Teaching guide

IDENTIFICATION DETAILS

Degree:	Computer Engineering
Scope	Ingeniería informática y de sistemas
Faculty/School:	Escuela Politécnica Superior
Course:	ELECTRONICS AND TECHNOLOGY OF COMPUTERS
Type:	Basic Training
ECTS credits:	6
Year:	1
Code:	5610
Teaching period:	Segundo semestre
Subject:	Física
Module:	Formación Básica
Teaching type:	Classroom-based
Language:	Inglés
Total number of student study hours:	150

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SUBJECT DESCRIPTION

The course Electronics and Computer Technology seeks to explore the fundamentals of electronics and their relationship with the physical functioning of computers, peripherals and communication devices used in computing. It addresses the following fundamental aspects: principles of electromagnetism, basic characteristics of

semiconductors, diodes and transistors, the operation and characteristics of the main logic families, along with the analysis and synthesis of digital circuits.
This course corresponds to the Basic Training module and, within this module, to the subject area of physics. It is taught in the second semester of the first year of the Computer Engineering Degree and requires 150 hours of student work. The course has two aspects: a theoretical component focused on understanding the basic principles and concepts of electronics present at the physical and logic levels of any digital system, and a practical component, where digital system design techniques are applied through laboratory sessions.
The contents are organized in two blocks:
- The first covers the logic level, presenting the characteristics of basic digital components as well as techniques for the synthesis and analysis of combinational and sequential digital circuits.
- The second explores the underlying principles that govern the operation of digital systems at the physical level: applied concepts of waves and electromagnetism, basic electrodynamics and analysis of analog circuits, characteristics of semiconductor materials and the most important transistor technologies and logic families used in the implementation of logic gates.
In addition, the course seeks to foster in students an attitude of wonder and curiosity about the physical reality that supports the operation of computer systems, encouraging the intellectual search for nature’s beauty and the habit of wondering about the truth underlying the systems and phenomena they study . Furthermore, it aims to broaden the student's critical thinking and lead them to question the validity of their own beliefs and preconceptions in relation to this physical reality.

GOAL

The course aims to provide students with a solid understanding of the fundamentals of electronics and their relevance to the physical operation of computing systems, as well as the skills to design, analyze, and implement digital circuits.

The specific aims of the subject are:

Design and analysis of combinational systems

Design and analysis of sequential systems

Analysis of simple analog circuits

Introduction to Semiconductors

CMOS digital circuits

PRIOR KNOWLEDGE

Knowledge about the binary number system and the representation of information in that system (Course: Foundations of Computer Engineering).
Main characteristics of Boolean Algebra (Course: Discrete Mathematics).
Basic concepts of electricity, its main quantities and Ohm's law.

COURSE SYLLABUS

Topic 1: Combinational Systems

- Introduction to digital systems: Signal. Information encoding.
- Analog and digital electronics. Noise.
- Specification of combinational systems: truth tables and logic expressions. Simplification by Boole and Karnaugh.
- Design, analysis and synthesis of combinational circuits.
- Transformation of circuits using Boolean algebra.
- Universal set of gates.
- Complex combinational logic circuits: adders, comparators, decoders, multiplexers, parity checkers.
- Modular design applied to combinational systems.
- Introduction to modern design using hardware description language (HDL).

Topic 2: Sequential Systems

- States and Finite State Machines (FSMs). Moore and Mealy machines.
- Bistables. Synchronism.
- Design and synthesis of synchronous sequential systems.
- Basic sequential blocks: counters, parallel registers, sequence detectors and shift registers.
- Modular design applied to sequential systems.
- Introduction to modern design using hardware description language (HDL).

Topic 3: Electricity and Electromagnetism

- Introduction.
- Main quantities of moving charges. Resistance, current, voltage, power.
- Ohm's Law and Kirchhoff's Laws. Basic circuit analysis.

Topic 4: Semiconductors

- N-type and P-type materials, NP junction, potential barrier.
- Diodes, bipolar and field-effect transistors.

Topic 5: Integrated Circuits

- Scale integration.
- CMOS logic.
- Integrated circuit manufacturing.

EDUCATION ACTIVITIES

The course consists of two components:

- Theoretical : introducing the basic principles and concepts of electronics present at the physical and logic levels of simple digital and analog systems.
- Practical : focusing on the application of basic digital system design techniques.

For this reason, lectures are complemented by discussions and laboratory sessions, using dynamic and engaging methodologies that go beyond traditional content delivery—such as problem-based learning and collaborative activities in the classroom—aimed at fostering a student-centered learning experience that emphasizes interaction between students and with the instructor. Non-face-to-face activities, supervised by the instructor during class sessions and/or tutoring, are designed to support the development of students' autonomous learning skills. Specifically, the teaching activities and methodologies planned for the course include:

- (AF1) **Lectures and discussions**: aimed at presenting and developing the theoretical foundations of the subject. An expository methodology will be primarily employed by the instructor, supported by audiovisual materials, and combined with an interactive approach that uses questioning as a tool for communication and reflection, promoting a deeper and more meaningful learning process.

- (AF2) **Problem-solving and case studies**: sessions focused on applying techniques and procedures for analyzing and designing circuits. These will primarily follow a problem-based learning methodology. A collaborative and constructive learning environment will be fostered, with student participation and peer interaction at the core of the problem-solving process.
- (AF4) **Practical sessions using specific technological resources**: focused on the design and implementation of small digital circuits through simulation and/or real-world environments. Challenges may be addressed in groups, encouraging collaborative work. At the end of the lab sessions, a project will be assigned to integrate the knowledge and skills developed throughout the course.

The face-to-face work will be complemented by a significant amount of autonomous work by the student, some of which may be done in groups to promote collaborative or cooperative learning (AFA1). Planned non-face-to-face activities include individual study and assignments—supporting the understanding of concepts covered in lectures and the application methods practiced in practical classes and labs—as well as group work, mainly intended as preparation for laboratory sessions.
All student activities will be supervised and guided by the instructor through individual or group tutoring sessions (AFE1). In some cases, students may be required to present the main conclusions of their work in class, encouraging the exchange of knowledge and experiences among peers. Finally, to facilitate access to materials, help students organize their work, and support communication with both the instructor and classmates, Canvas, an online learning platform that provides a range of digital resources, will serve as the central hub for all academic interactions during the course.

DISTRIBUTION OF WORK TIME

TEACHER-LED TRAINING ACTIVITIES	INDIVIDUAL WORK
60 Horas	90 Horas
• AF1 - Lecture and discussion 26h AF2 - Problem solving or case studies 8h AF4 - Practical classes with specific technological resources 22h • AFE1 - Academic tutoring and evaluation activities 4h	• AFA1 - Student autonomous work and study 90h

LEARNING RESULTS

Comprensión y dominio de los conceptos básicos de campos y ondas y electromagnetismo, teoría de circuitos eléctricos, circuitos electrónicos, principio físico de los semiconductores y familias lógicas, dispositivos electrónicos y fotónicos, y su aplicación para la resolución de problemas propios de la ingeniería.

SPECIFIC LEARNING RESULTS

Ability to analyze direct current electrical circuits and to obtain the main electrical quantities (voltage, current and power).

Ability to understand and describe the basic operation of diodes and bipolar and field-effect transistors.

Ability to analyze circuits that implement logic functions using CMOS technology.

Ability to analyze, specify, design, and implement digital circuits that perform basic operations with binary information using SSI and MSI integrated circuits.

Apply Boolean algebra and Karnaugh maps to simplify digital circuits. Apply modular design to complex problems.

Ability to validate and debug digital circuits, using simulation tools or real test environments.

LEARNING APPRAISAL SYSTEM

ORDINARY CALL:
- (SE1) 60%: One or more theoretical-practical exams.
- (SE3) 30%: Final practice of digital systems.
- (SE2) 10%: Participation in the activities and exercises proposed during the course. It requires assistance equal to or greater than 80%.

- To pass the course in the ordinary call, ALL of the following conditions must be met:

- The SE1 score must be 5 or higher.
- The SE3 score must be 4 or higher.
- The simple average of SE1 and SE3 must be 5 or higher.
- The weighted average of SE1, SE3, and SE2 must be 5 or higher.

EXTRAORDINARY CALL:
Follows the same evaluation as the one presented in ordinary call, with the following considerations:

- The participation in class activities (SE2) is not recoverable. The same grade obtained in the ordinary call will be considered in this call.
- Ordinary call grades (in the SE1 and SE3 tests) that have been marked with a 5 or higher will be kept for this call.

STUDENTS WITH ACADEMIC EXEMPTION:
Students with academic exemption granted by the academic director will have the following evaluation elements in both calls:
- (SE1-Disp) 60%: One or more theoretical-practical exams for the subject.
- (SE3-Disp) 40%: Final practice of digital systems.

- To pass the course in any call, ALL of the following aspects must be fulfilled:

- The SE1-Disp mark must be 5 or higher.
- The SE3-Disp mark must be 4 or higher.
- The weighted average of SE1-Disp and SE3-Disp must be 5 or higher.

- Ordinary call grades that have been marked with a 5 or higher will be carried to the extraordinary call.

TOTAL NUMBER OF CALLS: The student has 6 calls to pass this course, two per academic year. The UFV Evaluation Regulations include everything related to the evaluation and call consumption processes.

ACADEMIC INTEGRITY: Any type of fraud or plagiarism by the student in an evaluated activity will be sanctioned as set out in the UFV Coexistence Regulations. In this regard, any attempt to defraud the assesment process, such as copying exercises, exams, practices, works or any other type of submission, either from another colleague, or from unauthorized materials or devices, in order to make the teacher believe that the submitted materials are their own, will be considered “plagiarism”.

ETHICAL AND RESPONSIBLE USE OF ARTIFICIAL INTELLIGENCE

1.- The use of any Artificial Intelligence (AI) system or service shall be determined by the lecturer, and may only be used in the manner and under the conditions indicated by them. In all cases, its use must comply with the following principles:
a) The use of AI systems or services must be accompanied by critical reflection on the part of the student regarding their impact and/or limitations in the development of the assigned task or project.
b) The selection of AI systems or services must be justified, explaining their advantages over other tools or methods of obtaining information. The chosen model and the version of AI used must be described in as much detail as possible.
c) The student must appropriately cite the use of AI systems or services, specifying the parts of the work where they were used and describing the creative process followed. The use of citation formats and usage examples may be consulted on the Library website(https://www.ufv.es/gestion-de-la-informacion_biblioteca/).
d) The results obtained through AI systems or services must always be verified. As the author, the student is responsible for their work and for the legitimacy of the sources used.
2.- In all cases, the use of AI systems or services must always respect the principles of responsible and ethical use upheld by the university, as outlined in the Guide for the Responsible Use of Artificial Intelligence in Studies at UFV. Additionally, the lecturer may request other types of individual commitments from the student when deemed necessary.
3.- Without prejudice to the above, in cases of doubt regarding the ethical and responsible use of any AI system or service, the lecturer may require an oral presentation of any assignment or partial submission. This oral evaluation shall take precedence over any other form of assessment outlined in the Teaching Guide. In this oral defense, the student must demonstrate knowledge of the subject, justify their decisions, and explain the development of their work.

BIBLIOGRAPHY AND OTHER RESOURCES

Basic

Brock J. Lameres Introduction to logic circuits & logic design with VHDL 2019
https://link.springer.com/book/10.1007/978-3-030-12489-2

Sergey N. Makarov, Reinhold Ludwig, Stephen J. Bitar Practical electrical engineering 2016
https://link.springer.com/book/10.1007/978-3-319-21173-2