



Universidad  
de Alcalá

# TEACHING GUIDE

## Electronic Technology

**Degree in  
Industrial Electronics and Automatics Engineering**

**Universidad de Alcalá**

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**Academic Year 2022/2023**

2<sup>nd</sup> Year - 2<sup>nd</sup> Semester

## TEACHING GUIDE

Course Name:	<b>Electronic Technology</b>
Code:	<b>600012</b>
Degree in:	<b>Industrial Electronics and Automatics Engineering</b>
Department and area:	<b>Electrónica Electronic Technology</b>
Type:	<b>Compulsory</b>
ECTS Credits:	<b>6.0</b>
Year and semester:	<b>2<sup>nd</sup> Year, 2<sup>nd</sup> Semester</b>
Teachers:	Check Website in UAH
Tutoring schedule:	By appointment
Language:	English

## 1. COURSE SUMMARY

The course *Electronic Technology* aims to complete the training of students about the characteristics, properties and applications of basic electronic circuits as building blocks of more complex electronic systems.

As a result, this course continues the contents, techniques, activities and knowledge base acquired in *Analog Electronics*, with code 600008. For this reason, the students of *Electronic Technology* must have an appropriate level of formation, knowledge and abilities about the contents included in the *Analog Electronics* course.

The course *600012-Electronic Technology* begins with the study of the active semiconductor devices, such as bipolar and unipolar transistors. Initially, this study will focus on their basic characteristics, models, biasing and their applications. Then, we will study the basic amplification configurations and their properties. Next, the study will continue with the multistage amplifiers, focusing on differential stages and integrated amplifiers. This block will finish with the frequency dependencies and the consequences of feedback on discrete amplifiers.

Next block includes an introduction to the linear power systems, beginning with general concepts like efficiency and thermal analysis. Then the study continues with some basic linear power applications: amplifiers, power supplies and regulators.

The course on *Electronic Technology* will finish with an introduction to the parameters and performances of semiconductor devices (diodes and transistors) under switching conditions. This block will present basic switching circuits both in digital (CMOS inverter) and in analog (D class amplifiers) applications.

For the Continuous Assessment model, in order to ensure adequate follow-up of the programmed activities, attendance at face-to-face theory and lab sessions is mandatory.

## 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\_TR5** - Ability to handle specifications, regulations and mandatory standards.

**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\_CEI2** - Knowledge of the fundamentals and applications of analog electronics.

**en\_CEI6** - Ability to design analog, digital and power electronic systems.

**en\_CEI7** - Knowledge and capacity for modeling and simulation of systems.

### Learning Outcomes

The expected learning outcomes, expressed in the form of knowledge, skills and abilities that students should have achieved are as follows:

**RAEI1.** To describe and explain the basic operation of differential amplification stages.

**RAEI2.** To model basic and differential amplification stages.

**RAEI3.** To describe and explain the effects of feedback on electronic amplifiers.

**RAEI4.** To apply technical feedback on amplifiers to improve their parameters according to the given specifications.

**RAEI5.** To analyze and design linear stages and low power supplies according to electrical parameters, thermal and efficiency requirements.

**RAEI6.** To describe and explain the operation of the electronic switching devices and their typical applications.

**RAEI7.** To use tools and simulation software to support electronic design and the modeling of electronic circuits.

## 3. CONTENTS

Module contents	Lecture hours
<b>Block 1: Transistors.</b> Structure and behaviour of bipolar and unipolar transistors. Phototransistors. Curves: working areas. Linear and switching applications. Large signal models. Biasing and Load lines. Stability and sensibility of bias points. Current sources.	8 hours
<b>Block 2: Transistor amplifiers.</b> Small signal models. Equivalences. Basic configurations. Multistage amplifiers. Differential amplifiers. Integrated amplifiers. Frequency response.	12 hours
<b>Block 3: Feedback.</b> Basic concepts and equation. Advantages and drawbacks of feedback. Loop gain and stability. Feedback in ideal amplifiers. Practical feedback: loading effects.	8 hours
<b>Block 4: Switching in discrete devices.</b> Switching of diodes and transistors. CMOS inverter. Power dissipation in digital circuits.	5 hours
<b>Block 5: Linear Power Circuits.</b> Power systems and their applications. Efficiency. Safe Operating Area. Thermal analysis. Linear power supplies and regulators. Power amplifier classes. Protections: thermal runaway and short-circuits. Integrated power amplifiers. Switched output stages: class D amplifiers.	10 hours
<b>Laboratory sessions (LAB).</b> - Additional activities related to the contents of the module. Analysis and design of amplifiers. Computer-based simulation of electronic circuits.	15 hours
<b>Total of presential activities:</b>	58 hours

## 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

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

- **Theory classes** taught in large groups based on lectures that allow the teacher to introduce the required contents for the correct development of the learning process. These lectures will present essential contents later serving to develop broader skills.
- **Practical lectures** taught mostly in small groups based on solving exercises and problems. The

aim of these classes is to promote meaningful learning that allows students to deepen their theoretical knowledge, relate and apply them creatively to solve more complex problems.

- **Practical laboratory classes**, exclusively taught in small groups based on problem or project solving.
- **Tutorials**: individual and group.

The following additional resources could also be used, among others:

- Individual and group work, including proposed problem solving, with the additional possibility of making a public presentation to the rest of the students to foster discussion and improve the assimilation of key concepts.
- Attendance at conferences, meetings and scientific discussions related to the course topics.

Throughout the course theoretical and practical activities will be proposed to the students. Practical work will be carried out in the laboratory to complement and support the teaching of theoretical concepts, or develop additional skills. In this way the student can experiment and thus consolidate the acquired concepts, both individually and in groups.

For the laboratory assignment, the student will have access to basic equipment (oscilloscope, power supply, signal generator) and a computer with electronic circuit design and simulation software. The laboratory assignments will be carried out in groups of two students.

Along the course, students should make use of different sources and electronic or bibliographic resources, so that they will become acquainted with the future documentation environments they will use professionally.

The teaching staff will facilitate the materials for the module (theoretical, exercises and problems, practice manuals, visual references, etc.), so that students can meet the objectives of the course and be familiar with the documentation used in the professional environment.

The student may attend group and individual tutorials (if requested by the students) according to his/her needs and after agreement with the corresponding lecturers. Whether individually or in small groups, these tutorials will allow to solve the questions and consolidate the acquired knowledge. They also help to make an adequate monitoring and to evaluate the progress of the teaching-learning mechanisms.

Finally, the development of the course will be detailed in the course website. All materials produced for the course will be available (slides, set of exercises and solutions, problem statements for lab sessions, detailed schedules for each group and class, intermediate scores and all relevant information).

## 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 Assessment 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 Assessment 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.

Within the Continuous Assessment Model (CAM), the attendance of students to the lectures and lab sessions is a fundamental part of the learning process. Because of that, **the attendance is mandatory in CAM**. The continuous assessment tests have the following features:

- Allow the student to know, with real and objective evidence, what are the criteria of evaluation and qualification.
- Allow the student to know at regular intervals the results of the learning process and the acquired knowledge and skills.
- Provide to the teaching staff objective information on the development of the module.
- Do not reduce contents for the final test, since the purpose of such testing is to assess the overall acquisition of the skills of the module.

## 5.2. EVALUATION

### EVALUATION CRITERIA

The evaluation process aims at assessing the degree and depth of the student's acquisition of the course skills previously described. Consequently, the evaluation criteria to be applied in the various tests that are part of the process ensure that the student has the appropriate level in the following contents and skills:

**CE1.** Knowledge of the basic properties of electronic devices, applicable models and operating margins.

**CE2.** Correct application of the theory and resolution techniques in the analysis of electronic circuits.

**CE3.** Ability to solve simple exercises of electronic circuit synthesis from a given set of specifications.

**CE4.** Ability to reasonably justify the steps followed when solving a problem of electronic circuit analysis and synthesis.

**CE5.** Ability to assemble electronic circuits without errors, and measure their characteristics and fundamental parameters.

**CE6.** Ability to adequately document the theoretical and practical works carried out

According to current regulations and considering that the experimental laboratory is essential for the acquisition of the course skills (especially CE4, CE5 and CE6), attendance to all laboratory sessions is compulsory.

Furthermore, since passing the evaluation criteria set for the Laboratory does not guarantee the right level in all the module skills (based on criteria CE1, CE2 and CE3), it is considered that the overcoming of the scheduled theoretical and practical tests is also an essential element of the assessment, both in the ordinary and the extraordinary calls, and in its two types: continuous and non-continuous.

Consequently, in order to pass the course, students must demonstrate appropriate minimum level of knowledge and skills in both test groups (theoretical-practical and laboratory). Such minimum standards are established in the grading criteria.

Within the continuous assessment model, the attendance to all the subject sessions (theory, exercises and laboratory) is mandatory. Those students who cannot follow such schedule, must move to the non-

continuous model (final evaluations).

## GRADING TOOLS

The assessment criteria, as defined in previous section, apply to the following assessment instruments:

- **A set of short exercises (EJ)**, to be done during the theory sessions. They will be proposed by the lecturer at any teaching session and the students should provide the solution at the time the exercise is proposed.
- **Objective intermediate assessment (PEI)**, to be performed at the middle of the term. It is an individual written test, which involves solving exercises of analysis and / or synthesis corresponding to the subjects taught until the date of the test.
- **Lab practices and tests (LAB)** They are complementary to the theoretical part of the course, including individual tests about the achievement of the goals regarding the measurement and verification methods and techniques on electronic circuits.
- **Final test (PC)**. It is based on a number of questions (theory and practice, analysis and / or synthesis) regarding to the specific aspects of all content covered by the course in the theoretical, exercises and laboratory teaching sessions.

## GRADING CRITERIA

### Ordinary call, continuous assessment.

In the ordinary call, **continuous assessment** model, 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
CEI:2, 6, 7. TR: 2, 3, 4, 5, 9.	RAEI: 1, 2, 3, 4, 5, 6 and 7 (note 1)	CE: 1, 2, 3, 4.	<b>EJ</b>	10%
CE: 2, 6, 7. TR: 2, 3, 4, 5, 9	RAEI: 1, 2, 3, 4, 5, 6 and 7 (note 1)	CE: 1, 2, 3, 4.	<b>PEI</b>	20%
CE: 2, 6, 7. TR: 2, 3, 4, 5, 9	RAEI: 1, 2, 3, 4, 5, 6 and 7	CE: 1, 2, 3, 4, 5, 6. (note 2)	<b>LAB</b>	30%
CE: 2, 6, 7. TR: 2, 3, 4, 5, 9	RAEI: 1, 2, 3, 4, 5, 6 and 7	CE: 1, 2, 3, 4.	<b>PC</b>	40%

**Note 1:** The assessment of the RAEI depends on the module schedule and its relation with the contents taught at the corresponding dates.

**Note 2:** The lab skills are partially assessed, according to the lab sessions carried out.

### **Conditions for overcoming the continuous assessment:**

According to the assessment criteria of the course, students are deemed to have passed the course (proving the acquisition of the theoretical and practical skills) if the following requirements are met:

- They have successfully acquired the skills related to the laboratory assignment (**LAB**), according to criteria published in practice guides and in the individual tests. It is understood that a student



successfully acquire these skills, if their score is equal (or higher) to **50%** of the maximum score (5 out of 10).

- They have successfully acquired the skills related to the set of all tests and theoretical-practical assignments (if any) [**EJ+PEI+PC**]. It is understood that a student successfully acquire these skills, if their average score in all related assignments and tests is equal (or higher) to **45%** of the maximum obtainable score (4,5 out of 10).
- The minimum **final weighted score** of the two previous parts should be at least **5 out of 10** to pass the module.

If one of the previous parts is not passed (LAB or PEI+PC), the final mark would be the lower of:

- The final weighted score.
- 4 out of 10 points.

Students who are not satisfied with their results of the **PEI**, they will have the option to do it again through **additional tests to be done** together with the overall exam (PC).

The mark of the **EJ part can be neither improved nor repeated**, as it is an activity carried out during the ordinary sessions.

#### Grade as "Not presented":

Students who follow the continuous assessment model, will be considered as "**not presented**" when one of the following circumstances happen:

- They do not do the intermediate test (**PEI**).
- They do not provide all the required grading assignments in the lab: reports and individual test (**LAB**).
- To have any unexcused absence in the laboratory sessions. If there is a valid justification for the absence, the student must follow the instructions of the lab instructor in order to recover it.

#### Ordinary call, final assessment model (non-continuous)

In the ordinary call, **final assessment model**, 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
CE: 2, 6, 7. TR: 2, 3, 4, 5, 9	RAEI: 1, 2, 3, 4, 5, 6 and 7	CE: 1, 2, 3, 4.	<b>PC</b>	70%
CE: 2, 6, 7. TR: 2, 3, 4, 5, 9	RAEI: 1, 2, 3, 4, 5, 6 and 7 (note 1)	CE: 1, 2, 3, 4, 5, 6.	<b>LAB</b> (note 2)	30%

**Note 1:** The lab skills are partially assessed, according to the lab sessions carried out.

**Note 2:** These tests are carried out provided it is obtained a minimum mark of 4,5 out of 10 in the PC.

#### Extraordinary call

For all students, the extraordinary call will follow the guidelines set for the ordinary one in their final assessment model.

Those students who having failed the ordinary examination as a whole, if they have achieved a score equal to or greater than the minimum score (5 in the lab section, or 4,5 in Theory section), they could

keep that mark in the extraordinary call. In any case, to pass the course the conditions for overcoming the continuous assessment will apply.

## 6. BIBLIOGRAPHY

### 6.1. Basic Bibliography

- Documentation generated by teachers for the course, which will be provided to students directly, or posted on the course Web site.
- Selected web sites related to the content of the module.
- "Microelectronic Circuits". Sedra/Smith. Oxford ed. ISBN: 970-613-379-8.
- "Electronic Circuits. Analysis and simulation design". Norbert R. Malik, Prentice Hall, London 1996. ISBN: 84-89660-03-4.

### 6.2. Additional Bibliography

- "Electronics". Allan R. Hambley. Ed Pearson Education, Madrid 2001. ISBN: 84-205-2999-0.
- "Electrónica: teoría de circuitos y dispositivos electrónicos". R.L Boylestad, L. Nashelsky, Pearson Prentice Hall, 2003 (8ª ed.). ISBN: 970-2-0436-2.

## **Disclosure Note**

The University of Alcalá guarantees to its students that, if due to health requirements the competent authorities do not allow the total or partial attendance of the teaching activities, the teaching plans will achieve their objectives through a teaching-learning and evaluation methodology in online format, which will return to the face-to-face mode as soon as these impediments cease.