

Course guide

230911 - DD - Digital Design

Last modified: 13/06/2024

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

Degree: BACHELOR'S DEGREE IN ELECTRONIC ENGINEERING AND TELECOMMUNICATION (Syllabus 2018).
(Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: DIEGO CESAR MATEO PEÑA

Others: Primer quadrimestre:
DANIEL BARDES LLORENSI - 11
DIEGO CESAR MATEO PEÑA - 11, 12, 13
OLIVER MILLÁN BLASCO - 12

PRIOR SKILLS

Basic analysis of electronic circuits.
Basic knowledge of electronic devices and, in particular, the MOS transistor.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE14. (ENG) GREELEC: Capacitat d'anàlisi i disseny de circuits combinacionals i seqüencials, sincrònons i asincrònons i d'utilització de microprocessadors i circuits integrats. (Mòdul comú a la branca de telecomunicació).

CE15. (ENG) GREELEC: Coneixement i aplicació dels fonamentals llenguatges de descripció de dispositius de hardware. (Mòdul comú a la branca de telecomunicació).

CE25. (ENG) GREELEC: Capacitat de dissenyar circuits d'electrònica analògica i digital, de conversió analògica-digital i digital-analògica, de radiofreqüència, d'alimentació i conversió d'energia elèctrica per aplicacions de telecomunicació i computació. (Mòdul de tecnologia específica- Sistemes electrònics).

Transversal:

CT3. (ENG) GREELEC: COMUNICACIÓ EFICAÇ ORAL I ESCRITA. Comunicar-se de forma oral i escrita amb d'altres persones sobre els resultats de l'aprenentatge, d'elaboració del pensament i de la presa de decisions, participar en debats sobre el tema de la pròpia especialitat.

Basic:

CB3. (ENG) GREELEC: Que els estudiants tinguin la capacitat de reunir i interpretar dades rellevants (normalment dins de la seva àrea d'estudi) per emetre judicis que incloguin una reflexió sobre temes rellevants de caire social, científic o ètic.

TEACHING METHODOLOGY

Lectures and application classes

Laboratory classes

Group work (distance)

Individual work (distance)

Exercises

Short answer tests (Control)

Long answer tests (Final Exam)

Laboratory work

LEARNING OBJECTIVES OF THE SUBJECT

The student must be able to analyze, design and experimentally verify combinational and sequential digital subsystems. This course introduces and uses the hardware description language VHDL. It also includes an introduction to CMOS logic circuits, an introduction and utilization of programmable logic devices and an introduction to complex digital systems.

STUDY LOAD

Type	Hours	Percentage
Hours large group	39,0	26.00
Hours small group	26,0	17.33
Self study	85,0	56.67

Total learning time: 150 h

CONTENTS

Module 1. Introduction to digital design

Description:

The digital abstraction, systems and digital signals, behavior vs. structure, hierarchical design. Logic functions and Boolean algebra. Number systems and codes. Under the digital abstraction: power, delay, power consumption, logic levels and high impedance.

Full-or-part-time: 8h

Theory classes: 3h

Self study : 5h

Module 2. Combinational design

Description:

SdP and PdS canonic design. Combinational design based on logic gates and on standard combinational modules. Multiplexers, decoders, adders, comparators, etc.

Full-or-part-time: 36h

Theory classes: 6h

Laboratory classes: 6h

Self study : 24h

Module 3. Combinational design with VHDL

Description:

History and basic features of HDLs, methodologies and design tools. Basic elements: data types, objects, operators. Units Description: entities, architectures, packages and libraries. Concurrent assignments, conditional assignments and selections. Processes and sequential statements. Declaration and instantiation of components.

Full-or-part-time: 26h

Theory classes: 6h

Laboratory classes: 6h

Self study : 14h

Module 4. Sequential design

Description:

Asynchronous and synchronous sequential systems, time behavior. Latches and flip-flops. Analysis and synthesis of synchronous state machines. Sequential modular design, registers and counters. Sequential design with VHDL. Time performance: output delay, hold time, setup time, skews, maximum frequencies, clock and reset signal managing. Algorithmic machines, data unit and control unit.

Full-or-part-time: 59h

Theory classes: 13h 30m

Laboratory classes: 33h 30m

Self study : 12h

Module 5. CMOS digital circuits

Description:

Types of digital ICs and logic families. MOS transistors. CMOS inverter and basic logic gates. CMOS features: circuit delays, spurious, static and dynamic power consumption. Programmable logic devices, logic cells, and types of synthesis. Memory structures.

Full-or-part-time: 20h

Theory classes: 7h 30m

Self study : 12h 30m

GRADING SYSTEM

Final grade based on the respective qualifications of the theory (60%) and the laboratory (40%) parts. The theory mark consists of 70% from the final theory exam and 30% from the control at the middle of the term and the delivery of activities done during the course. If the grade corresponding to the previous 30% is smaller than that of the final theory exam, that one becomes the 100% of the theory grade. The laboratory mark is obtained from the laboratory work done during the course and from the final lab exam.

The re-evaluation of the course involves having to do the final exam again, which includes theory and laboratory parts. Grades earned replace the previous ones. Laboratory work together with control and/or delivered activities are not re-evaluable.

EXAMINATION RULES.

During the exams it is not allowed to use wireless devices (mobile phones, laptops, tablets, etc..) nor programmable calculators. It is also necessary to provide some identification document (ID card, passport, etc).

BIBLIOGRAPHY

Basic:

- Harris, S.L.; Harris, D.M. Digital design and computer architecture. ARM ed. Waltham, MA: Morgan Kaufmann, 2016. ISBN 9780128000564.

- Pardo Carpio, F.; Boluda Grau, J.A. VHDL: lenguaje para síntesis y modelado de circuitos. 3a ed. act. Paracuellos de Jarama, Madrid: Ra-ma, 2011. ISBN 9788499640402.

- Ercegovic, M.D.; Lang, T.; Moreno, J.H. Introduction to digital systems. Estats Units d'Amèrica: John Wiley and Sons, 1999. ISBN 0471527998.

RESOURCES

Computer material:

- Quartus II Web edition. Resource