Universidad de Alcalá

TEACHING GUIDE

Digital Electronic System Design

University Master in Electronic Engineering

University of Alcala

Academic Year 2023/2024

1st Semester

COURSE GUIDE

Name of the module:	**Digital Electronic System Design**
Code:	**202571**
Degree:	**University Master in Electronic Engineering**
Department and Area of Expertise:	**Electronics / Electronic Technology**
Character:	**Compulsory**
ECTS credits:	**4.5**
Year and semester:	**1st semester**
Teaching staff:	**Check at http://www.uah.es**
Office hours:	**Check at http://www.uah.es**
Mode	Face-to-face
Language of teaching:	Spanish

1. INTRODUCTION

This course is located in the Electronic Systems subject of the Master's Study Plan.
The course is aimed at providing advanced theoretical-practical training in Digital Electronic Systems for Electronic Engineers, both with a research/academic and professional profiles.
The course has a twofold focus: addressing advanced knowledge of processor-based digital electronic systems; and advanced electronic design, mainly oriented to programmable devices.

2. SKILLS AND LEARNING RESULTS

This course provides the Basic, General and Specific Competences detailed below:

Basic Competences	
CB6	Obtain and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.
CB7	That students know how to apply the acquired knowledge and their problem-solving capacity in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study.
CB10	That students obtain the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

General Competences	
CG2	Conceive, design, implement and maintain an electronic system in a specific application.
CG3	Acquire skills for understanding new technologies for use in electronic systems and their proper use and integration for solving new problems or applications.
CG6	Adopt the scientific method as a fundamental work tool to be applied in both the professional and research fields.

Specific Competences	
CE1	Ability to design electronic systems both at the conceptual level, based on specific specifications, and at the system level, using modelling and simulation tools, as well as at the subsystem level using, among others, hardware description languages.
CE3	Ability to handle advanced tools, techniques and methodologies for designing electronic and photonic systems or subsystems.
CE4	Ability to design a device, system or application that meets some specifications, using a systemic and multidisciplinary approach and integrating advanced modules and tools that are specific to the field of Electronic Engineering.
CE7	Ability to experimentally verify in the laboratory the compliance with the specifications required of a new electronic and photonic system after its design.
CE9	Ability to identify merit factors and effective comparison techniques to obtain the best solutions for scientific and technological challenges in the field of Electronic Engineering and its applications.
CE10	Ability to apply optimization techniques for the development of electronic circuits and subsystems.
CE11	Ability to carry out effective information searches, and to identify the state of the art of a technological problem in the field of electronic and photonic systems, as well as its possible application to the development of new systems.

On the other hand, the expected learning results from this course are the following:

RAP1. Know advanced digital electronic systems based on processors, making use of different types and memory accesses.

RAP2. Design digital electronic systems based on programmable devices using advanced techniques and high-level languages.

3. CONTENTS

The course includes the following contents:

Content modules	Hours
Unit 1: Digital electronic systems based on multiprocessors	• 8 hours
Unit 2: Semiconductor memories	• 7 hours
Unit 3: Advance digital system design	• 10 hours
Unit 4: High-level hardware design languages (HLS)	• 10 hours
Unit 5: Introduction to Systems-on-Chip	• 10 hours
	45 hours

4. TEACHING METHODOLOGIES-LEARNING ACTIVITIES

4.1. Credit distribution (specified in hours)

Number of hours for lectures:	45 hours
Number of hours of work by the student:	67,5 hours
Total hours	112,5 hours

4.2. Methodological strategies, materials and resources

The teaching-learning process will be carried out through the following activities:

Theory classes and practical lectures for exercises	20 hours
Theoretical-practical lectures and practical laboratory classes	17,5 hours
Tutorials	12,5 hours
Others: individual work, virtual classroom and tests	62,5 hours
Total hours	112,5 h

Throughout the course, students will be proposed activities and tasks so that they can experiment and strengthen the concepts acquired. To carry out the practice, students will have in the laboratory a post with a computer and the necessary elements to experiment with design techniques for digital electronic systems.

During the entire learning process of the course, students must use different sources and bibliographic or electronic resources, so that they become familiar with the documentation environments that they will use in the research or professional fields.

5. ASSESSMENT: Procedures, assessment criteria and grading system

Preferably, students will be offered a continuous assessment system that has characteristics of formative evaluation, so that it serves as feedback in the teaching-learning process for the student.

5.1 Assessment Procedures

The proposed assessment process is inspired by continuous evaluation, although, respecting the regulations of the University of Alcala, the student will be able to take the final evaluation[11].

5.2. Assessment Criteria

The Assessment Criteria must take into account the degree of acquisition of the competences by students. For this, the following criteria are defined.

- C1: That the student be able to correctly solve problems related to the design of processor-based electronic systems using different typologies and memory accesses.
- C2: That the student be able to solve problems related to digital electronic systems based on programmable devices using advanced techniques and high-level languages.
- C3: That the student implement digital electronic systems that provide solutions to the proposed problems, integrating the knowledge acquired, making use of bibliographic resources and computer tools at their disposal.
- C4: That the student be able to generate correctly written, clear and precise documentation on the work done in the laboratory.
- C5: That the student present and defend in a clear and reasoned way their proposals for the resolution of the proposed problems.

[1] Students will have a period of 15 days to request to the EPS Director their intention to use the final evaluation model (non continuous), citing the reasons they deem appropriate, according to the indicated in the regulations governing the learning assessment processes (approved by Governing Council of September, 2021).

5.3. Assessment Instruments

This section lists the assessment instruments for the face-to-face mode that will be applied:

1. Individual or group works (TR). These are works that students must carry out and present on certain theoretical aspects of the course. The topics will be proposed by the professor.
2. Theoretical-practical test/s (PT). These are written tests on theoretical and practical aspects of the course.
3. Lab practical tests (PL). These are tests about implementation of digital electronic system designs on programmable and/or configurable systems.

5.4. Grading Criteria

5.4.1. Continuous Assessment:

a) **Ordinary Call.** Students will be assessed continuously through tests distributed throughout the academic period. The weight percentages of such tests on the final grade, as well as the relationship between the criteria and assessment instruments of the subject, is as follows:

Learning Results	Assessment Criteria	Assessment Instruments	Grading Weight
RAP1, RAP2	C1, C2, C5	TR	15%
	C1, C2, C5	PT	20%
	C1, C2, C3, C4, C5	PL	65%

A student will be considered to have participated in the teaching-learning process and therefore have attended the ordinary call if he/she attends any of the scheduled tests.
Students will be considered to have passed the course if they achieve a weighted global grade equal to or greater than 5 (out of 10) among all the grading instruments, having obtained a minimum grade in each of the parts (TR, PT and PL) of at least 40% of the maximum grade.

b) **Extraordinary Call**. Those students who do not pass the ordinary call will be entitled to an extraordinary call. The theoretical-practical part (PT) will be assessed through a test-type exercise and questions, and the practical part (PL) through deliverables, reports and a practical laboratory exam. The weight percentages of such tests on the final grade, as well as the relationship between

the criteria, assessment instruments and the learning results of the subject, is as follows:

Learning Results	Assessment Criteria	Assessment Instruments	Grading Weight
RAP1, RAP2	C1, C2, C5	PT	35%
	C1, C2, C3, C4, C5	PL	65%

Students will be considered to have passed the course if they achieve a weighted global grade equal to or greater than 5 (out of 10) among all the grading instruments, having obtained a minimum grade in each of the parts (PT and PL) of at least 40% of the maximum grade.

5.4.2. Non-Continuous Assessment:

Ordinary and Extraordinary call

Those students who choose the final assessment model (non-continuous), both in the ordinary and extraordinary calls, must pass: the theoretical-practical part (PT) through a test-type exercise and questions, and the practical part (PL) through deliverables and a practical lab exam. The weight percentages of such tests on the final grade, as well as the relationship between the criteria, assessment instruments and the learning results of the subject, is as follows:

Learning Results	Assessment Criteria	Assessment Instruments	Grading Weight
RAP1, RAP2	C1, C2, C5	PT	35%
	C1, C2, C3, C4, C5	PL	65%

Students will be considered to have passed the course if they achieve a weighted global grade equal to or greater than 5 (out of 10) among all the grading instruments, having obtained a minimum grade in each of the parts (PT and PL) of at least 40% of the maximum grade.

6. BIBLIOGRAPHY

6.1 Basic bibliography

- Documentation generated by the teaching staff for the course, which will be provided to students directly, or posted on the course website.
- “Multiprocessor system-on-chip hardware design and tool integration”, Michael Hübner, Springer, 2011.

- “Memory Systems: Cache, DRAM, Disk”. Bruce Jacob, Spencer Ng, David Wang, Elsevier, 2007.
- “Computer System Design: System-on-Chip”, Michael J. Flynn, Wayne Luk, Wiley 2011.
- “Designing with Xilinx® FPGAs Using Vivado”. Churiwala, Sanjay. Springer, 2017.

6.2 Complementary bibliography

- “Computer Architecture: A Quantitative Approach”. John L. Hennesy y David A. Patterson, 5th edition, Morgan Kaufmann, 2012.
- “Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers”. Tammy Noergaard, 2nd edition, Newnes, 2013.