



COMILLAS

UNIVERSIDAD PONTIFICIA

ICAI

ICADE

CIHS

Syllabus
2024 - 2025

GENERAL INFORMATION

Data of the subject	
Subject name	Digital Systems I
Subject code	DEA-GITT-214
Main program	Bachelor's Degree in Engineering in Telecommunication Technologies
Involved programs	Grado en Ingeniería en Tecnologías de Telecomunicación [Second year] Grado en Ingeniería en Tecnologías de Telecom. y Grado en Análisis de Negocios/Business Analytics [Second year]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	6,0 ECTS
Type	Obligatoria (Grado)
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DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Course contents

Contents

Theory

Introduction

1. Introduction to digital technique.
2. Bits and logic levels.
3. Technologies to implement digital circuits
4. Design levels.

Boolean algebra

1. Definitions and theorems of boolean algebra.
2. Non-basic logic functions.
3. Normal forms of a boolean function.
4. Simplification using Karnaugh diagrams.

Number systems

1. Positional number systems.
2. Base Conversion.
3. Range of unsigned numbers.
4. Hexadecimal and octal systems.
5. Mathematical operations with binary numbers.
6. Representation of integers.
7. Range in signed numbers.
8. Mathematical operations with signed numbers.
9. Other binary codes.

Introduction to VHDL

1. Design flow.
2. File structure.
3. Examples.
4. Data types, constants and operators.



5. Concurrent sentences.

Arithmetic Circuits

1. One-bit adder.
2. n-bit adder.
3. n-bit subtracter.
4. n-bit Adder/Subtracter.
5. Multipliers.
6. BCD Adder.

Combinational Blocks

1. Multiplexers.
2. Demultiplexers.
3. Encoders.
4. Decoders.
5. Comparators.

Sequential circuits. Fundamentals

1. Introduction.
2. Basic concepts.
3. Bistable.

Digital Circuits Timing

1. Introduction.
2. Timing hazards.
3. Synchronous Design.
4. Technological parameters of flip-flops.
5. Synchronous design and clock period.
6. Clock skew and clock distribution.
7. Synchronization of asynchronous inputs.

Finite State Machines

1. Nomenclature.
2. Design of finite state machines.
3. Description in VHDL.
4. Sequence detector.
5. Sequence detector using edge detectors.

Registers

1. Introduction.
2. Parallel input/output registers.
3. Shift Registers.



Counters

1. Ascending binary counter.
2. Descending binary counter.
3. Up/down counter.
4. Counters with enable.
5. M module counters.
6. Cascade counters connection.
7. Counters with parallel load.
8. Arbitrary Sequence Counters.

Complex system design: data path + control

1. Introduction.
2. Control of a parking barrier.
3. Bull quality control.
4. Binary to BCD converter.
5. Interconnection of devices through SPI.

Laboratory

- Lab 1: Introduction to logic gates and the digital oscilloscope
- Lab 2: Introduction to schematic capture and compilation with Quartus II.
- Lab 3: Introduction to simulation and physical implementation with Quartus II.
- Lab 4: Combinational circuits. Design with VHDL.
- Lab 5: Arithmetic circuits. 5 bit adder.
- Lab 6: Arithmetic circuits. 5 bit multiplier.
- Lab 7: Arithmetic circuits. 5 bit ALU.
- Lab 8: Introduction to flip-flops.
- Lab 9: Electronic lock.
- Lab 10: Parking control.
- Lab 11: Timer for a microwave oven.

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
<ul style="list-style-type: none">Final Exam	<ul style="list-style-type: none">Understanding of concepts.Application of concepts to the resolution of practical problems.Analysis and interpretation of the results obtained in solving problems.Presentation and written communication.	42
	<ul style="list-style-type: none">Understanding of concepts.Application of concepts to the resolution of	



<ul style="list-style-type: none">• Short controls (in class).• Mid-semester exam.	<p>practical problems.</p> <ul style="list-style-type: none">• Analysis and interpretation of the results obtained in solving problems.• Presentation and written communication.	18
<ul style="list-style-type: none">• Lab Tests.• Working of the circuits implemented in the lab.• Documentation of the results.• Final laboratory exam.	<ul style="list-style-type: none">• Understanding of concepts.• Application of concepts to the resolution of practical problems and to carrying out practices in the laboratory.• Handling of laboratory tools.• Analysis and interpretation of the results obtained in the laboratory.• Group work capacity.• Presentation and written communication.	40

Grading

Final grade

The evaluation of the student consists of two parts: theory and laboratory.

To evaluate the theory, the following tests will be carried out:

- Short exercises in class (10 minutes). The objective of these exercises is that the student knows what he knows (and what he doesn't know). The average of these exercises gives the class grade n_c .
- A mid-term exam, from which the grade n_i will be obtained.
- A final exam that will include all the material taught in the course. From this exam the grade n_e will be obtained.

To obtain the final mark of the theory, a weighted average of the previous marks will be obtained according to the following formula:

$$n_t = n_i * 0.2 + n_e * 0.7 + n_c * 0.1$$

The laboratory evaluation is made from:

- The previous work of the practice, which is evaluated by means of a 10-minute test at the beginning of the lab. From the mean of all test the grade n_t is obtained.
- Documentation and operation of the designed circuits. From the average of all the practices, the note n_p is obtained.
- The final laboratory exam, n_{ex}

The final laboratory grade is obtained from the weighted average of the previous grades, as long as the final exam grade of laboratory is greater than or equal to four, according to the following formula:

$$n_l = n_{ex} * 0.5 + n_t * 0.3 + n_p * 0.2$$

If the grade of the final laboratory exam is less than four, then the final grade of the laboratory will be the grade of said exam:

$$n_l = n_{ex}$$

It is mandatory to deliver all practices. If any of them has not been delivered, the laboratory grade will be a zero.

To pass the course, the marks n_t and n_l must be greater than 5. If this condition is met, the final mark for the course is calculated:



$$n_{end} = n_t * 0.6 + n_l * 0.4$$

Otherwise, the final grade will be the lower of the two grades n_t and n_l .

Extraordinary evaluation

The extraordinary call is considered as a second opportunity in case the student has failed one or both parts of which the subject is composed.

If the student has failed the theory, she will take the theoretical exam n_{jt} and the new theory mark will be obtained according to the formula:

$$n_t = n_{jt} * 0.8 + n_i * 0.1 + n_c * 0.1$$

If the student has failed the laboratory, she will take the laboratory exam n_{jl} and the new laboratory grade will be obtained according to the

formula:

$$n_l = n_{jl} * 0.65 + n_t * 0.15 + n_p * 0.2$$

As long as the laboratory test grade is greater than or equal to four. Otherwise, the laboratory grade will be the grade of said test:

$$n_l = n_{jl}$$

The final mark for the extraordinary call will be obtained in the same way as for the ordinary call: if the marks n_t and n_l are greater than 5, the final mark of the subject is calculated:

$$n_{end} = n_t * 0.6 + n_l * 0.4$$

Otherwise, the final grade will be the lower of the two grades n_t and n_l .

Attendance Rules

Class attendance is mandatory, according to the Academic Regulations of ICAI. The attendance requirements will be applied independently for the theory and laboratory sessions:

In the case of theory sessions, failure to comply with this rule may prevent taking the exam in the ordinary call.

In the case of laboratory sessions, failure to comply with this rule may prevent them from taking the exam in the ordinary and extraordinary calls. In any case, unjustified absences from laboratory sessions will be penalized in the evaluation.

BIBLIOGRAPHY AND RESOURCES

Basic References

- José Daniel Muñoz Frías. Introducción a los sistemas digitales. Un enfoque usando lenguajes de descripción de hardware. (2017)

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