Universidad de Alcalá

TEACHING GUIDE

Digital electronics

Degree in
Industrial Electronics and Automatics Engineering

Universidad de Alcalá

Academic Year 2025/2026

2nd Year - 1st Semester

Approved by the EPS School Board on June 16th, 2025

TEACHING GUIDE

Course Name:	**Digital electronics**
Code:	**600028**
Degree in:	**Industrial Electronics and Automatics Engineering**
Department and area:	**Electrónica** **Electronic Technology**
Type:	**Compulsory**
ECTS Credits:	**6.0**
Year and semester:	**2nd Year, 1st Semester**
Teachers:	View website https://www.uah.es/es/estudios/estudios-oficiales/grados/asignatura/Electronica-Digital-600028
Tutoring schedule:	Consultar al comienzo de la asignatura
Language:	English

1. COURSE SUMMARY

The aim of this course is to introduce students to the study and basic design of digital systems, both combinational and sequential. Hardware Description Languages â€‹â€‹(HDL) and Programmable Logic Devices (PLD) are presented. On this basis, it is possible to address systems based on microprocessors, microcontrollers, system-specific hardware, etc. that will be discussed in subsequence subjects.

For better understanding of the course, it will be necessary to have prior knowledge acquired in the course of Circuit Theory. It is particularly interesting to have attended and passed lab part of this subject.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the Annex to the Orden CIN/351/2009:

en_TR2 - Knowledge in basic and technological subjects, which enables them to learn new methods and theories, and gives them versatility to adapt to new situations.

en_TR3 - Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.

en_TR4 - Knowledge to carry out measurements, calculations, assessments, appraisals, appraisals, studies, reports, work plans and other similar works.

en_TR9 - Ability to work in a multilingual and multidisciplinary environment.

en_TRU1 - Capacity of analysis and synthesis.

en_TRU2 - Oral and written competencies.

en_TRU3 - Ability to manage information.

en_TRU4 - Autonomous learning skills.

en_TRU5 - Team work.

Professional Skills

This course contributes to acquire the following professional skills, which are defined in the Section 5 of the Annex to the Orden CIN/351/2009:

en_CEI3 - Knowledge of the fundamentals and applications of digital electronics and microprocessors.

en_CEI6 - Ability to design analog, digital and power electronic systems.

Learning Outcomes

After succeeding in this subject the students will be able to:

LR1. Design simple digital systems with HDLs.

LR2. Understand the logic functions that describe a digital system, as well as its implementation with basic logic gates.

LR3. Identify the different combinational circuits used in digital systems.

LR4. Use the necessary techniques and circuits to implement the basic binary-arithmetic operations.

LR5. Use the different sequential systems.

3. CONTENTS

Contents Blocks	Total number of hours (Teory/Prob/Lab)
Module 1. Introduction. Overview of digital circuits. Boolean algebra. Basic logic gates. Synthesis and implementation of logic functions. Tristate gates. Basics of logic families. Introduction to Programmable logic devices.	7/2/0 hours
Module 2. Analysis and design of combinational digital circuits: multiplexers, demultiplexers, decoders and drivers (BCD-7s), encoders, comparators and binary arithmetic circuits.	9/6/8 hours
Module 3. Analysis and design of sequential digital circuits: bistables, registers and counters.	6/6/4 hours
Module 4. Synthesis of sequential systems. Sequential systems design: Moore and Mealy automata.	4/4/0 hours

These contents add up to 56 hours of lectures, problems and lab and, coupled to two-hour mid-term tests and two hours of final evaluation, make 58 hours in a classroom setting.

Students are also provided, on the course website (UAH virtual platform: http://www.uah.es/aula_virtual), with a detailed description of each lesson that includes:

- Contents each in-person classes.
- Available resources for each lesson.
- Work that the students must perform before and after classes in the hours allotted for their work.

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (56 hours on-site +2 exams hours)
Number of hours of student work:	92
Total hours	150

4.2. Methodological strategies, teaching materials and resources

In the teaching-learning process, the following training activities will be held:

- **Lectures (theory classes)** given in large groups based on presentations that allow the teacher to introduce the skills necessary for the proper development of the learning process. These classes will present essential contents, subject of a reasoned conceptual learning, subsequently used to develop broader skills.
- **Practical classes** taught in large group, based mainly on solving exercises and problems. The aim of these classes is to promote meaningful learning that will allow students to deepen the knowledge acquired, relate and apply it creatively in order to solve situations, as the course progresses, that will gradually become more similar to real-world engineering problems.
- **Lab classes** taught exclusively in small groups and based on practical circuit implementation, scheduled so that they serve as a complement for better understanding of the concepts acquired in the room sessions, through practical experimentation.
- **Tutorship sessions**: individual or group sessions.
  Student previous or subsequent work: essential part of the teaching-learning process that will be guided and described in detail in the student's notebook quoted above

The following additional resources may also be used:

- **Individual and group works**, which could pose, in addition to its realization, the relevant public presentation to the rest of the class to stimulate discussion.
- **Attendance at conferences**, meetings or discussions related scientific field.

In the lab classes, the students will have at their disposal a work station provided with the basic equipment (oscilloscope, power supply end signal generator) and a computer with HDL design and simulation software. In this course, lab should be carried out in groups of two students.

Throughout the learning process in the course, students will use different bibliographic and electronic resources, in order to become familiar with the environments of documentation they will use professionally in the future. In addition, teachers will provide own materials developed specifically for the course (theoretical papers, collections of exercises and problems, practice manuals, audiovisuals, etc.) so that students can meet the course objectives and achieve the competences described.

Students will be provided throughout the semester with tutorship in group (if requested by the students themselves) or individual. Whether individually or in small groups, this tutorship will resolve doubts and consolidate the knowledge acquired. Also it will help to make appropriate monitoring and assess the proper functioning of the mechanisms of teaching and learning.

Finally, the whole development of the subject will be detailed on the website of the course (see table at the beginning of the document). All resources developed for the subject, such as slides, exercise statements and solutions, statements of problems for practices, detailed schedules for each group and class, mid-term exams marks and any other information that teachers consider appropriate for the proper teaching and learning process will be available on the website.

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start

of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Continuous assessment implies and/or allows for the following:

- The student knows, by means of real and objective tests, his evaluation criteria.
- The student knows regularly the results of his learning process.
- Provide the teacher with objective information about subject evolution
- Intermediate tests do not release any contents from the final test, as long as this one aims at evaluating globally all the competences of the course.

According to current UAH regulations (rules governing the processes of learning assessment approved by the Governing Council of March 24, 2011, Article 6, paragraph 4), and, as long as the laboratory module is considered as an essential part to reach the capacities aimed by the Digital Electronics course, attendance to all the lab practicals, as well as successfully completing them, is considered as an essential and also compulsory element for the course assessment, either under continuous assessment or final evaluation format. For this reason, lab practicals are common and mandatory, both for continuous and final assessment too.

5.2. EVALUATION

EVALUATION CRITERIA

The assessment criteria measure the level in which the competences have been acquired by the student. For that purpose, the following are defined:

AC1: The student solves correctly analysis and design problems of combinational and sequential circuits, synchronous and asynchronous. The student must be able to solve new problems, different from the ones addressed in the classes.

AC2: The student is able to integrate all conceptual knowledge explained in the theoretical sessions to solve new problems in a creative and original way.

AC3: The student explains and shows in a clear way the solutions proposed

AC4: The student implements practical real circuits as a solution to a problem stated integrating his theoretical knowledge, using discrete components and HDLs too, and making use of bibliography and informatics.

AC5: The student is able to generate, clearly presented, concise and rigorous technical reports.

GRADING TOOLS

The work of the student is graded in terms of the assessment criteria above, through the following tools:

1. On-site activities for continuous assessment (AP): tests, problems, theoretical-practical tests and training and assessment activities, throughout the four-month period, during the on-site sessions.
2. Mid-term exams (MTE): one or two mid-term exams that consist of a number of questions (analysis and / or synthesis) on specific aspects of the syllabus covered by the lectures, exercises classes and lab along the whole course.
3. LP: Three lab projects (LP1, LP2, LP3) covering the whole subject knowledge including combinational and sequential circuits. They are continuously assessed along the practical sessions.
4. FE: A final exam that consists of a number of questions (analysis and / or synthesis) on specific aspects of the syllabus covered by the lectures and exercises classes along the whole course.

GRADING CRITERIA

In the ordinary call-continuous assessment the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, CEI-3, CEI-6	LR2-LR5	AC1-AC3	AP	5%
TR2, TR3, CEI-3, CEI-6	LR2-LR5	AC1-AC3	MTE(s)	35%
TR2, TR3, CEI-3, CEI-6	LR2-LR5	AC1-AC3	FE	40%
TR4, TR9, CEI-3, CEI-6	LR1-LR5	AC4-AC5	LP	20%

A student will successfully pass the course following the continuous assessment model if he or she shows that has acquired the theoretical and practical skills, which means:

- The student has attended and performed the three laboratory practicals, and has successfully passed the evaluation of the lab skills and competences. A student is considered to have successfully reached these skills if he or she has attended and completed all the lab practicals. The evaluation of the lab skills along the course may also include either practical and/or more conceptual questions, asked by the teacher by means of an oral or written test
- Obtaining a mark equal or greater than the 45% of the maximum possible total mark in the theory-tests carried out (hence successfully passing the evaluation of the skills and competences related to theory tests).
- The student must obtain a final global mark equal to or greater than 5 (out of 10) calculated as a weighted average with the percentages detailed before.

The student who follows the continuous assessment process is considered as**not presented**, in case he does not perform, apart from the laboratory practicals, the final exam (FE).

In the **ordinary call-final evaluation**, the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, CEI-3, CEI-6	LR2-LR5	AC1-AC3	FE	80%
TR4, TR9, CEI-3, CEI-6	LR1-LR5	AC4-AC5	LP	20%

In order to pass the course, the same criterion applies in this case. The student must show that he/she has successfully acquired the practical skills corresponding to the lab sessions (i.e., he/she has attended and carried out all the scheduled regular lab practicals, as explained in previous sections), and has obtained a mark equal or greater than the 45% of the maximum possible total mark in the theory-tests carried out (hence successfully passing the evaluation of the skills related to theory tests). The final global mark must be equal to or greater than 5 (out of 10) calculated as a weighted average with the corresponding percentages detailed for the extra exam session.

Extraordinary call

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, CEI-3, CEI-6	LR2-LR5	AC1-AC3	FE	80%
TR4, TR9, CEI-3, CEI-6	LR1-LR5	AC4-AC5	LP	20%

As for the other two modalities, to successfully pass the course the student must show that he/she has successfully acquired the practical skills corresponding to the lab sessions (i.e., he/she has attended and carried out all the scheduled regular lab practicals, as explained in previous sections), and has obtained a mark equal or greater than the 45% of the maximum possible total mark in the theory-tests carried out (hence successfully passing the evaluation of the skills related to theory tests). The final global mark must be equal to or greater than 5 (out of 10) calculated as a weighted average with the corresponding percentages detailed for the extra exam session.

The teaching-learning methodology and the evaluation process will be adjusted when necessary, with the guidance of the Diversity Support Unit, to apply curricular adaptations for students with specific needs

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Course notes specifically prepared by teachers which will be provided to students directly through the website of the course (including slides, notes, data sheets and collections of exercises).
- Websites on the topic of the course to be selected in advance by the faculty.
- Circuitos electrónicos digitales. Manuel Mazo y otros. Servicio de Publicaciones. Universidad de Alcalá.
- Problemas de electrónica digital. Manuel Mazo y otros. Servicio de Publicaciones. Universidad de Alcalá.

6.2. Additional Bibliography

- Digital Fundamentals. Thomas L. Floyd. Prentice Hall. Comprehensive and detailed introduction to digital electronics covering all aspects of the syllabus except the design of synchronous sequential circuits. It is especially interesting because of the number of solved examples and exercises.
- Digital Systems. Principles and Applications. Ronald. J. Tocci. Prentice Hall. It is also a book with a broad introduction to digital electronics that fits quite well the basic concepts of this course.

Disclosure Note

During the evaluation tests, the guidelines set out in the Regulations establishing the Rules of Coexistence of the University of Alcalá must be followed, as well as the possible implications of the irregularities committed during said tests, including the consequences for committing academic fraud according to the Regulation of Disciplinary Regime of the Students of the University of Alcalá.