Teaching Plan for the Subject

Educational Guide (v1.0)

Academic course:	2011-12
Name of the subject:	Digital Logic and Computers
Codi assignatura:	21407, 21298 i 21596
Degree:	Bachelor's degree in Computer Engineering, Bachelor's degree in Telecommunications Network Engineering and Bachelor's degree in Audiovisual Systems Engineering
Credits ECTS:	6
Hours of dedication:	150
Teachers:	Enric Peig, Montserrat Fernández, Chema Martínez, Carlos Encabo, Chong Zhang, Luis Bobo
Group:	1 i 2

Educational Guide

1. Descriptive data of the subject

- Academic course: 2011-12
- Name of the subject: Digital Logic and Computers Codi: 21407, 21298 and 21596
- Type of subject: Basic
- Degree: Bachelor's degree in Computer Engineering, Bachelor's degree in Telecommunications Network Engineering and Bachelor's degree in Audiovisual Systems Engineering
- Credits ECTS: 6
- Hours of dedication: 150
- Temporalization:
  - Course: 1r
  - Type: bitrimestral
  - Period: 2nd and 3rd trimester
- Coordination: Enric Peig
- Teachers: Enric Peig, Montserrat Fernández, Chema Martínez, Carlos Encabo, Chong Zhang, Luis Bobo
- Departament: Tecnologies de la Informació i les Comunicacions
- Group: 1, 2
- language: EP: Catalan; MF: Catalan; ChM: Spanish, CE: Spanish; ChZ: Spanish / English; LB: Spanish
- Building where the subject is taught: Campus de la Comunicació-Poblenou
- Schedule:

  Group 1:
  Tuesday, 12:30-14:30
  Wednesday, 8:30-10:30
  Friday, 8:30-10:30

  Group 2
  Wednesday, 12:30-14:30
  Thursday, 8:30-10:30
  Friday, 12:30-14:30

2. Presentation of the subject

Digital Logic and Computers aims to show the principles of the technologies used in the development of computer architectures. The main objective of the subject is that the student acquires a good level of knowledge of the operation of computers, at the hardware level.

The first part of the subject presents the principles of operation of digital systems in general. Binary information representation systems, the principles of Boolean algebra, and the techniques of analysis and design of combinational logic systems are studied.

In the second part, the sequential logic systems, their basic elements, are presented, and a methodology is proposed to analyze and synthesize them. Next, we explain the architectural model of Von Neumann, which is based on the large part of computer systems. This model subdivides a computer into three subsystems: processor, memory and input / output. In this subject, the student is introduced into the operation of the processor, through the study of a simple processor. The study of a real processor and the memory and input / output subsystems is left for the Computer Architecture subject.

The subject has a considerable load of new concepts for the first year student, but that will be acquired progressively through the carrying out of exercises and practices in the laboratory, so that the necessary memorization is minimal. Therefore, it can be said that you have to pay as much or more attention to the procedures as the new concepts.

3. Prerequisites for the follow-up of the training itinerary

Being a first-year subject, prior knowledge is not required beyond those acquired in the baccalaureate.

4. Skills to be achieved in the subject

General competences	Specific competences
Instrumental 1. Capacity for analysis and synthesis 2. Troubleshooting 3. Logical reasoning 4. Organization of time and planning Systemic 5. Ability to apply theoretical knowledge to practice	1. Knowledge of the basic principles of digital electronics 2. Knowledge of the binary number system, and how it is used to represent natural numbers, integers and real ones. 3. Sum and subtraction operations and detection of overflow with numbers in binary 4. Knowledge of Boolean algebra and its application to logical system design 5. Simplification of logical functions through Veitch-Karnaugh maps 6. Design of combinational logic systems 7. Use of combinational functional blocks to design more complex systems 8. Knowledge of bistable devices 9. Design of sequential logic systems 10. Use of sequential functional blocks to design more complex systems 11. Knowledge of the Von Neumann model for computers and the main features of their elements 12. Understanding the operation of a simple processor 13. Write simple programs in assembly language 14. Making small modifications to the simple processor architecture 15. Understanding the high level step at low level and related tools such as the memory map and the symbol table 16. Use of a simulator to see the operation of the processor

5. Learning objectives

In this subject, it is intended that students be able to analyze the operation of combinational and sequential logic systems, as well as design simple systems, either following formal procedures or with more intuitive and creative methods. All this should allow students to understand the operating bases of computers, and how they are able to execute the code that is provided through the programs.

To be able to perform these processes of analysis and design of logical systems, it is imperative to master the methods of binary representation of the numbers and principles of Boolean algebra, which is the one that allows mathematical modeling of the operation of logical systems.

Another great goal is to know the operating principles of computers and how they are able to execute the code that is provided through the programs. This implies for a corner to extend the knowledge about the logical systems introduced in the first part, with the sequential systems, and for another to present the architectural model that follow the computers, which allows to dissect the tasks performed by the computer for functional blocks .

This knowledge of the operation of computers is achieved both from the point of view of the analysis and from the synthesis. If the students are capable of designing new circuits or modifying the ones analyzed, the degree of achievement is much more satisfactory.

6. Evaluation

6.1 General evaluation criteria

To pass the subject, students must pass the final exam and conduct 7 practical sessions in the laboratory. These practices will be reviewed and rated by the teachers during the laboratory sessions, and the score will be equal to or greater than 5 if they have been made in a beneficial way. The practices will be carried out in groups of 3 students.

If a group has not been able to deliver any of the practices, the assessment will be carried out in a personal interview with the laboratory professor, which must be arranged during tutoring hours before the period of the examinations of the trimester.

Seminar sessions will be proposed and will include a series of exercises that, in the same way as practices, have a continuous assessment. The main objective is that the student can be aware of the level of achievement of the competences.

At the end of the second trimester there will be an exam that will cover the subject corresponding to the second trimester. At the end of the third trimester there will be another exam that will have two parts: the first (which will contain questions related only to the competences worked in the second trimester) will have to be carried out by the students who have suspended the examination of the second term, and the Second, for all, that will be related to all the competences, but with more emphasis on those of the third trimester. The September exam will have the same structure as in June.

With the approved two parts, the examination mark is the average of the two.

The final grade of the subject will be the sum of 75% of the exam mark and 25% of the practical mark. It is essential to have 5 or more points in the two partial notes to be able to pass the subject.

If all the exercises carried out in the seminar sessions are delivered, the final grade will be uploaded to one more point (depending on the correctness of the exercises), provided the final grade is equal to or greater than 5.

Any of the four notes (examination of the first part, examination of the second part, practices or exercises) can be saved until the September call. In no case do one course for another.

6.2 Concretion for competencies

Skills to be achieved in the subject	Achievement indicator	Evaluation procedure	Temporalization
1. Knowledge of the basic principles of digital electronics 2. Knowledge of the binary number system, and how it is used to represent natural numbers, integers and real ones. 3. Subtotal and subtraction operations and detection of overflow with binary numbers 4. Knowledge of Boolean algebra and its application to logical system design 5. Simplification of logical functions through Veitch-Karnaugh maps 8. Knowledge of bistable devices	Correctly answer the questions of the final exam Correctly solve the exercises proposed	Exam with problems and theoretical questions Exercises	At the end of the trimester Exercises to be solved in the seminar sessions
6. Design of combinational logic systems 7. Use of combinational functional blocks to design more complex systems 9. Design of sequential logic systems 10. Use of sequential functional blocks to design more complex systems	Correctly answer the questions of the final exam Perform the practices satisfactorily	Exam with problems and theoretical questions Laboratory practices	At the end of the trimester Practices to be performed in the laboratory sessions

7. Contents

7.1 Content blocks

1. Binary representation of the information
2. Boolean algebra and logic gates
3. Analysis and synthesis of combinational logic systems
4. Analysis and synthesis of sequential logic systems
5. The Von Neumann model for computers
6. The processor subsystem

7.2 Organization and content specification

Content block 1.-Binary representation of the information

Concepts	Procedures	Attitudes
1. Binary and hexadecimal numbering systems 2. Pure binary system and arbitrary codes 3. Representation in complement for integers 4. Representation of real numbers	1. Basic changes between base 10, 2 and 16 2. Basic arithmetic operations in binary, in the different formats of representation 3. Construction of arbitrary binary codes	

Content block 2. -Boolean algebra and logic doors

Concepts	Procedures	Attitudes
1. Truth table 2. Logical doors 3. Postulates and theorems of Boolean Algebra 4. Normal forms of a Boolean function	1. Simplification of Boolean functions with algebraic methods 2. Implementation of Boolean functions with logic doors	

Content block 3. -Analysis and synthesis of combinational logic systems

Concepts	Procedures	Attitudes
1. Veitch-Karnaugh Diagrams 2. Functional blocks: encoders, decoders, multiplexers, demultiplexers 3. Arithmetic blocks: adders, resellers, comparators	1. Minimization of logical functions with V-K diagrams 2. Analysis of the behavior of combinational systems 3. Design of simple combinational systems	1. Clarity and neatness in the realization of the practices

Content block 4. - Analysis and synthesis of sequential logic systems

Concepts	Procedures	Attitudes
1. Biestables RS, JK, D and T: Behavior and excitation tables 2. Synchrony by level and by flank 3. Functional blocks: registers and counters 4. State diagrams to model the behavior of sequential systems	1. Analysis of the behavior of sequential systems: chronograms 2. Design of simple sequential systems 3. Methods of Moore and Mealy for sequential systems	1. Clarity and neatness in the realization of the practices

Content block 5. - The Von Neumann model for computers

Concepts	Procedures	Attitudes
1. The Von Neumann model 2. Processor subsystems, memory, input / output 3. Hierarchical structure of computers: the main levels		

Content block 6. - The processor subsystem

Concepts	Procedures	Attitudes
1. Process unit and control unit 2. Assembler language 3. Tools for the realization of programs in machine language	1. Write simple programs in assembler language 2. Step of code of high level to low level 3. Analysis of the operation of a processor 4. Small modifications to the architecture of a processor	1. Clarity and neatness in the realization of the practices

8. Methodology

8.1 Methodological focus of the subject

In theory sessions, all in large groups, the basic theoretical concepts will be introduced and the appropriate procedures for problem solving will be shown. The seminar sessions will discuss the problems that the students have previously worked on, and the doubts that may arise will be resolved. Laboratory sessions will be carried out with software that allows you to design logic circuits and check their operation. The objective is double: for a corner they must serve to understand and consolidate the theoretical concepts and on the other serve as indicators of evaluation of the achievement of the competences related to the design of logical systems.

The work outside the classroom will consist basically in the resolution of proposed problems and the preparation of the practices and the realization of previous studies.

8.2 Temporary organization: sessions, learning activities and estimated time of dedication

The face-to-face sessions in the classroom are organized as follows:

Block of contents	Big group	Laboratory	Seminar
Introduction	T_1		
1. Binary representation of the information	T_1		S_1
2. Boolean algebra and logic gates	T_2		S_1
3. Analysis and synthesis of combinational logic systems	T_3 T_4 T_5 T_6 T_7	P_1 P_2 P_3	S_2 S_3
4. Analysis and synthesis of sequential logic systems	T_8 T_9 T_{10}	P_4 P_5	S_4
5. The Von Neumann model for computers	T_{10}		
6. The processor subsystem	T_{11} T_{12} T_{13}	P_6 P_7	S_5 S_6

The expected deliveries will be in the seven sessions of the laboratory and the six sessions of the seminar.

The estimated hours of dedication are:

	Activities in the classroom			Activities outside the classroom		Evaluation
	Big group	Laboratory	Seminar	Preparation of practices	Personal study and problems	Exam
Introduction	1					
1. Binary representation of the information	1		1		3	
2. Boolean algebra and logic gates	2		1		3	
3. Analysis and synthesis of combinational logic systems						
Veitch-Karnaugh Diagrams	4	2	2		10	
Functional blocks	5	4	2	6	14	
4. Analysis and synthesis of sequential logic systems	5	4	2	6	16	
5. The Von Neumann model for computers	1				1	
6. The processor subsystem	7	4	4	6	25	
Evaluation					4	4
Total	26	14	12	18	76	4

Total: 150

9. Sources of information and didactic resources

9.1 Sources of information for learning. Basic bibliography (paper and electronic support)

- ANGULO, J.M.: *Sistemas digitales y tecnología de computadores*. Ed. Thompson, 2002
- LLORIS, A.; PRIETO, A.: *Diseño lógico.* Ed. McGraw-Hill, 1996.
- HERMIDA, R.: Fundamentos de computadores. Madrid: Síntesis, 1998.

9.2 Sources of information for learning. Complementary bibliography (paper and electronic support)

- GAJSKI, D. D.: *Principios de diseño digital*. Ed. Prentice-Hall, 1997.

9.3 Teaching resources. Teaching material of the subject

- Collection of problems
- Notes for the exam