24h

2. Synthesis with VHDL

Description:

- 2.1. Reminder of the main features.
- 2.2. Libraries.
- 2.3. Functions and procedures.
- 2.4. Inference of specific blocks.
 - 2.4.1. Generation and distribution of clock signals.
 - 2.4.2. Arithmetic blocks.
 - 2.4.3. Memory blocks. Implementation of stacks.

Full-or-part-time: 37h

Theory classes: 6h 30m

Laboratory classes: 6h 30m

Self study : 24h

3. Design techniques

Description:

- 3.1. Concurrent state machines.
- 3.2. Algorithmic machines.
 - 3.2.1. Data subsystem. Pipelining.
 - 3.2.2. Control subsystem.
 - 3.2.3. Microprogrammable systems.
- 3.3. Methods to reduce consumption.
- 3.4. Structures and standards of test.
- 3.5. IP cores.

Full-or-part-time: 37h

Theory classes: 6h 30m

Laboratory classes: 6h 30m

Self study : 24h

4. Design Issues.

Description:

- 4.1. Timing of digital circuits.
 - 4.1.1. Temporal analysis.
 - 4.1.2. Metastability.
 - 4.1.3. Hazards.
 - 4.1.4. Synchronous versus asynchronous.
- 4.2. Synthesis of frequency.
- 4.3. Interface with memories and other peripherals.
- 4.4. Test.

Full-or-part-time: 37h

Theory classes: 6h 30m

Laboratory classes: 6h 30m

Self study : 24h

GRADING SYSTEM

Continuous theory assessment: controls, exercises and / or works to be done during the course (CT)
Final theory exam (FTE)
Final theory grade of (FTG): Maximum (FTE , 0.5FTE + 0.5CT)
Continuous laboratory assessment (CL): Activity Tracking
Final Laboratory exam (FLE)
Final Laboratory grade (NLG): 0.75CL + 0.25 FLE
Final note subject = 0.5FTG + 0.5 NLG

EXAMINATION RULES.

Exams: Individual
Individual work: Individual
Laboratory groups: maximum two students

BIBLIOGRAPHY

Basic:

- Harris, S.L. ; Money, D. Digital design and computer architecture. ARM ed. Waltham, MA: Morgan Kaufmann, 2016. ISBN 9780128000564.
- Gajski, Daniel D. Principles of digital design. Upper Saddle River, N.J: Prentice Hall, 1997. ISBN 0132423979.
- Skahill, Kevin. VHDL for PROGRAMMABLE LOGIC. 2006. Reading [etc.]: Addison Wesley, 1996. ISBN 0201895730.
- Scarpino, Frank. VHDL and AHDL Digital System Implementation. Prentice Hall, 1998. ISBN 9780138570873.
- Brown, S.D.; Vranesic, Z. Fundamentals of digital logic with VHDL design. 3rd ed. Boston [etc.]: McGraw-Hill, 2009. ISBN 9780071268806.
- Ashenden, P. J. The VHDL cookbook [on line]. Adelaide, S. Aust.: Dept. of Computer Science, University of Adelaide, 1991 [Consultation: 15/06/2017]. Available on: <https://pdfs.semanticscholar.org/75a1/318163592901aaa5a83728615979bba13707.pdf>.
- Ashenden, P. J. The Designer's guide to VHDL [on line]. 3rd ed. Burlington: Morgan Kaufmann, 2008 [Consultation: 14/06/2017]. Available on: <http://www.sciencedirect.com/science/book/9780120887859>. ISBN 9780120887859.