Course guide
340123 - ELDI-K4O10 - Digital Electronics

Last modified: 18/06/2024

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).

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

LECTURER

Coordinating lecturer: LOPEZ MARTINEZ, ANTONIO MIGUEL
SARRIA GANDUL, DAVID

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE21. Knowledge of basics and application of digital electronics and microprocessors.
2. CE24. Ability to design electronical, analog, digital and power systems.
3. CE25. Knowledge and ability of systems modeling and simulation.

Transversal:
4. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
5. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
6. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

TEACHING METHODOLOGY

The teaching methodology will be active / participatory.

LEARNING OBJECTIVES OF THE SUBJECT

· Designing digital systems at different levels of difficulty.
· Designing complex digital systems through control algorithms.
· Choosing both the design tools such as the physical construction of system between which will show: Component Interconnect standard design implementation on a gate array, or on a programmable logic device, or using a custom-made integrated circuit.
· Define the specifications of a digital system to meet industrial needs which they will go.
· Minimize the economic cost.
· Design bearing in mind aspects such as reliability, power consumption, size, sustainability, etc

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours small group	30,0	20.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

Módulo 1. Introduction to Digital Systems.

Description:
· Know the mathematical tools for the analysis of binary systems.
· Apply the pad to facilitate snap digital design.
· Understand the need to use different binary codes according to the objectives of the designed digital system.

Specific objectives:
1. Binary systems. Change numbers and basic linear algebra operations.
2. Add number in decimal and binary. Binary codes.
3. Introduction to combinational and sequential systems.

Related activities:
· Know the mathematical tools for the analysis of binary systems.
· Apply the pad to facilitate snap digital design.
· Understand the need to use different binary codes according to the objectives of the designed digital system.

Related competencies :
. CE21. Knowledge of basics and application of digital electronics and microprocessors.
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

Full-or-part-time: 7h
Theory classes: 4h
Guided activities: 1h
Self study : 2h

Module 2.- Boolean algebra. Combinational and Sequential Systems.

Description:
· Postulates and theorems of Boolean Algebra. Definition of logic function.
· Representation and simplification of logic functions.
· Using basic logic gates.
· Resolution of problems related to combinatorial systems.
· Difference between combinational and sequential system.
· Sequential System. Memoirs. Mealy design structures and Moore.
· Flow diagrams and state tables. Different exercises.
· Sequential blocks: Computers, shift registers, memories.

Specific objectives:
· Know Boolean algebra mathematical logic as a basis for the design and implementation of digital systems. Using the Basic Theorems of Boolean algebra to simplify logic functions analytically.
· Use combinatorial systems as functional block composed of logic functions that solve problems raised by different statements related to the digital environment in different settings.
· Know different functional blocks to compact simple combinatorial systems such as multiplexers, comparators, adders, etc.
· Develop different methodologies for designing a structure-based sequential logic Moore and Mealy.
· Use functional blocks that define sequential systems to facilitate the design more complex digital systems that are used in a hierarchical fashion.

Related activities:
· Knowing how to represent and simplify logic functions.
· Use Boolean algebra theorems for solving combinatorial and handling systems.
· Apply design methods to implement sequential systems.
· Use different functional blocks of sequential systems to create complex systems based on hierarchical levels.

Related competencies :
. CE21. Knowledge of basics and application of digital electronics and microprocessors.
. CE25. Knowledge and ability of systems modeling and simulation.
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

Full-or-part-time: 51h
Theory classes: 10h
Practical classes: 6h
Laboratory classes: 6h
Guided activities: 1h
Self study : 28h

Module 3.- Digital Technology.

Description:
General characteristics of different logic families.
Structure and specificities of different logic families.
The MOSFET structure based on CMOS.
Family CMOS.
Architecture of programmable logic devices PLD, FPGA, etc.

Specific objectives:
· Know what are the different devices of digital technology.
· Make proper use of general parametric features that distinguish the different logic families according to their technology.
· Knowing how to use integrated circuits of a given logic family to develop complex digital systems.
· Understanding concepts related to the design and implementation in microelectronics by developing VLSI.

Related activities:
· Knowing how to use the general characteristics of different logic families to develop a digital system.
· Know the design of logic functions using CMOS technology as the basis for the implementation microelectronics and nanoelectronics.
· Learn to develop a logic diagram of programmable logic devices such as PAL, FPGA, etc.
· Knowing how to use programmable devices to solve specific complex digital systems

Related competencies :
. CE21. Knowledge of basics and application of digital electronics and microprocessors.
. CE24. Ability to design electronical, analog, digital and power systems.
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

Full-or-part-time: 21h
Theory classes: 6h
Practical classes: 3h
Laboratory classes: 3h
Guided activities: 1h
Self study : 8h

Module 4.- Calculation schemes. Programmable resources.

Description:
· Learn to use the method of designing digital systems called "schemes of calculation" as an algorithm without forks or combinatorial algorithm.
· Develop the process unit and the control unit to implement the scheme of calculation.
· Learn to use the precedence relationship graph and properly allocate resources and memories.
· Make use of programmable resources to minimize space.

Specific objectives:
· Learn to use the method of designing digital systems called "schemes of calculation" as an algorithm without forks or combinatorial algorithm.
· Develop the process unit and the control unit to implement the scheme of calculation.
· Learn to use the precedence relationship graph and properly allocate resources and memories.
· Make use of programmable resources to minimize space.

Related activities:
· Learn · design a complex digital system without branching through schemes of calculation.
· Distinguish between processing unit and control unit as an essential part of a scheme of calculation.
· Learn to develop a digital system giving preference to the execution time or the number of resources used.
· Develop different exercises related to the subject to seat concepts.

Related competencies :
. CE24. Ability to design electronical, analog, digital and power systems.
. CE25. Knowledge and ability of systems modeling and simulation.
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

Full-or-part-time: 35h
Theory classes: 5h
Practical classes: 3h
Laboratory classes: 3h
Guided activities: 1h
Self study : 23h

Module 5.- Algorithmic machines. Control Unit.

Description:
Definition and objectives of the algorithmic machine.
Stages of implementation of an algorithm.
Control Program.
Realization of sequential machine.
MUX and RP design unit processes.
Realization of the control unit via PAL.
The Processing Unit. by bus architecture.
The control unit made with PAL. New operating control.
Practical examples.

Specific objectives:
Know the algorithmic machines as a design tool for digital systems with fork or decision.
· Knowing how to allocate and interlinking the different schemes of calculation and / or algorithms involved in each branch.
· Optimize the control program that is used to develop the instruction stream according to the decision chosen.
· Learn to develop sequential machine that generates the different control variables.
· Develop appropriate processing unit using programmable multiplexers and resources. Using the structure of buses rather than multiplexers.
· Learn to design possible architectures for the control unit.
· Develop different examples of algorithmic machines.

Related activities:
Definition and objectives of the algorithmic machine.
Stages of implementation of an algorithm.
Control Program.
Realization of sequential machine.
MUX and RP design unit processes.
Realization of the control unit via PAL.
The Processing Unit. by bus architecture.
The control unit made with PAL. New operating control.
Practical examples.

Related competencies :
. CE24. Ability to design electronical, analog, digital and power systems.
. CE25. Knowledge and ability of systems modeling and simulation.
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

Full-or-part-time: 36h
Theory classes: 5h
Practical classes: 3h
Laboratory classes: 3h
Guided activities: 2h
Self study : 23h

GRADING SYSTEM

continuous evaluation with:

NF = 0.3 N1 + 0.3 N2 + 0.3 N3 + 0.1 N4

where N1, N2, N3 and N4 are punctuated on 10;

NF: final grade of the subject.
N1: qualification of a theoretical exam in the Partial Evaluation period.
N2: qualification of a theoretical exam in the Final Evaluation period.
N3: qualification of activities related to laboratory sessions.
N4: qualification of activities related to theoretical sessions

In the N2 exam, there will be a part to revaluate N1.

All students who have a total qualification between 3 and 4.9 can do the revaluation of the subject. In this case, the theory part can be revaluated, and the final qualification will be a maximum of 5 for the students who need to do it.

BIBLIOGRAPHY

Basic:
- Gajski, Daniel D. Principios de diseño digital. Madrid [etc.]: Prentice Hall, 1997. ISBN 8483220040.
- McCalla, Thomas Richard. Lógica digital y diseño de computadoras. México: Megabyte : Noriega Editores, 1994. ISBN 9684850300.
- Deschamps, Jean-Pierre; Angulo Usategui, José Ma. Diseño de sistemas digitales. 2a ed. Madrid: Paraninfo, 1992. ISBN 8428316953.

Complementary:
- Mano, M. Morris. Diseño digital : con una introducción a Verilog HDL [on line]. 5a ed. Madrid: Pearson, 2013 [Consultation: 19/02/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4407. ISBN 9786073220415.
- Glasford, Glenn M. Digital electronic circuits. New Jersey: Prentice-Hall International, 1988. ISBN 0132116081.
- Deschamps, Jean-Pierre. Síntesis de circuitos digitales : un enfoque algorítmico. Madrid: International Thomson, 2002. ISBN 8497320557.

RESOURCES

Other resources:
Class notes.
Tutor multimedia
Subject notes.